ANALYZING DIFFERENCES BETWEEN PUBLIC AND PRIVATE SECTOR INFORMATION RESOURCE MANAGEMENT: STRATEGIC CHIEF INFORMATION OFFICER CHALLENGES AND CRITICAL TECHNOLOGIES

THESIS

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Abstract

The office of the Chief Information Officer is still new within public sector organizations. Further, the office of the CIO was hastily created by Federal laws that provide only broad direction for its implementation and practice while at the same time limiting each office's power and reach within Federal agencies. Presently, because of broadly defined scope and the newness of the office in the public sector, Federal CIOs now face many challenges and critical technologies in managing their agency's information resources.

Private sector organizations have a valuable knowledge base from their CIO office implementation efforts and subsequent operations. This private sector knowledge could offer public sector CIOs invaluable insight into successful information resource management practices. However, public and private managers must take great care in deciphering which IRM prescriptions are relevant to their organizational situation.

The goal of this research is to discover if public and private sector CIOs are faced with the same challenges and view the same technologies as critical for their organization's operations. The results of an annual survey of public sector CIOs and senior IRM managers are compared with data collected from FORTUNE 1000 CIOs using the same instrument. Findings from this study provide evidence that public and private sector CIOs do perceive to be faced with many of the same challenges and also view many of the same technologies as critical to their organization's operations.

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I. Introduction

Overview

The study of information resource management is an evolving topic in research. The terms "information systems" (IS) management, "information management" (IM), and "information technology" (IT) management have been used interchangeably by many scholars and practitioners. Although all of these terms have significance in the field of interest, this thesis uses the term information resource management (IRM) as it "entails a broader conceptual definition of management as well as the human resources and technical components more typically associated with IT management" (Lewin and Sprehe, 1996:53).

Several definitions have been suggested for information resource management. The Office of Management and Budget (1993) defines IRM as "the planning, budgeting, organizing, directing, training, and administrative control associated with government information resources to include both the information itself, as well as the related resources such as personnel, equipment, funds, and information technology." Lewin and Sprehe (1996) define IRM as "the management of information as a resource as well as the management of those resources associated with information." This thesis uses section 3502 (7) of title 44, United States Code, to define information resource management as "the process of managing information resources to accomplish agency missions and

improve agency performance" (United States Congress, Title 44, 1997: Section 3502). This definition is used because of it simplicity, inclusion of the organizational behavior component of IRM at a macro level, as well as its generalizability to the both the public and private sectors.

Because IRM is increasingly important to both public and private sector organizations (Bretschneider, 1990) and because managerial values are crucial in understanding organizational behavior (Posner and Schmidt, 1996), this research attempts to compare each sector's IRM practices from the strategic perspective of the office of the Chief Information Officer (CIO). Specifically, this research is concerned with contributing to existing organizational IRM theory by comparing public and private sector organizations in terms of their strategic IRM challenges as well as the technologies that their senior IRM managers perceive as critical to their respective organization's operations.

Background

Over the past fifty years information technology has evolved from mainframe support offices into entire functional departments and sovereign academic disciplines. Exponential improvements in processing power, data storage, and networking speed and capacity have led to dramatic increases in information availability. Organizations now devote entire departments and processes to managing information while universities now offer IRM curricula to meet these organizational needs. Because of increasing information needs, managers are forced to make decisions without the luxury of time to research the "best" course of action. Furthermore, customer needs are changing on a

minute-by-minute basis. Managers must be prepared to address these changing needs with minimal delay to the customer. Therefore, managers must be able to locate, organize, transfer, and use their organization's information to achieve organizational goals.

Information resource management has become such a dominant organizational enabler that an entire era, the Information Age, has been named in its honor. In the 1980's, the position of Chief Information Officer began to appear in private sector organizations as a means of addressing IRM needs. At first, CIOs were subordinated to existing executives such as Chief Financial Officers (CFO) because IRM was viewed from a technology acquisitions perspective. Later, as new technologies were radically changing organizational processes, the position of CIO was elevated to an executive level position. In 1996, the Clinger-Cohen Act (P.L. 104-106), followed by Executive Order 13011 (1996), "Federal Information Technology," created and defined the CIO position to be implemented within every federal executive branch agency.

The creation of the Office of the CIO has created new organizational challenges. Since the office's implementation in 1996, the non-profit Association for Federal Information Resource Management's (AFFIRM) Emerging Issues Forum has conducted annual surveys of senior Federal information technology managers in an effort to measure the most critical challenges facing the Federal CIO. Additionally, AFFIRM measures which technologies senior Federal information technology managers consider the most critical to their organization's operations (AFFIRM, 2001). The results of these annual surveys demonstrate how the top challenges facing Federal CIOs today, as viewed by senior Federal government IRM managers, have evolved since the office's 1996

implementation as well as how changing priorities have effected which technologies are viewed as critical.

Problem Statement

Although Federal agencies increasingly rely on information technology to meet their information management challenges, they have experienced many challenges in their IRM implementation efforts (Holden, 1996). According to Caudle (1996), government managers have trouble with IRM because of the difficulty in defining which information is critical and also which technologies are needed for their agency's operations. Caudle's assertions are supported by reports from the Office of Management and Budget (1994) and the General Accounting Office (1994) that call for a reassessment of government-wide IT management policy and implementation. The office of the CIO was created, in part, to address these IRM challenges. However, the CIO office is still new within public sector organizations. Further, the office of the CIO was created by Federal laws that provide only broad direction for implementation and practice within Federal agencies. Presently, because of broadly defined scope and the newness of the office in the public sector, Federal CIOs now face many challenges and critical technologies in managing their agency's information resources (Association for Federal Information Resource Management, 1996).

Research Focus

Private sector organizations have a valuable knowledge base from their CIO office implementation efforts and subsequent operations. According to Bozeman and Bretschneider (1986), the majority of IRM knowledge has been developed from private

sector research to be applied in a private sector framework. This private sector knowledge could offer public sector CIOs invaluable insight into successful information resource management practices. However, public and private sector managers must take great care in deciphering which IRM prescriptions are relevant to their organizational situation (Bretschneider, 1990). The goal of this research is to discover if public and private sector CIOs are faced with the same challenges and view the same technologies as critical for their organization's operations. It is hoped that the results of this research will help public and private managers to understand sector similarities and differences in the application of IRM prescriptions.

Private sector businesses for this research are represented by the 1000 largest companies in the United States, as measured by year 2001 revenues and recognized in *Fortune Magazine's* Fortune 1000 rankings of American businesses (2002). Executive branch federal agencies are represented by the responses of senior information technology managers and CIOs within the 23 federal agencies named by the Clinger Cohen Act (United States Congress, 1996) and as measured by the Association for Federal Information Resource Management's annual CIO Challenges surveys (AFFIRM, 2001). Discovering the similarities and differences between the public and private sector's use of IRM provides a new perspective of strategic information resource management as well as advances the existing body of organizational IRM theory.

Thesis Overview

The goal of this section is to provide a background for this research effort, establish its purpose and scope, and introduce the structure of this thesis. In order to

discover a new view of public and private sector IRM practices, one must understand how public and private sector organizations are similar and how they are different. The next chapter introduces prior research devoted to discovering the similarities and differences between the public and private sector's use of IRM. First, research is presented that attempts to define the public and private sectors in terms of three comparison models. Next, a comparison of the IRM practices of public and private sector organizations are compared. Chapter two concludes with a presentation of existing private sector CIO challenges and critical technologies research. Next, chapters three and four present the methodology used for data collection, analysis tools employed, and the results of the data analysis. Finally, chapter five presents the implications of the data analysis results including a discussion of the research questions, the limitations of the research, and recommendations for future research.

Existing literature in organizational research suggests several differences between public and private sector IRM practices. Understanding these differences provides an important starting point from which to compare the results of this research effort.

II. Literature Review

Overview

This literature review discusses the body of research devoted to discovering empirically, and comparing, information resource management (IRM) practices in public sector and private sector organizations. Discovering the similarities and differences between the public and private sector's use of IRM provides a new perspective on strategic information resource management for scholars and researchers as well as logically advances the existing body of organizational IRM theory. Although the public-private sector debate can be traced to the beginnings of the twentieth century, the scope of this literature review is restricted to the empirical research that began to surface in the 1970's and which has been revised and advanced to the present. Specifically, this literature review presents an overview of organizational research that compares public and private organizations in terms of how they view information resource management from the strategic perspective of the organization's chief information officers and senior information resource managers. The first section of this review introduces the research that has attempted to define the public and private sectors by presenting three existing models for comparing public and private sector organizations. Next, the major strategic management differences between public and private sector organizations are presented emphasizing the way these organizations view and implement strategic level information resource management. Then the role and information resource management practices of public and private sector Chief Information Officers (CIOs) are presented. The CIO section presents an overview of the body of research devoted to defining the organizational position of chief information officer. Further, the CIO section concludes

with an annual study of the way Federal CIOs use and view information resource management.

Classifying Public and Private Sector Organizations

Before a comparison of the strategic IRM practices of public and private sector organizations can be presented, an explanation of what constitutes a public sector and private sector organization must be considered. The words public and private are derived from the Latin language: public means 'of the people,' while private means 'set apart' (Nutt and Backoff, 1993). Defining what is referred to by the terms public and private sectors has become an increasingly popular topic in public administration and organizational theory research as the influence of the federal government has grown within the traditional private sector. Although noteworthy research prior to 1970 compares public and private sector organizations (e.g., Dahl and Lindblom, 1953; Blau and Scott, 1962; Kilpatrick et al., 1964; Paine et al., 1966; Pugh et al., 1969; and Rhinehart et al., 1969), the last three decades have provided significant empirical research that first defines what constitutes a public or private sector organization before comparing the two.

One of the earliest historical analyses proposes four ways for describing public and private organizations: a common sense approach; a practical definitions approach; a denotative approach; and an analytic approach. The common sense approach describes an organization as either public or private without using a formal definition of either, assuming that the audience can distinguish between the two. The practical definitions approach uses "unsubtle rules of thumb" to describe an organization as either public or

private. The denotative approach describes an organization as either public or private based upon the sub-organizations under its control or by the activities with which it is involved. Finally, the analytic approach describes an organization as either public or private based upon "defining factors or sets of factors" (Rainey et al., 1976). Further, Rainey et al. asserts that none of these approaches is fully adequate and thus the differences between public and private organizations are unclear, but that an unclear distinction between the two can still be useful, especially in the absence of a convincing alternative. In a later research effort to classify organizations as either belonging to the public or private sectors, Rainey (1983) concludes that delineations can be made between public and private organizations based upon their internal structure. Although this approach fails to definitively classify every organization, it does easily address the vast majority of organizations as either belonging to the public or private sector. These classification approaches were an important impetus for further organizational sector research. Currently, research in the field is converging, leading to the development of three major approaches to classifying organizations as either public or private. This section introduces three dominant approaches towards distinguishing between what is a public sector and a private sector organization: the generic approach; the core approach; and the dimensional approach.

The Generic Approach

The generic approach for classifying organizations as either public or private downplays the existence of differences between public, private, and hybrid organizations (those organizations that exhibit major characteristics of both public and private organizations). Thus, research that supports the generic approach (Murray, 1975; Lau et

al. 1980) asserts that every organization, regardless of sector, is similar based upon its management functions, organizational processes, managerial values, and decision making processes. The generic approach also references the increasing number of hybrid organizations, the movement towards the privatization of many public services, and the adoption of many private sector business practices (e.g., process reengineering, the establishment of the chief information officer, and quality management) by public sector organizations as evidence that distinct lines between the public and private sectors are disappearing. Further, there is growing evidence of the "revolving door phenomenon" in which the skill sets of senior managers are easily transferable between positions in the public sector and private sector (Scott and Falcone, 1998). The ability for managers to easily transpose their skill sets across organizational and sector boundaries supports the generic approach as a classification method. Indeed, the recent migration of many organizations towards a hybrid structure has led to a blurring of distinct organizational boundaries that renders the classification of organizations as either public or private as insufficient when compared to other organizational classification methods.

The Core Approach

While the generic approach holds that there are inconsequential differences between public and private sector organizations, the core approach (also referred to in literature as the ownership model) asserts that there exist fundamental differences that allow organizations to be uniquely classified by sector. Essentially, the core approach classifies organizations as either distinctly public or distinctly private based upon their formal legal status (Bozeman and Bretschneider, 1994). Formal legal status refers to an organization's structure as well as how it is funded and owned. For example, under the

core approach, an organization owned by private citizens that receives no funding from any governmental entity to include government contracts for work could be considered as distinctly private. Alternatively, an organization such as a federal agency that is wholly "owned" by executive branch oversight and funded by legislative allocation can be considered distinctly public.

Researchers have proposed several core differences between public and private sector organizations. Scott and Falcone suggest that the core differences can be broken into two streams of research; property rights theorists, and public choice theorists. Property rights theorists suggest that private managers have an incentive to manage organizational resources efficiently and effectively because good economic returns will result in increased rewards. Public choice theorists suggest that public managers lack the market condition indicators that private managers have and thus depend upon budget levels, manpower allocations, and other non-market indicators to determine production levels for public goods and services. Therefore, public managers are less sensitive to the need for efficient resource use (1998). Other core differences between public and private organizations include political and legal constraints (Rainey et al., 1976). These conclusions suggest that public agencies are more influenced and constrained by judicial systems, congressional legislation and budgeting, federal oversight agencies, lobbyists, and public scrutiny than are private sector organizations.

Classifying organizations as either public or private based upon core differences has many advantages. First, the core approach provides a simple standard for quickly classifying organizations based upon a few key factors. For example, assuming that public agencies are operating within their federally mandated roles and jurisdictions, it

would be difficult to argue that a federal agency such as the department of defense was a private sector organization. Thus, the core approach allows many organizations to be easily classified as either distinctly public or distinctly private. Next, research has supported the existence of core differences between public and private sector organizations. These core differences include job satisfaction and organizational commitment (Buchanan, 1974), incentives and rewards perceptions (Rainey, 1979), organizational formalization (Rainey, 1983), senior management control (Blumenthal, 1983) and employee decision making practices (Coursey and Bozeman, 1990). Although the existence of core differences between public and private sector organizations has been tested in research, the core approach suffers from its inability to classify organizations that exhibit core characteristics of both public and private sector organizations (e.g. hybrid organizations). Examples of hybrid organizations are private, non-profit organizations (Nutt and Backoff, 1987). These organizations, sometimes referred to as third sector organizations, are usually service oriented while more purely public organizations are often involved in information processing and contracting for services (Nutt and Backoff, 1993). This key weakness of the core approach is addressed by proponents of another approach to classifying organizations as either public or private, the dimensional approach.

The Dimensional Approach

Although many organizations can be clearly classified as either dominantly public or dominantly private, many organizations fall between these two extremes. The dimensional approach of classifying organizations as either public or private suggests that distinctions between the two can be made based upon how an organization is constrained

or influenced by external political and economic authority. Bozeman, building upon Wamsley and Zald's (1973) assertion that a delineation between public and private sector organizations can be made based upon what entities comprise the organization's owner and major financial supporter, proposes the dimensional approach as an evaluation of the degree of influence that the government and economic forces have over an organization. According to Bozeman, every organization has several dimensions of publicness that are independent of each other and of an organization's formal, legal status. Publicness is the degree to which an organization is influenced by governmental and economic forces (1984). For example, the department of justice would be classified as having a high degree of publicness whereas a privately owned store that does no business with any government entity would have a small degree of publicness. Figure 1 illustrates a

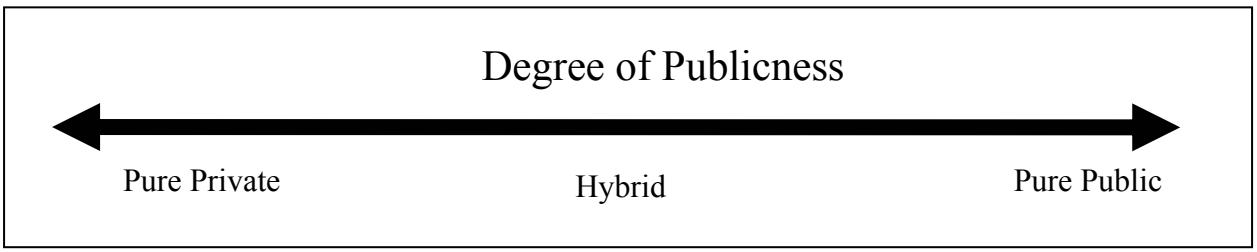


Figure 1: Scale of the Range of Publicness levels for Organizations

hypothetical sliding scale of publicness upon which organizations could fall. Pure private organizations reflect those organizations that are not influenced by any governmental forces and hence have no degree of publicness. Pure public organizations are those organizations that are not influenced by any economic forces. Bozeman and Bretschneider (1994) suggest that few, if any organizations are purely private because all organizations are subject to some aspect of governmental influence even if the influence is from paying income taxes or adhering to environmental protection agency mandates.

Similarly, few organizations are purely public because all public agencies are at the very least subject to market conditions and economic forces which directly influence the governmental budgeting process and thus an agency's budget allocation. Finally, the dimensional approach allows for the possibility that some business organizations could possess a greater degree of publicness in some dimensions than some public organizations (Bozeman, 1984). Thus the dimensional approach goes beyond the classification capabilities of the core approach by accounting for the many hybrid organizations that exist in today's organizational environment.

Several research efforts have demonstrated empirical support for the dimensional approach. In an exploratory study to test for the existence of differences between hybrid organizations, Emmert and Crow (1988) propose four classifications for classifying organizations on the publicness scale. Classical private organizations are those wholly owned and operated by a private entity. The privately owned and operated fast food chain Chick-fil-a is an example of a classical private organization. Classical public organizations are those wholly owned and operated by a governmental entity. A federal agency such as the Treasury department is an example of a classical public organization. Cooperative hybrid organizations are those owned and operated by many entities from both the public and private sectors. Many of the Department of Defense's laboratories are owned and operated by both private defense contractors such as Boeing and the government. Finally, mixed hybrid organizations are those that have pieces of their facilities and programs owned by a classically private or classically public organization. Emmert and Crow conclude that these organizational types can be assigned based upon the following dimensions: the extent of government influence on organizational goals;

the pattern of the organization's funding relationships; and the arrangement and implementation of the organization's human resources (1988). In addition, research by Coursey and Bozeman (1990) finds that the dimensional approach was useful in explaining certain types of strategic decision making processes within organizations. Finally, Scott and Falcone (1998) find that organizational dimensions exist and that some dimensions are more susceptible to governmental influence than others. Although research using the dimensional approach is still expanding, these findings provide some support for the ability of the dimensional approach to stand empirically.

Classifying organizations as either public or private based upon their degree of publicness has advantages and disadvantages. For example, many of today's largest organizations are difficult to classify as purely public or purely private. Empirical research has demonstrated that governmental and economic forces are at work influencing both public and private organizations so that their boundaries are blurring. The dimensional approach allows these organizations to be classified. However, classifying these organizations as hybrid organizations may not be descriptive enough to be useful. Once an organization has been classified as a hybrid organization, the dimensional approach does not provide a simple mechanism for describing these organizations further (Bozeman and Bretschneider, 1994).

Although the dimensional approach provides some explanatory power for classifying organizations, research comparing it to other classification approaches has not proven it to be superior. The next section presents an overview of research comparing the generic approach, the core approach, and the dimensional approach. These findings

are used to define what constitutes a public and private organization for this research effort.

Comparing Public/Private Classification Approaches

The three approaches to classifying organizations as public or private are listed below in Table 1.

Table 1: Three Approaches for Classifying Organizations as either Public or Private Sector

	Major premise	Sample Supporting Literature
Generic Approach	Asserts that there are no meaningful differences between public and private sector organizations.	Murray, 1975 Lau et al., 1980 Stiullman, 1988
Core Approach	Distinctions can be made between public and private organizations based upon their formal, legal status	Buchanan, 1974 Rainey, 1979 Rainey, 1983
Dimensional Approach	Distinctions can be made based upon how an organization is constrained or influenced by political and economic authority	Wamsley & Zald, 1973 Bozeman, 1984 Bozeman, 1987 Emmert & Crow, 1988

Comparing these approaches reveals a broader perspective of organizational classification. Several recent studies have sought to evaluate empirically the major approaches for classifying organizations as either public or private. Bozeman and Bretschneider's (1994) comparison of the core and dimensional approaches concludes that, in a study of research laboratories, the two are not mutually exclusive and should be used as complementary classification approaches. Scott and Falcone (1998), in a study of public, private, and hybrid research and development laboratories, affirm that using both the core and the dimensional classification approaches is more useful than using either model alone. Furthermore, the results of this study generate no support for the generic

approach. Rainey and Bozeman (2000), in an analysis of past research comparing public and private organizations, conclude that results in the field are converging. The conclusions from these studies provide support for applying more than one framework when classifying organizations as public or private.

This research effort utilizes aspects of the core and dimensional approaches in classifying the participating organizations as public or private. The generic approach is inadequate for this study because its key premise discounts the existence of public/private differences. Since the sample used to measure private sector organizations is composed of Fortune 1000 companies and the sample used to measure public sector organizations is composed of executive level federal agencies, measuring the dimensionality of organizations will not be a main factor in this study. Although many of the participating private organizations have some degree of publicness, they can still be classified as predominantly core private. Further, the public agencies used in this study are distinctly public, composing agencies wholly contained within the executive branch of government. This study recognizes that all organizations have some degree of publicness from governmental influence. However, the majority of organizations in the population under study reflect the extremities of the publicness scale.

Public and Private Sector Management

Comparing public and private sector management is a topic of increasing importance for public administration researchers and practitioners. The latest management movement within public administration research has been dubbed New Public Management (NPM), a reform program that adopts the principles of private sector

management into public sector management (Box, 1999; Hood, 1991). The goals of NPM are to emulate the private sector's assumed ability to operate efficiently and effectively while maintaining employee and customer satisfaction. Programs such as total quality management, process reengineering, and activity based costing are all tools that proponents of the NPM movement suggest be applied in an effort to transform public management. However, some researchers are cautious to embrace NPM (e.g. Boyne, 1996; Ransom and Stewart, 1994). They assert that the existence of fundamental differences between public and private sector organizations mandates that models of organizational management cannot be blindly applied to all organizations irregardless of their sector affiliation because the differences act as obstacles to successful model implementation (Boyne, 2002). This section focuses on past research that presents core distinctions between public and private sector organizations with an emphasis on their management. This top down perspective provides a foundation for this research effort's strategic management focus from the view of an organization's top IRM executive.

There have been many research efforts to compare public and private sector organizations. Rainey et al. (1976), in a qualitative study of previous research, suggest that public and private sector differences can be classified according to their purposes, objectives and planning; selection, motivation and management; and by how they control and measure results. Research has not been restricted to motivation, environments, goals, and structures of public and private sector organizations. For example, Ring and Perry (1985) suggest that public organizations are more open to their external environment, face unique challenges such as the mandated merit-based personnel system and political appointees' "spoils system," and must contend with a separation of powers structure in

which no agency has both policy formulation and policy implementation powers. In a study of the Department of Defense's acquisitions process, Fox (1974) suggests that the defense industry is different from commercial industry because there is only one buyer, there are usually very few sellers, the buyer's bottom line is usually based on performance instead of price, the buyer operates with public funds, decision making power is divided between subcommittees within multiple branches, and decisions are subject to greater public oversight. Baldwin (1987), in a comparison of private sector managers from multiple industries with public sector managers from the city, county and state level, finds that there exist significant, but limited differences between public and private sector organizations in terms of their goal clarity, leadership turnover, and job security. Emmert and Crow (1988) conclude that public sector organizations produce more generic products than private sector organizations. Perry and Rainey (1989), building upon the works of Rainey et al. (1976), Neustadt (1979), and Allison (1984), classify public/private differences into environmental, transactional, and process distinctions. Environmental factors are those that are external to an organization. Transactional factors are those that involve the many relationships that an organization has with its external environment. Processes are the internal operations of an organization. However, the majority of past empirical research on public and private sector organizational differences can be classified according to differences by motivation, environment, goals and objectives, structure, management processes, decision making, and strategic management.

Motivation

The topic of motivation in public and private sector organizations has been very popular and resulted in mixed conclusions. Some research suggests that public sector employees are motivated by job security and stability while private sector employees are motivated by status, opportunity, pay, and the desire for autonomy (e.g. Kilpatrick, Cummings and Jennings, 1964; Baldwin, 1987; Bozeman, 1987; Perry and Rainey, 1988). Wittmer (1991) and Khojasteh (1993), in separate studies of public and private sector managers, found that the private sector participants were more motivated by pay. However, these results are not completely supported by literature. Rainey (1983) found that motivation was the same in a study of middle managers from public and private sector organizations. Gabris and Simo (1995), in a study of public and private sector employees, found that both sectors were equally motivated by pay but that the public sector employees reported a greater desire to serve the community. The desire for public sector managers to serve the community is also reported by Rainey (1982), Alban Metcalfe (1989), Wittmer (1991), and Posner and Schmidt (1996). The majority of research on motivation seems to support the notion that public sector managers are more concerned with serving their community and less concerned about financial compensation than are private sector managers. However, research supporting these results is mixed and evolving. For example, Jurkiewicz et al. (1998) suggest that there is a growing desire within private sector employees to benefit society.

Organizational Environment

An organization's environment is composed of all entities, internal and external, that exert a degree of influence over it. One of the most popular variables used to classify

public and private sector organizations is to compare how they are influenced by their environment. Lachman (1985), in a study of public and private sector CEOs in Israel, found that there was no difference in the perceived influence of external entities between public and private sector managers. Kenny et al. (1987) found that government organizations more directly influenced private sector decision making than public sector decision making. They suggest that this anomaly in research could be because public sector managers underestimate the true influence exerted upon them by their parent organizations. However, other research efforts do not support these findings. Rainey (1988) suggests that privately owned organizations are less prone to governmental oversight and more prone to economic market changes than are public agencies, but that many private firms are still very much influenced by government contracts and regulations. Baldwin (1990), in a study of middle and senior managers from public and private sector organizations in Atlanta found that the public organizations in the study perceived a greater degree of influence from external entities such as the media and from public opinion than did the private sector managers. Coursey and Bozeman (1990), in a study of upper managers in public and private sector organizations in the Syracuse, NY area, found that public managers face more external constraints in their decision making than do private sector managers. Although not overwhelming, the majority of past empirical research on the environmental differences between public and private sector organizations supports the assertion that public organizations are more open to external influences (Boyne, 2002).

Organizational Goals

Several past researchers have argued that public and private sector organizations have different goals. However, empirical research offers mixed results in support of this assertion. Rainey (1983) found that there was no difference between public and private sector manager's perceptions of goal clarity. Baldwin (1987) found that public sector goals were slightly less clear than private sector goals. Rainey et al. (1995) found that there was no difference in goal ambiguity between public and private sector organizations. Lan and Rainey (1992) find that public organizations have clearer goals than do private sector organizations. However, Solomon (1986) finds that task clarity was greater in private sector organizations. Scott and Falcone (1988) finds that public and private managers receive their directives from different societal sub sectors, and thus respond in different ways. For example, private managers might receive directives from shareholders and executive boards while public managers receive directives from Congress and the Executive branch of the government. Emmert and Crow (1988) suggest that the goals of public sector organizations are more heavily influenced by governmental factors than are the goals of private sector organizations. This research also supports the existence of environmental differences between the public and private sectors. Again, the empirical results comparing public and private sector organizations are mixed. In a study of past empirical research that compares organizational goal differences, Boyne (2002) asserts that where significant differences in goal clarity do exist, the measurement differences in the studies are small. However, research focusing on goal types suggests that private firms place more weight on commercial goals whereas public agencies are more concerned with research based objectives.

Organizational Structure

An organization's structure refers to "the formal pattern of how people and jobs are grouped in an organization" (Gibson et al., 2003:8). Research that focuses on organizational structure generally refers to differences surrounding bureaucracy and red tape (Boyne, 2002). Bureaucracy refers to the negative consequences often associated with the structure of large organizations. These consequences include procedural delay, personnel frustrations, and excessive red tape (Crozier, 1964). In a study of middle managers from public and private sector organizations, Rainey (1983) finds that public sector managers perceive a greater emphasis on formal rules and procedures than did private sector managers. These results have been supported by the findings of Emmert and Crow (1988), Baldwin (1990), and Lan and Rainey (1992). Further, Rainey and Bozeman (2000), in an analysis of previous empirical research, conclude that the evidence exists to suggest that public managers face greater constraints from personnel and purchasing rules. However, Buchanan (1975) concludes that private sector organizations have more rules and regulations and are therefore more bureaucratic while Lachman (1985) finds that managers in private firms in Israel are subject to greater bureaucratic controls than are public managers. These results are consistent with the conclusions of Knott (1993) whose research finds that many successful private businesses make extensive use of bureaucratic controls in order to ensure the uniformity and quality of their product across a large numbers of market outlets. Research does not conclusively support the claim that public sector organizations are more bureaucratic than their private sector counterparts. However, their exists credible evidence to suggest that public sector

managers have reported that they perceive excessive controls and regulations within their organizations more often than do private sector managers.

The term red tape (Buchanan, 1975; Bozeman et al., 1992; and Bozeman, 1993) refers to the many levels of accountability within public organizations that are often synonymous with an increased number of steps to complete tasks (Bretschneider, 1990). Red tape is sometimes referred to as a by-product of excessive bureaucracy (Bozeman and Scott, 1996). Its existence implies that an organization is not operating efficiently or effectively because of burdensome regulations that emphasize rules over results (Boyne, 2002). The often hypothesized claim that public organizations are overburdened by red tape has led to many studies in organizational research. Bretschneider (1990) finds that red tape is more pervasive, and hinders decision making more, in the public computing agencies that he studied. Bozeman et al. (1992), Bozeman and Bretschneider (1994), and Rainey et al. (1995) all report evidence that supports Bretschneider's conclusions The evidence from these three studies is not overwhelming and thus the results of the red tape question are still not conclusive. However, the evidence demonstrates that many public sector managers are reporting greater levels of perceived red tape than their private sector counterparts.

Decision Making

One of the primary roles of managers is to make decisions. Decision making is often included as an organizational process and more specifically, as a strategic management process (Gibson et al., 2003). The topic of decision making is separated from the section on strategic management because many research efforts have focused solely on managerial decision making differences between organizational sectors.

Nutt states that "strategic decision making involves gathering intelligence, setting directions, uncovering alternatives, assessing these alternatives to choose a plan of action, and implementing the plan" (1999:305). Strategic decisions are those that the decision makers feel will have a significant impact on the future of their organization (Coursey and Bozeman, 1990). Examining strategic decision making is important because decisions at this level often involve the commitment of large amounts of organizational resources and risk (Mintzberg et al., 1976; Butler et al., 1979; Hage, 1980). Therefore, this section focuses the decision making differences between public and private sector managers from research.

Studying the strategic decision processes of managers is critical to understanding senior management because "those who reach the highest level and make the most significant decision will, therefore, be more effective if they are sufficiently educated to understand their role in society rather than simply the techniques to govern a market stall" (Chandler, 1991:391). In a study of the types of decisions made by public and private sector managers, Coursey and Bozeman (1990) find that public sector managers are more likely to describe control, service, and reorganization as typical strategic decision types. Private sector managers are more likely to choose technology, product, and boundary as typical strategic decision types. This suggests that there are differences in the types of decisions made by senior public and private sector managers. Other research efforts have attempted to measure the length of decision processes within public and private sector organizations. Bozeman et al. (1992), in their study of organizational red tape, find that the greater levels of red tape within public sector organizations lengthens the time it takes for public managers to make decisions. These findings are

supported by Bozeman and Bretschneider's (1994) study of red tape in public and private sector research and development organizations. Bretschneider (1990), in a study of public and private computing organizations, finds that the increased levels of red tape within public organizations does increase decision times, especially decisions on personnel issues. Scott and Falcone (1998) also find that personnel decisions take longer in public organizations and adds that procurement decisions take longer as well. These research efforts support the conclusions that public and private sector organizations are faced with different decision types and that increased levels of red tape in public organizations lead to longer decision times.

Strategic Management

The term strategic manager for this research effort refers to the body of senior managers who report directly to their organization's top executive or who is one of the top executives in their field of interest. For example, this study is concerned with the strategic management of an organization's information resource management processes and therefore focuses on each participant organization's chief IRM executive. These senior IRM managers commonly hold titles such as Chief Information Officer, Senior Vice President, and Executive Vice President. This section does not only focus on strategic IRM managers. However, the research reviewed here is relevant and provides a starting point for the more specific study of senior IRM executives.

Past research on strategic management differences between public and private sector senior leaders provides an important foundation for understanding the position of the CIO. Ring and Perry (1985) present several fundamental strategic management differences between the way public and private sector organizations operate. They

suggest that policy directives are more ambiguous for public managers than for business executives; public sector decision making is open by mandate which creates more obstacles for public sector managers than for private sector managers who are not constrained by such rules; public sector managers face greater outside influences than do private sector managers; and coalitions instituted by public managers during policy formulation are more likely to break apart during implementation. Buchanan's (1974) study of organizational experiences, job satisfaction, and organizational commitment of senior managers finds that business executives report more favorable attitudes towards their organization than do public sector managers and that government managers reported less involvement, less loyalty, and that they do not identify as strongly with their organization as do private sector managers. These findings are similar to many of the widely held stereotypes previously discussed. Other studies also provide evidence that there are differences between public and private sector strategic management. Scott and Falcone (1988) find that public and private managers receive their directives from different societal sub sectors, and thus respond in different ways. For example, senior managers in the private sector receive directives from shareholders and executive boards while public managers receive directives from Congress and the Executive branch of the government. It should be noted that this example illustrates a comparison between organizations that exhibit extreme levels of publicness and thus should not be interpreted as a generalization, merely as an illustration. Allison (1984) and Weinberg (1983) claim that public managers have less autonomy in their jobs. This assertion is particularly prevalent in the management of personnel issues such as hiring, firing, taking punitive actions, and implementing rewards structures for employees (Boyne, 2002). Similarly,

Hooijberg and Choi (2001), in a study of senior managers in a large purely public and purely private firm find that public sector managers perceive that they have less leeway in exercising leadership than do private sector managers. Therefore, past research supports the existence of strategic management differences between public and private sector organizations.

Implications for Public and Private Management

Although research supports the existence of differences between public and private sector organizations, many of the traditional stereotypes surrounding management and administration differences by sector still lack convincing evidence. Therefore one must be careful not to place blanket classifications upon an organization because of its sector affiliation. Ring and Perry (1985) present several fundamental differences between the way public and private sector organizations operate. They suggest that the constitution divides policy formulation and policy implementation into separate branches while private sector organizations do not; the merit based personnel system of the civil service places personnel constraints on managers in terms of employee rewards, incentives, and advancement; most senior management positions in the executive branch such as the each department's secretary are appointees and change with each administration; and public sector managers are heavily influenced by legislation, lobbyists, and the public. In addition, traditional thought has asserted that private businesses are not accountable to public opinion, that profits are the sole objective of private sector organizations, that public sector organizations act as monopolies, that the private sector is wholly competitive, and that only the public sector has a responsibility to society (Chandler, 1991). All of these claims can be supported and contradicted by

conflicting illustrations. For example, although many public organizations are the sole provider of some public good or service, there are private businesses, many in the utility industry, that have regulated monopoly characteristics. It is also short sighted to suggest that private businesses are not accountable to public opinion. Public opinion is a driving force in supply and demand. Many businesses invest large sums of capital in advertising campaigns and public affairs to appear socially conscious and appealing to public opinion. Also, the private sector will never be wholly competitive as long as government regulation exists. Government regulations such as FAA mandated flight schedules, OSHA building requirements, EPA emissions rules and many others impact the competitive nature of private sector businesses. Finally, if profits were the sole objective of private businesses then why are they not exploiting new ventures in potentially lucrative, yet morally questionable, markets? The answer is because all legitimate businesses answer to public opinion in some form. However, these often touted stereotypes do have varying degrees of applicability within public and private sector organizational management. Private sector managers are in large part driven by profit goals, public sector managers are more accountable to public opinion and are faced by many legal and political constraints, and many government organizations do act as monopolies (Rainey et al., 1976).

It is difficult to make the claim that differences between sectors can be applied to all public and private organizations as exceptions can be illustrated for every stereotype. However, research demonstrates that these differences are significant to understanding the distinctions that exist between each sector's strategic management processes and

therefore must be carefully applied when studying an organization regardless of its sector affiliation.

IRM in Public and Private Sector Organizations

Existing literature in organizational research suggests several differences between public and private sector IRM practices. Bozeman and Bretschneider (1986) classify public and private sector IRM strategy differences based on evaluation, planning, structure, and practices. Public sector organizations should evaluate their IRM strategy decisions based upon economic and political efficiency and the goals of government policy while private sector organizations tend to evaluate based on economic efficiency and profitability. IRM planning in public sector organizations should be incremental and extra-organizational focused as opposed to the holistic and intra-organizational approach favored by many private sector organizations. Senior management of public sector IRM should be placed at a level that is below the political appointee level in government because political appointees are usually not experienced in operations and also tend to change with administrations. This is in contrast to the private sector where senior leadership of IRM is placed at as high a level in the organization as possible because IRM success has been shown to be closely related to the support and attentiveness of executive level management. Next, public sector IRM strategy should focus on leasing equipment because there are no tax benefits for purchasing equipment and resale of equipment is regulated to the point that assets are routinely sold for below fair market value. In contrast, private sector organizations routinely purchase IRM hardware because of the tax benefits associated with fixed assets. Finally, the acquisition and implementation of IRM

processes should not be undertaken for the purpose of reducing labor costs. Although reduced labor costs are often the results of an IRM implementation effort, the savings from reduced labor have less benefit in the public sector than in the private sector and should never be the only goal of an IRM strategy.

Bretschneider (1990) followed up on these prescriptions with empirical evidence in a study of public and private technology managers. The results from this study led Bretschneider to suggest several propositions concerning public and private sector IRM differences in terms of their organizational environment and management activity. First, public IRM managers are subjected to a greater level of organizational interdependence than are private IRM managers. Further, public IRM managers must contend with more layers of organizational oversight from higher levels within the executive branch, from Congressional committees, and from lobbyists than do private IRM managers. Next, public IRM managers are subjected to greater levels of "red tape" than are private IRM managers. Other studies have also support IRM differences between public and private sector organizations. In terms of management activity, public IRM managers must consider different criteria when making hardware and software purchasing decisions (see for example Hamilton and Chervany, 1981 and Rainey et al., 1976); public IRM managers are more concerned with extra organizational planning decisions (see for example Ein-Dor and Segev, 1978a and Bozeman and Bretschnieder, 1994); and public IRM executives tend to be placed at lower organizational levels than are private IRM managers (see for example Ein-Dor and Segev, 1978b and Ein-Dor and Segev, 1982). The main theme in research that compares IRM in the public and private sectors is that the organizations in each sector operate in very different environments which influence

the management of organizational information technology resources (Bretschneider, 1990). Understanding these differences provides an important starting point from which to compare the results of this research effort.

The CIO in Public and Private Organizations

The term chief information officer was first proposed by Synott and Gruber (1981) as a means of identifying "the senior executive responsible for establishing corporate information policy, standards, and management control over all information resources." Historically, the senior information systems manager was in charge of an organization's mainframes and technology. This role expanded over time as the use of computers in organizations shifted from accounting data to information work. However, the role of the CIO has grown as the organizational view of information has grown, instituting the office of the CIO as a new corporate function on par with marketing, manufacturing, human resources, and operations (Strassman, 1995). The CIO is more than just the top IT manager within an organization; they have the authority to influence corporate change at the executive level (Boyle and Burbridge, 1991).

The Role of the CIO

The role of the CIO is continuously evolving (see for example Applgate and Elam, 1992; Feeny et al., 1992; Stephens et al., 1992). In a study of the changing role of the CIO, Applegate and Elam (1992) find that new IS executives focus on IT strategic planning and control, IT architecture management and standards development, and human resource management while established IS executives focus on IT architecture management and standards development, human resource management, and operations.

According to an *Infoworld* survey of 77 CIOs in Europe, the United States, and Australia, CIOs view their roles as a technology policy-maker, functional leader, systems strategist, service deliverer, and change leader (2000). Stephens et al. (1992), in a study of the nature of the CIO's role, find that CIO's operate as business executives, not as functional managers who are concerned only with their own department. Gottschalk and Taylor (2000) explain that the CIO operates at an executive level rather than as a functional manager because their roles are more reflective of the strategic focus of executive level work. Thus, CIOs act as a link between IRM and the rest of their organization's functional departments. Stephens (1995) suggests that the role of the CIO is the development of information resources policy, strategic planning for information resources, coordination of IT, educating management on IT, and environmental scanning. Miller (1989) asserts that the CIO's role is to transform the overall organizational strategy into a plan that exploits technological opportunities to create value for stakeholders. However, Welter (1987) takes a broader view of the CIO's role by stating that the two primary roles of the CIO are to keep their organization current in technological applications and to exert an organization-wide presence for IT.

Organizational roles can sometimes be determined by analyzing a position's responsibilities. Strassman (1995) suggests that one of the top responsibilities of the CIO is to align the company's IRM plans with its business plans in order to ensure that technology contributes to operations. This statement is supported by Pemberton (1992) who claims that the CIO must span the worlds of technology and business in order to eliminate discrepancies between the two. In fact one of the most critical issues reported by CIOs in the 1980s was strategic information systems planning, which is the alignment

of IS and strategic business plans (Brancheau and Wetherbe, 1987; Hartog and Herbert, 1986).

CIO Challenges

The evolution of the role of the CIO in both the public and private sectors has led to many challenges. For example, a central problem for CIOs is keeping up with the rapid pace of technology (Romanczuk and Permberton, 1997; Applegate and Elam, 1992; Stephens et al., 1995; Watson et al., 1997). Another major challenge for CIOs is an ill-defined role for IRM within their organization (Romanczuk and Permberton, 1997). Launchbaugh (2002) asserts that the CIO's top priorities are relationship management, business partnerships, sourcing strategies, and visionary leadership. Watson (1990) suggests five key issues for CIOs. These five issues are illustrated below in Table 2.

Table 2: Top Five Key Issues for CIOs (Watson, 1990)

Improving IS strategic planning
Specifying, recruiting, and developing human resources of IS
Developing an information architecture
Aligning the IS organization with that of the enterprise
Improving the effectiveness of software development

Gottschalk and Taylor (2000) suggest that aligning organizational and IRM strategies is one of the greatest challenges faced by CIOs. In a 1984 study of CIO challenges, Dickson et al. found that strategic information systems planning was one of the most critical challenges cited. Many of these challenges are in part determined by the CIO's relationship with the CEO. This relationship is critical for the successful implementation of an IRM strategy and its alignment with the business plan (Gupta, 1991; Feeny et al.,

1992). Other studies have sought to determine what critical success factors are critical for IRM managers. Table 3 below illustrates the results of a study by Magal et al. (1988).

Table 3: Critical Success Factors for IRM managers (Magal et al., 1988)

A Competent Staff	Promote IC services
Communication with users	Atmosphere for users
Top management support	Commitment of end users to IC concept
Reliability of applications developed	Define IC mission
End-User training	Career paths for IC staff
Understanding of user's business and problems	Priority criteria for work
Training for information center (IC) staff	Provide services to distributed sights
Organizational acceptance of IC concept	Control procedures to ensure that standards and policies are adhered to
Standardized hardware and software	System performance
Liaison function with end user departments	Monitor and coordinate end user application development
Support software packages	User's understanding of data processing
Cost effective solutions	Response to applications requests

These critical success factors provide an important insight into the focus of this research effort. The researcher expects that many of the challenges faced by public and private sector CIOs will be reflective of these factors.

Public Sector CIOs: A Study of Challenges and Critical Technologies

The office of the CIO is still new within Federal agencies. Since the office's implementation by the Clinger-Cohen Act in 1996, the Association for Federal Information Resource Management's (AFFIRM) Emerging Issues Forum has conducted annual surveys of senior federal information technology managers in an effort to measure the most critical challenges facing the Federal CIO. Additionally, AFFIRM measures

which technologies senior federal information technology managers "consider the most critical to implementing IT-based solutions" (AFFIRM, 2001:iii). An excerpt from the *2001 Federal Chief Information Officer Sixth Annual Top Ten Challenges Survey* results is presented below in Tables 4 and 5 respectively.

Table 4: Challenges Faced by Federal Chief Information Officers from the Association for Federal Information Resource Management Annual CIO Challenges Studies (1996-2001)

2001 Votes	2001 Ranking	Challenge Description	Annual Ranking				
			2000	1999	1998	1997	1996
29	1	Using IT to improve service to customers/stakeholders/citizens	8	5	6	7	11
28	2	Making the business and cultural changes necessary for full e-Government transformation	--	--	--	--	--
27	3	Hiring and retaining skilled professionals	1	1	13	--	--
26	4	Obtaining adequate funding for IT programs and projects	4	5	--	--	--
25	5	Preventing unauthorized system intrusions (hackers, terrorists, etc.)	3	2	--	--	--
24	6	Formulating or implementing an agency IT architecture	6	7	3	1	3
23	7	Building effective relationships in support of IT initiatives with agency senior executives (agency head, CFO, etc.)	7	15	9	12	6
19	8	Capturing, organizing and making accessible Agency knowledge and expertise (knowledge management)	8	10	10	--	--
18	9	Simplifying business processes to maximize the benefit of technology (see note)	10	13	10	9	5
17	10	Unifying "islands of automation" within lines of business	--	--	--	--	--
16	11	Aligning IT and organizational mission goals	12	11	5	5	4
15	12	Implementing e-business/e-government solutions	2	3	--	--	--
15	13	Providing effective IT infrastructure and related services (not including the desktop)	11	9	10	6	9
14	14	Implementing IT capital planning and investment management across the agency	5	5	4	2	1
12	15	Assessing and developing agency IT competence (training and education)	9	8	9	11	12
12	16	Implementing solutions in support of Government Elimination Act (GPEA)	--	--	--	--	--
10	17	Measuring and reporting past performance	15	12	--	--	--
9	18	Ensuring public access to information vs. the need for system security	13	9	8	--	--
9	19	Controlling IT budgets	17	11	7	13	13
8	20	Managing or replacing legacy systems	11	12	9	12	15
8	21	Developing agency-wide IT accountability	18	12	13	8	14
3	22	Identifying and reporting specific CIO/IRM measures/outcomes under the Government Performance and Results Act	16	6	6	--	--
3	23	Implementing COTS solutions (ERP, CRM, etc.)	19	15	--	--	--
3	24	Planning and implementing IT disability access solutions into existing and new IT systems	20	--	--	--	--
3	25	Responding to outsourcing (A76) requirements	--	--	--	--	--
		Note: replaced "championing BPR as a precursor to IT decisions" from prior surveys					

Table 5: Technologies Perceived as Critical by Federal Chief Information Officers for their Organization's Operations from the Association for Federal Information Resource Management Annual CIO Challenges Studies (1996-2001)

2001 Votes	2001 Ranking	Technology Description	Annual Ranking				
			2000	1999	1998	1997	1996
55	1	Security Infrastructure	1	14	1	2	2
34	2	Internet / Intranet / Web infrastructure	2	1	2	1	1
24	3	Knowledge management	3	5	3	--	--
23	4	E-Mail	14	11	13	8	10
21	5	Internet/ Intranet/ Web applications	2	1	2	1	1
20	6	Remote and mobile computing including personal digital assistants	5	4	9	*	*
19	7	Data warehousing/data mining	6	2	4	3	4
15	8	Security Applications	1	14	1	2	2
14	9	Virtual Private Networks	--	--	--	--	--
12	10	Wireless technology	--	--	--	--	--
11	11	Records management	--	--	--	--	--
11	12	Executive information and decision support systems	10	6	15	10	7
10	13	Data, voice and video convergence (was voice and data integration)	4	10	12	12	12
10	14	Storage and storage networks	--	--	--	--	--
9	15	Video solutions (distance learning, virtual office, desktop)	13	7	--	--	--
8	16	Workflow	7	5	10	6	6
8	17	Portal technologies	--	--	--	--	--
7	18	Training technology and applications					
7	19	COTS applications including ERP, CRM and SCM (was COTS development S/W)	14	11	11	8	1
6	20	Middleware	16	9	14	11	13
5	21	Online analytical processing (OLAP)	19	13	14	10	14
4	22	EC/EDI	8	3	5	5	3
4	23	IT accommodation – disability access solutions	11	12	--	--	--
3	24	Relational databases	16	11	14	9	8
2	25	Next generation Internet	9	11	8	--	--
2	26	Voice integration	21	--	--	--	--
2	27	Groupware	21	11	8	9	8
1	28	Application Service Provider (ASP)	12	--	--	--	--
1	29	Imaging	18	10	12	7	9
0	30	LINUX	19	14	--	--	--

The survey used by AFFIRM to measure public sector CIO challenges and critical technologies has evolved over the life of the research. Since the initial measurement was taken in 1996, each subsequent annual survey uses the previous year's responses to alter the survey instrument to reflect current realities. For example, the number two Federal CIO challenge reported, "Making the business and cultural changes necessary for full e-Government transformation," was not even included on the previous year's (2000) survey as an option. However, so many of the previous year's participants had written this challenge in as critical that it was included in the 2001 survey. The results of these annual surveys demonstrate how the top challenges facing Federal CIOs today, as viewed by senior Federal government IRM managers, have evolved since the office's 1996 implementation as well as how changing priorities have effected which technologies are viewed as critical.

Research Focus

This research seeks to discover if public sector CIOs and private sector CIOs are faced with the same challenges and view the same technologies as critical for their organization's operations. Based on the literature review, past research does not provide a decisive explanation for whether differences will exist in the challenges faced by CIOs or in the technologies that they perceive as critical to their organization's operations. Therefore, the researcher proposes the following hypotheses for this study:

H1: There is no association between the challenges that public sector and private sector CIOs perceive to face.

H2: There is no association between the technologies that public sector and private sector CIOs perceive as critical to their organization's operations

Summary

The goal of this literature review is to provide the framework for the methodology section. It presents an overview of the existing body of organizational research that defines the pubic and private sectors, compares each sector's management and IRM processes, and explains the role of the office of the CIO in public and private sector organizations.

Past research focuses on three models for defining what constitutes a public versus a private sector organization. The generic approach downplays the existence of differences between public, private, and hybrid organizations. Proponents of the core approach assert that there exist fundamental differences that allow organizations to be uniquely classified by sector. Finally, the dimensional approach suggests that distinctions between the two can be made based upon how an organization is constrained or influenced by external political and economic authority. An analysis of the field reveals that there is evidence to support aspects of all three models, though it should be noted that evidence is weakest for the generic approach. This research effort utilizes aspects of the core and dimensional approaches in classifying the participating organizations as public or private because the majority of organizations in the population under study reflect the extremities of the publicness scale and thus reflect characteristics usually associated with core public and core private organizations.

An analysis of existing research reveals the existence of fundamental differences between public and private sector organizations. The majority of this research focuses on management processes and can be classified according to differences by motivation, environment, goals and objectives, structure, management processes, decision making and strategic management. However, many of the traditional stereotypes surrounding management and administration differences by sector still lack convincing evidence. Therefore one must be careful not to place blanket classifications upon an organization because of its sector affiliation.

The review of past research comparing public and private sector IRM use reveals several fundamental differences. The main theme in this research is that the organizations in each sector operate in very different environments which influence the management of organizational information technology resources. Understanding these differences provides an important starting point from which to compare the results of this research effort.

The role of the CIO has grown as the organizational view of information has grown, instituting the office of the CIO as a new corporate function on par with marketing, manufacturing, human resources, and operations (Strassman, 1995). This role is continuously changing. The results of AFFIRM's annual studies demonstrate how the top challenges facing Federal CIOs today, as viewed by senior Federal government IRM managers, have evolved since the office's 1996 implementation as well as how changing priorities have effected which technologies are viewed as critical.

With a definition of the public and private sectors elucidated, management differences between organizations in each sector identified, a comparison of each sector's

IRM processes presented, and an understanding of the position of the CIO explained, the researcher can now establish a methodology in which to address the research focus. The next section presents the methodology used for this study.

III. Methodology

Overview

The previous chapters presented a summary of past research that discusses what constitutes a public and private sector organization, the management differences between public and private sector organizations, the current state of information resource management (IRM) in public and private sector organizations, background research on the position of the chief information officer (CIO) (also known by other titles), and past research that has sought to identify the challenges and critical technologies faced by public sector CIOs. Research from these chapters support several conclusions. First, although all organizations are subject to some form of governmental influence, many (such as the organizations in this study) can still be classified as predominantly public or private on a scale of publicness. Next, differences between public and private sector organizations do exist and are significant to understanding a comparison of each sector's IRM processes. Finally, many senior managers in the public and private sectors continue to struggle with the role of the CIO and IRM within their organizations.

This chapter describes the methodology used to identify and compare what organizational IRM challenges are faced by public and private sector CIOs as well as what technologies they view as critical for their organization's operation. It includes a description of the population under study, the methods used for data collection, the process undertaken to develop and deploy the survey instrument, and the investigation techniques used to analyze the survey data.

Population

The term strategic manager for this research effort refers to the body of senior managers who report directly to their organization's top executive or who is one of the top executives in their field of interest. For example, this study is concerned with the strategic management of an organization's information resource management processes and therefore focuses on each participant organization's chief IRM executive. These senior IRM managers commonly hold titles such as Chief Information Officer, Director of IT Services, Senior Vice President, and Executive Vice President.

Two populations were chosen for this study. The public sector is represented by senior information technology officials and managers at federal departments and agencies. This population comprises a broad spectrum of executive and management levels within the Federal IRM community and was determined early in this study based on existing data collected by the AFFIRM organization over the past six years. Although this population does not solely represent the thinking of Federal CIOs, it does represent a consensus of the broader Federal IRM community and provides an understanding of the key challenges faced by public sector CIOs and also what technologies are considered most critical to implementing IT-based solutions in support of the Information Technology Management Reform Act of 1996.

The private sector is represented by the senior information resource management manager (CIO or equivalent) from each of America's highest grossing businesses as measured by the 2002 FORTUNE 1000 index. The FORTUNE 1000 index was chosen because it represents a broad spectrum of private sector businesses from many different industries. Further, the population of public sector managers represents the views of

federal agencies and departments whose budgets are on par with or exceed the budgets of many private sector businesses. The companies included in the FORTUNE 1000 index represent a population of organizations that manage large budgets, have both a national and international focus, and have implemented and utilize the office of the CIO (or equivalent) to achieve organizational goals.

For this study, the entire population of FORTUNE 1000 CIOs (or equivalent title) was polled. Using the entire population allows for an analysis to be conducted across a wide range of organizations and decreases the effects of disconfirming cases from different participants (Babbie, 1998:462). Therefore, the population size is 1000 individuals.

Questionnaire Design

The instrument used for this research was developed by the Association for Federal Information Resources Management (AFFIRM). According to the organization's website, AFFIRM was founded in 1979 to facilitate the advancement of the management of Federal IRM with a focus on strategic management issues. AFFIRM is composed of members from the Federal government, private industry, and from academia.

The survey instrument is divided into two sections. The first version of this instrument was developed in 1996 in order to assess what challenges were being faced by the newly formed office of the CIO within Federal agencies as well as which technologies were viewed as the most critical for implementing the CIO functions over the next year, 1996-1997. Section one sought to determine the greatest challenges faced by Federal CIOs, as viewed by senior Federal IRM managers. Section two of the survey

sought to capture the technologies viewed by Federal CIOs as most critical in performing their CIO function over the next year. In each section, participants were presented with a list of key challenges and critical technologies. The original lists of key challenges and critical technologies were created from an analysis of government publications concerning the implementation of the Information Technology Reform Act of 1996. The analysis from these documents revealed the existence of similarities, across federal agency boundaries, in the key challenges faced by agency CIOs and the technologies viewed as critical in implementing the CIO function. The original 1996 lists of key challenges and critical technologies included in the initial survey instrument are displayed below as Table 6 and Table 7 respectively.

Table 6: Key Chief Information Officer Challenges from the First Annual Association for Federal Information Resource Management CIO Challenges Survey (AFFIRM, 1996)

[3]

Aligning IT and organizational mission goals
Integrating or consolidating program/administrative information systems
Using IT to improve service to customers/stakeholders/citizens
Managing or replacing legacy systems
Formulating or implementing an agency IT architecture
Championing business process reengineering as a precursor to IT decisions
Ensuring Year 2000 operation
Implementing IT capital planning and investment management across the agency
Gaining a seat at the senior management table
Building effective relationships with agency senior executives (agency head, CFO, etc.)
Controlling IT budgets
Obtaining adequate resources
Shaping realistic senior management expectations
Assessing and developing agency IT competence (train and education)
Providing effective IT infrastructure and related services
Ensuring timely and effective IT procurements
Measuring IT contribution to mission performance
Implementing cross-government IT projects
Achieving a CIO Council that provides timely, effective, action-oriented leadership for
Federal IT activities and services
Engaging senior executives on IT strategic directions
Developing genocide IT accountability
Maintaining effective relationships with oversight organizations
Maximizing agency use of commercial/government off-the-shelf-technology

Table 7: Technologies Perceived as Critical by Chief Information Officers from the First Annual Association for Federal Information Resource Management CIO Challenges Survey (AFFIRM, 1996)

Data warehousing	Object databases
EC/EDI	Distributed computing
Internet/intranet/web	Client-server computing
Email	Imaging
Groupware	Workflow
Middleware	ATM
Mobile communications	Voice integrated
EIS/DSS	On-line analytical processing
CASE	Security technology
Relational databases	Components/JAVA

The initial survey instrument has evolved over the life of the research. Since the initial measurement was taken in 1996, each subsequent annual survey uses the previous year's responses in conjunction with government publications and research from private industry and academia to alter the survey instrument to reflect current realities. For example, older technologies or challenges that received consistently low scores and are not supported by research were dropped from the list of choices and replaced by options that did reflect current research from the IRM community. The results of these annual surveys demonstrate how the top challenges facing Federal CIOs today, as viewed by senior Federal government IRM managers, have evolved since the office's 1996 implementation as well as how changing priorities have influenced which technologies are viewed as critical.

The survey instrument used for this research effort is the same instrument used by AFFIRM to conduct their 2001 CIO challenges study. This instrument is the most up to date version and therefore represents the most accurate and current realities in IRM research and practice compared to instruments used by AFFIRM in previous years. With the exception of minor changes made to the survey after pilot testing (to be discussed later in the Pilot Study section), the instrument for this study is the same as the one used and developed by AFFIRM to survey senior IRM officials and managers in Federal agencies and departments in 2001. A copy of the survey used in this study is presented in Appendix A. In order to see how the challenges faced by federal CIOs and technologies perceived as critical have changed since 1996, the CIO challenges and critical technologies from AFFIRM's 2001 survey are listed below in Tables 8 and 9.

Table 8: Chief Information Officer Challenges from 2001 Association for Federal Information Resource Management CIO Challenges Survey

Using IT to improve service to customers/stakeholders/citizens
Making the business and cultural changes necessary for full e-Government transformation
Hiring and retaining skilled professionals
Obtaining adequate funding for IT programs and projects
Preventing unauthorized system intrusions (hackers, terrorists, etc.)
Formulating or implementing an agency IT architecture
Building relationships in support of IT initiatives with agency senior executives (agency head, CFO, etc.)
Capturing, organizing and making accessible Agency knowledge and expertise (knowledge management)
Simplifying business processes to maximize the benefit of technology (see note)
Unifying "islands of automation" within lines of business
Aligning IT and organizational mission goals
Implementing e-business/e-government solutions
Providing effective IT infrastructure and related services (not including the desktop)
Implementing IT capital planning and investment management across the agency
Assessing and developing agency IT competence (training and education)
Implementing solutions in support of Government Elimination Act (GPEA)
Measuring and reporting past performance
Ensuring public access to information vs. the need for system security
Controlling IT budgets
Managing or replacing legacy systems
Developing agency-wide IT accountability
Identifying and reporting specific CIO/IRM measures/outcomes under the Govt. Perf. and Results Act
Implementing COTS solutions (ERP, CRM, etc.)
Planning and implementing IT disability access solutions into existing and new IT systems
Responding to outsourcing (A76) requirements

Table 9: Critical Technologies from 2001 Association for Federal Information Resource Management CIO Challenges Survey

Security Infrastructure	Video solutions (distance learning, virtual office, desktop)
Internet / Intranet / Web infrastructure	Workflow
Knowledge management	Portal technologies
E-Mail	Training technology and applications
Remote and mobile computing	COTS applications including ERP, CRM and SCM
Internet/ Intranet/ Web applications	Middleware
Data warehousing/data mining	Online analytical processing (OLAP)
Security Applications	EC/EDI
Virtual Private Networks	IT accommodation – disability access solutions
Wireless technology	Relational databases
Records management	Next generation Internet
Executive information and DSS	Data, voice and video convergence
Voice integration	Groupware
Storage and storage networks	Application Service Provider (ASP)
LINUX	Imaging

Data Collection Method

The two dominant approaches to survey administration in large populations are paper-based and web-based. Many research efforts have begun to use web-based surveys whenever possible because of their convenience. Web-based surveys allow the users to easily access and submit surveys more easily. They are also cheaper to distribute, easier to track, and allow researchers to have survey results inputted directly into an analysis tool such as a statistics package or spreadsheet. Additionally, research demonstrates that web-based surveys often result in fewer missed values than do paper-based surveys and that web-based and paper-based survey results should not differ (Stanton, 1998:720).

This research effort utilized both paper-based and web-based versions of the same instrument. Participants were notified by mail with an envelope addressed to the CIO or Senior Information Technology Manager at each respective company. The letters were not addressed solely to the CIO because of the variability of titles such as Vice President used by companies to denote their senior IRM executive (Brumm, 1988). The mailing contained a cover letter, copy of the paper-based survey, and a link to the web-based version of the survey. The dual version option was chosen for several reasons. First, a list of the population's email addresses could not be acquired which meant that notification of the survey would have to be mailed. Additionally, the researcher felt that a paper-based notification would be more professional and be perceived as more credible to the population since they are not familiar with the researcher (though there is no empirical evidence to support this assumption). Next, since the notification and invitation to participate in the study was to be mailed, the researcher felt that the availability of a paper-based version of the survey should be included since the cost to do

so would be minimal. Finally, given that the population consists of private sector CIOs (or equivalent title) whose jobs depend on the successful use of IRM, the researcher felt that a web-based version of the survey was particularly relevant and should be offered. The web-based version of the survey was stored on a network server at the Air Force Institute of Technology with no external support required. In designing the web-based survey, careful attention was paid to ensuring that both versions of the survey were as close as possible in presentation and identical in content.

Pilot Testing

Pilot testing of the survey instrument was conducted during the month of June 2002. The participants consisted of 30 active duty USAF officers from the communications/computer career field who were also graduate students enrolled in the CIO track of the Information Resource Management degree program at the Air Force Institute of Technology. These participants were selected because of their backgrounds as IRM professionals/managers as well as their knowledge of the office of the CIO. Each participant in the pilot study was given a paper copy of the survey instrument and asked to complete it and provide feedback using either the hard copy provided or online at a provided web link. These conditions were identical to the methodology employed during the actual experiment except that the pilot study participants did not receive their surveys via the mail. All 30 surveys were returned by the 30 June deadline and all were considered usable.

The goal of the pilot study was to detect any mechanical errors in the instrument, ensure that the wording of the instrument made sense, and to test the web survey option

for technical errors and accuracy. The results of the pilot test drove several changes in the instrument and experiment process. First, the original web-based version of the instrument did not allow participants enough space to make desired comments, did not force participants to make five selections in each section, and was deemed not visually accurate in presentation when compared to the paper based version of the instrument. All of these suggestions were implemented in the final version of the web-based survey. The second major change to the instrument involved the wording of the instrument cover letter. Feedback from the pilot study participants indicated that it was unclear as to what was meant by the terms critical challenges and technologies. Additional wording was added to the cover letter and to each section of the survey to clarify these terms. Next, the pilot test participants indicated that some of the items listed in the key challenges section of the instrument were not relevant to the private sector. For example, the original instrument included "Implementing solutions in support of the Government Paperwork Elimination Act (GPEA)." This key challenge was dropped from the list of key challenges on the final instrument to avoid confusion since private sector companies are not subject to the GPEA. Eliminating this item should not alter the final comparison results since this item was not in the top fifty percentile of the public sector's results and also was not even on any of the surveys before 2001. Finally, small wording changes were made to some of the items in the key challenges list. These changes are presented below in table 10 and can be contrasted against the original items from AFFIRM's 2001 survey in Table 8.

Table 10: Modifications made to the Critical Challenges Section of Original 2001 Association for Federal Information Resource Management Chief Information Officer Challenges Survey

Original Wording	Revised Wording in Final Instrument
Using IT to improve service to customers/stakeholders/citizens	No Change
Making the business and cultural changes necessary for full e-Government transformation	Making the business and cultural changes necessary for full e-Business transformation
Hiring and retaining skilled professionals	No Change
Obtaining adequate funding for IT programs and projects	No Change
Preventing unauthorized system intrusions (hackers, terrorists, etc.)	No Change
Formulating or implementing an agency IT architecture	Formulating or implementing an organizational IT architecture
Building effective relationships in support of IT initiatives with agency senior executives (agency head, CFO, etc.)	Building effective relationships in support of IT initiatives with your organization's senior executives (agency head, CFO, etc.)
Capturing, organizing and making accessible Agency knowledge and expertise (knowledge management)	Capturing, organizing and making accessible organizational knowledge and expertise (knowledge management)
Simplifying business processes to maximize the benefit of technology (see note)	No Change
Unifying "islands of automation" within lines of business	No Change
Aligning IT and organizational mission goals	No Change
Implementing e-business/e-government solutions	Implementing e-business solutions
Providing effective IT infrastructure and related services (not including the desktop)	No Change
Implementing IT capital planning and investment management across the agency	Implementing IT capital planning and investment management across the organization
Assessing and developing agency IT competence (training and education)	Assessing and developing organization IT competence (training and education)
Implementing solutions in support of Government Elimination Act (GPEA)	Eliminated
Measuring and reporting past performance	No Change
Ensuring public access to information vs. the need for system security	No Change
Controlling IT budgets	No Change
Managing or replacing legacy systems	No Change
Developing agency-wide IT accountability	Developing organization-wide IT accountability
Identifying and reporting specific CIO/IRM measures/ outcomes under the Government Performance and Results Act	Identifying and reporting specific CIO/IRM measures/outcomes
Implementing COTS solutions (ERP, CRM, etc.)	No Change
Planning and implementing IT disability access solutions into existing and new IT systems	No Change
Responding to outsourcing (A76) requirements	Responding to outsourcing requirements
Note: replaced "championing BPR as a precursor to IT decisions" from prior surveys	No Change

The majority of the wording changes are the result of changing instances of the word 'agency' in the original instrument to the word 'organization' in the final instrument. These changes were made because they do not alter the meaning of each item and because the word 'organization' is more inclusive and thus more applicable to the private sector than the word 'agency'. Another major wording change involved the elimination of the phrase 'under the Government Performance and Results Act (GPRA)'. This phrase was eliminated because private sector companies are not subject to the GPRA. However, the entire item was not eliminated because private sector CIOs may face 'identifying and reporting specific CIO/IRM measures/outcomes' as a key challenge.

Permission to Conduct Research

In accordance with Air Force Instruction 36-2601, all surveys to be administered to Air Force personnel must first be approved and assigned a survey control number by the Air Force Survey Branch (AFSB) at the Air Force Personnel Center (AFPC). Since no AF personnel were surveyed for this study, no authorization from AFSB was required. Additionally, on July 1, 2002, Mr. Steve Hufford of AFFIRM's Emerging Issues Forum gave permission to the researcher to utilize the CIO challenges survey instrument for this research effort.

Survey Administration

Survey notification was made on August 30, 2002 by United States mail. The survey packages were addressed to the CIO or Senior Information Technology Manager at each company on the 2002 FORTUNE 1000 index. The mailing address for each company in the population was obtained from FORTUNE Magazine's website. The

mailing contained a cover letter, copy of the paper-based survey, and a link to the web-based version of the survey. The survey was hosted by the Air Force Institute of Technology and could be accessed at the address http://en.afit.edu/env/cio_challenge/ . The cover letter included a brief introduction of the study's purpose, directions for the survey, and also stated that the research effort was academic and that anonymity would be upheld. A copy of the survey package including the cover letter can be referenced in Appendix A. Also included in the survey package was an envelope pre-addressed to the researcher's office that respondents could use to submit a completed paper-based survey. In order to increase the response rate, the cover letter was printed on AF letterhead and the packages were sent via official business mail. It was hoped that these measures would increase the perceived credibility of the study so that the mailing would not be prematurely discarded as junk mail before ever reaching the intended participant. Rejected mailings were routed back to the researcher's work address so that a new address for the intended recipient could be found and the survey package could be resent. Twenty-eight mailings were ultimately rejected due to incorrect addresses that could not be resolved.

Responses were stored in a database also hosted at the Air Force Institute of Technology. The researcher developed and maintained control of the results database throughout the duration of the study. Surveys submitted online were directly stored in the results database without contact from the researcher. Paper-based surveys had to be manually entered into the results database by the researcher. Error checking of these inputs was performed by several AF officers at AFIT who were independent of the research team.

Data Analysis

The data analysis phase of this study focuses on describing the association between the perceptions of public and private sector CIOs. The data consists of matched pairs of rankings that measure CIO perceptions of challenges faced and technologies critical for operations. Because the sampling situation consists of matched pairs of rankings (therefore non-normal), non-parametric statistical test must be employed to measure association. The two non-parametric tests employed in this study are Spearman's rank correlation coefficient and Kendall's Tau coefficient. These descriptive statistics reflect the degree of association between the ranks of the responses by CIOs in each sector. These tests measure the degree of association between the ranks of the variables, not the degree of association between the variables themselves. Association is a depiction of the relationship between two variables, but does not indicate any causal relationship (Gibbons, 1976). The existence of any association between variables may be because of one or many other variables. This section presents an explanation and comparison of each of these techniques.

Spearman's Rank Correlation Coefficient

Spearman's rank correlation coefficient (R) is a non-parametric measure of the linear relationship between two variables. When using Spearman's R, the null hypothesis indicates the absence of an association between the two tested variables while the alternative indicates the existence of an association between the variables. It is similar to Pearson's product-moment correlation coefficient of parametric statistics when the observations are in ranks (Gibbons, 1976). The magnitude of the response for each item is first ranked within each set. For example, in this study, each item within the

challenges section was ranked according to how many of the respondents chose the item in the public sector and private sector. This will produce two columns of ranks, one for the public sector responses and one for the private sector responses. The rankings are in perfect agreement if the ranks for each item are identical. They are in perfect disagreement if the ranks are in complete reverse order (Gibbons, 1976). These situations are illustrated below as table 11.

Table 11: Examples of Rank Orders needed to Produce Perfect Agreement or Disagreement values of Spearman's Rank Correlation Coefficient

Perfect Agreement		Perfect Disagreement	
Sample # 1 Rank	Sample # 2 Rank	Sample # 1 Rank	Sample # 2 Rank
1	1	1	n-1
2	2	2	n
.	.	.	.
.	.	.	.
.	.	.	.
n-1	n-1	n-1	2
n	n	n	1

The differences between the ranks are used as a measure of their disagreement (Gibbons, 1976). This measure of disagreement (R) ranges from -1 to 1. When R = 0 there is no association and therefore no agreement or disagreement between the overall rank comparisons. Similarly, when R = -1 of R = 1, there is either perfect disagreement of perfect agreement, respectively, between the overall rank comparisons. The sign of the R statistic indicates the direction of association, not the strength of association (Conover, 1980). Spearman's rank correlation coefficient is computed as follows:

$$\text{Spearman\_R} := 1 - \frac{6\left[\sum_{i=1}^{n}\left(\text{Public\_Rank}_i - \text{Private\_Rank}_i\right)^2\right]}{n \cdot \left(n^2 - 1\right)}$$

Therefore, Spearman's rank correlation coefficient is computed by computing one minus six times the summation of the differences squared for each rank of corresponding items, divided by the number of items multiplied by the number of items squared minus one. The same procedure for computing the rank correlation coefficient described above will also be applied to the critical technologies data.

Kendall's Tau Coefficient

Kendall's Tau Coefficient is another way to measure the degree of association between a set of ranked observations. It can be used in the same sampling situations as Spearman's rank correlation coefficient (Gibbons, 1976). However, the computation is not the same and hence produces a different value than Spearman's rank correlation coefficient.

The sampling situation for Kendall's Tau consists of a random sample on 'n' pairs of observations on at least an ordinal scale (Conover, 1980). Unlike Spearman's rank correlation coefficient, the observations do not have to be ranked to perform the test. The test statistic (τ) is a measure of the relative discrepancy between the actual (as observed) order of a set of observations and the two orders that would occur if the ranks were in perfect agreement and perfect disagreement (similar to the situations described in Table 4) (Gibbons, 1976). Gibbons (1976:297) states:

Kendall's Tau can be interpreted as the number of concordant pairs minus the number of discordant pairs, divided by the total number of distinguishable pairs, or equivalently as the excess of the proportion of concordant pairs over the proportion of discordant pairs.

To compute the test statistic, the first step is to arrange the observations into pairs by instrument item. For example, in this study, the pairs consist of the public sector rank and the private sector rank for each questionnaire item. The pairs should be arranged so that one of the observation sets is arranged in increasing order. For example, in this study, the pairs are arranged so that the public sector ranks appear in increasing order. The test statistic formula is as follows:

$$T := \frac{4S}{n(n-1)}$$

In this formula, 'S' is computed by summing, for each private sector rank, the number of private sector ranks that are greater than it minus the ones that are less than it, while 'n' represents the number of observations (Gibbons, 1976). When T = 0 there is no association and therefore no agreement or disagreement between the overall rank comparisons because the number of pairs that agree is the same as the number of pairs that disagree. Similarly, when T = -1 or T = 1, there is either perfect disagreement or perfect agreement, respectively, between the overall paired comparisons. The sign of the R statistic indicates the direction of association, not the strength of association (Conover, 1980).

Kendall's Tau and Spearman's rank correlation coefficient can be used interchangeably to measure the degree of association between sets of ranks. However, there are differences between the two. For example, the Tau statistic approaches normality more quickly than Spearman's R. Thus in moderately sized samples, a P-value based upon Kendall's Tau is more reliable than one based upon Spearman's R (Gibbons, 1976)). Next, Spearman's R usually produces a larger value than Kendall's Tau when each is calculated on the same sample set. Although each test statistic is computed differently, the association indicated by each test should agree when performed on identical sampling sets (Gibbons, 1976).

Summary

This research effort surveys CIOs from private sector companies using an instrument developed for and administered to public sector senior IRM managers by the AFFIRM organization annually since 1996. The purpose of the instrument is to discover what key challenges CIOs face and which technologies they perceive as critical to implementing IRM within their organization. The results collected by this research effort will then be analyzed with the results from the AFFIRM organization's 2001 CIO Challenges survey in order to test for an association between how the private sector participants in this study and the public sector participants from AFFIRM's 2001 study ranked the challenges they face and technologies they perceive as critical for their organization's operations.

The population for this study consists of the CIO (or equivalent title) from every company on the 2002 FORTUNE 1000 Index. The FORTUNE 1000 Index is determined

by each company's previous year's revenues. This population was chosen because the size and diversity of these companies offered a good private sector spectrum of companies with which to compare to public sector agencies and departments. The public sector population surveyed in 2001 by AFFIRM consists of CIOs and senior IRM managers within Federal agencies in the Executive branch of the government.

The AFFIRM developed version (public sector) survey was slightly modified for this study in order to provide relevance to private sector CIOs. Pilot testing was conducted with officers from the Air Force Institute of Technology before administering the survey. Feedback from the pilot test was used to test the technical robustness, grammar, and clarity of the instrument before deployment. Participants were given the option of either completing a paper-based or web-based version of the survey instrument. The results from AFFIRM's 2001 study and this research effort will then be compared.

This chapter presents the research design and methodologies used to discover what key challenges are faced by, and which technologies are perceived as critical, according to private sector CIOs as well as how these results are used in a comparison with data from the public sector. The following chapter discusses the survey results and their comparison with data from senior IRM officials and managers within public sector departments and agencies. The results of this data analysis are presented in chapter five along with a section on the study's limitations, implications, and suggestions for future research.

IV. Data Analysis

Overview

As stated previously, the goal of this research is to determine if public and private sector CIOs are faced with the same challenges and view the same technologies as critical for their organization's operations. This chapter presents an overview and analysis of the overall survey results using the statistical procedures previously discussed in the methodology section. First, an analysis of the survey response rate is presented, followed by a demographic analysis of the survey respondents. Next, analyses of the CIO challenges and critical technologies sections of the survey are presented using Spearman's coefficient of rank correlation and Kendall's Tau coefficient. Screenshots of each of these survey sections can be found in Appendix A.

Survey Response Rate

The total number of usable responses received from FORTUNE 1000 CIOs was 150. The web survey was accessible to participants from August 30, 2002 through October 18, 2002. Respondents choosing the paper based survey option were asked to have all responses mailed by October 11, 2002. The final web version of the survey submitted by the study participants occurred on October 17, 2000 while the last paper version of the survey was received on October 21, 2002. The initial response rate was 15 percent of the entire population. However, twenty-eight surveys are confirmed to have never reached their intended recipient because of irresolvable addresses. In addition, five members of the population expressed interest in the research but were unable to respond due to their organization's policies against participating in surveys. Given these factors,

the final response rate for this research effort, based upon an intended sample of 1000 participants, is 15.5 percent.

Stratification of FORTUNE Ranking

The goal of this research was to survey the entire population of FORTUNE 1000 corporations as representative of America's largest revenue netting organizations. The sample mean FORTUNE rank of the participant organizations was 496.05. The sampling distribution of the FORTUNE ranks of each participant's organization is shown below in Figure 2.

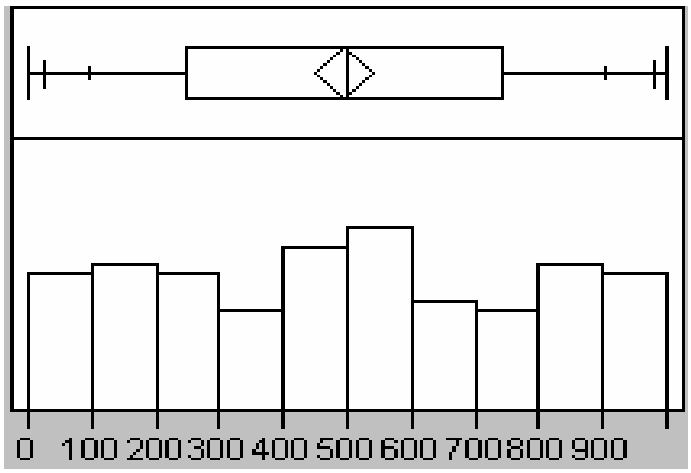


Figure 2: Stratification of the Sample's FORTUNE Ranks based upon the 2002 FORTUNE 1000 Rankings (April 15, 2002 issue)

Although the sample mean of FORTUNE rank appears to be close to the population mean of 500, another potential stratification variable to be considered, though not measured in this study, is each participant organization's annual gross revenue which is the basis for FORTUNE's ranking methodology.

Demographic Information

Some demographic information was collected from the participants during the survey process. This information was not used to differentiate groups within the sample. It was collected in order to help ensure that the sample was representative of the population as well as for future research. First, the participants were asked to indicate how long they have held their current position by selecting from a list of four time periods: less than six months; six months to one year; one year to five years; and greater than five years. One of the researcher's regrets in developing this section of the survey was limiting the respondents to these time periods and thus restricting any meaningful statistical analysis of this demographic. However, the results of this demographic do give some limited insight into the length of time that each participant has been in their current position as illustrated below in Table 12.

Table 12: Length of time that each Participant Chief Information Officer has been in their Current Position Summary

Time Period	Number of Respondents (N=150)	Percent of Respondents
Less than 6 Months	9	6.00%
6 Months to 1 Year	47	31.30%
1 to 5 Years	79	52.70%
Greater than 5 Years	15	10.00%

Although the mean length of time that each survey participant has been in their current position is not discernable from this data, it is apparent that the majority of the survey respondents have been the CIO or senior information technology manager in their respective organization for between one and five years. One interesting note is that 31.3

percent of the respondents have been in their position for between six months and one year and that 37.3 percent have been in their current position for less than one year. This finding is interesting in that 37.3 percent of the participants are relatively new to the office of the CIO. Further, only 10 percent of the respondents have been in their position for greater than five years. Although the data does not allow for a rigorous statistical analysis, it does appear that a significant percentage of the sample is relatively new to their position within their current organization while only 10 percent have greater than five years in their current position.

Another demographic collected was the position title held by each participant. Recognizing that the title of Chief Information Officer is not used universally, this demographic was collected in order to discover which titles are being used to describe executive level IRM positions as well as to provide data for future research. The titles claimed by the survey participants are illustrated below in Table 13.

Table 13: Organizational Titles of Survey Participants

Title	Quantity	% of Sample
Chief Information Officer	40	26.7
Chief Information Officer & Vice President	34	22.7
Chief Information Officer & Senior Vice President	28	18.7
Vice President Information Technology	7	4.7
Chief Information Officer & Executive Vice President	6	4
Vice President Information Services	5	3.3
Chief Information Officer & Vice President of MIS	2	1.3
Director of Information Services	2	1.3
Director of Information Technology	2	1.3
Chief Privacy Officer	1	0.7
Chief Information Officer & Chief Technology Officer	1	0.7
Chief Information Officer & Vice President of Information Services	1	0.7
Chief Information Officer & Vice President Operational Planning	1	0.7
Chief Technology Officer	1	0.7
Director	1	0.7
Director of Corporate Information Services	1	0.7
Director Technical Support	1	0.7
Executive Vice President of Information Technology	1	0.7
Executive Vice President of Operations & Technology	1	0.7
General Manager	1	0.7
Information Technology Administrator	1	0.7
Information Technology Manager & Director	1	0.7
Manager of Information Security & Information Technology	1	0.7
Manager of Information Solutions	1	0.7
Manager Technology Deployment Services	1	0.7
Managing Director - Information Technology	1	0.7
President, Information Technology Company	1	0.7
Senior Manager Global Information Technology Services & Support	1	0.7
Senior Vice President Technology Services Division	1	0.7
Senior Vice President Information Technology Operations	1	0.7
Vice President Corporate Systems	1	0.7
Vice President Information Systems	1	0.7
Vice President of Information Technology	1	0.7
sum	**150**	**100**

The title of chief information officer was the most frequently claimed by survey respondents. Out of 150 respondents, 113 (75.3 percent) claimed to be their company's chief information officer. Of these 113 respondents, 40 (26.7 percent) stated that the title of Chief Information Officer was their only role while the remaining 73 (48.7 percent)

stated having additional titles. The majority of these additional titles include vice president (22.7 percent), senior vice president (18.7 percent), and executive vice president (4.0 percent). Other titles claimed by survey respondents as the senior information technology executive in their organization include varying versions of manager, director, and administrator as well as chief technology officer and president.

This sample represents businesses that had average gross revenue of $3.1 billion in 2001. Therefore, the results of the demographic analysis reveal that the survey sample appears to be made up of executive level managers from some of the United States' largest firms. This conclusion satisfies the demographic goal of this study to compare public and private sector information resource management at the executive level.

Analysis of Part 1: CIO Challenges

Part 1 of the survey asked participants to select the five greatest CIO challenges faced by their organization from a list of the twenty-four most commonly cited challenges by public sector CIOs as determined by the AFFIRM organization's Federal Chief Information Officer Challenges and Critical Technologies Survey. Each item from part 1 of the survey, the number of private sector participants who selected the item (private sector score), and the rank of that item in relation to the rest of the sample (private sector rank) is displayed below in Table 14. The ranks were derived by summing the number of respondents that chose each respective item in part 1 of the survey. Additionally, the table displays the public sector score and rank for each survey item as collected in part 1 of AFFIRM's (2001) sixth annual Federal Chief Information Officer

Challenges and Critical Technologies survey. Table 14 is sorted by the rank that each item received by Federal (public sector) CIOs in the 2001 survey.

Table 14: Comparison of how the Public and Private Sector Chief Information Officer Participants Ranked the Challenges Faced by CIOs in Section One of the Survey, based on the number of Respondents that Selected each Item (Denoted by the Public and Private Sector Score Columns)

Challenges	Private Sector Score (N=150)	Public Sector Score (N=80)	Private Sector Rank	Public Sector Rank
Using IT to improve service to customers/stakeholders	71	29	2	1
Making the business/cultural changes for e-Business	31	28	10	2
Hiring and retaining skilled professionals	16	27	17	3
Obtaining adequate funding for IT programs and projects	47	26	5	4
Preventing unauthorized system intrusions	40	25	6	5
Formulating/implementing organization IT architecture	40	24	7	6
Building effective relationships w/ senior executives	67	23	3	7
Capturing/organizing/accessibility org. knowledge	27	19	15	8
Simplify business processes to maximize benefits of technology	73	18	1	9
Unifying "islands of automation" w/in lines of business	30	17	12	10
Aligning IT and organizational mission goals	55	16	4	11
Implementing e-business solutions	12	15	19	12.5
Providing effective IT infrastructure and related services	30	15	13	12.5
Implement IT capital planning/investment mgmt across org.	38	14	8	14
Assessing/developing org. IT competence (training/edu)	16	12	18	15
Measuring and reporting past performance	10	10	21	16
Ensuring public access to info vs. need for sys. security	8	9	22	17.5
Controlling IT budgets	23	9	16	17.5
Managing or replacing legacy systems	31	8	11	19.5
Developing organization-wide IT accountability	37	8	9	19.5
Identifying/reporting CIO/IRM measures/outcomes.	11	3	20	22
Implementing COTS solutions (ERP, CRM, etc.)	29	3	14	22
Planning/implementing IT disability access solutions	0	3	24	22
Responding to outsourcing requirements	3	3	23	22

(Public Sector Score and Rank data from Association for Federal Information Resource Management, 2001)

The data from Table 14 is used in this research effort to compare the private sector responses from this study with the public sector responses from AFFIRM's (2001) study in order to discover whether public sector and private sector CIOs are faced with the same organizational challenges. This section presents the statistical analysis of the ranks of these responses. Two rank sum statistics, the Spearman coefficient of rank correlation and the Kendall Tau coefficient, are used to test the following hypothesis:

$H1_o$: There is no association between the challenges that public sector and private sector CIOs perceive to face.

$H1_a$: There is an association between the challenges that public sector and private sector CIOs perceive to face.

Spearman Coefficient of Rank Correlation

A Spearman coefficient of rank correlation (Rho) was calculated using the public and private sector ranks of the CIO challenges obtained in part 1 of the survey. This coefficient is a measure of how closely the ranks of the public sector and private sector responses agree. A description of how this coefficient was calculated is described in chapter 3. The ranks of the results of part 1 of the survey and the results from the CIO challenges section of AFFIRM's (2001) survey were loaded in to the statistical software package JMP IN® version 5.0 to determine the value of the Spearman coefficient of rank correlation. The results of this test, followed by an explanation of the coefficient's meaning, are displayed below in tables 15 and 16 respectively.

Table 15: Spearman Rho Results for how Public and Private Sector Chief Information Officers Ranked the Challenges they Face

Variable	by Variable	Spearman Rho	p-value
Public Sector CIO Challenges Ranks	Private Sector CIO Challenges Ranks	0.6318	0.0009

Table 16: Spearman's Rho Coefficient Meanings for CIO Challenges

Value of Spearman's Rho	Type of Association	Type of Agreement
R = 1	Direct	Perfect Agreement
R = 0	None	Neither Agreement or Disagreement
R = -1	Inverse	Perfect Disagreement

The Spearman Rho value of .6318 and p-value of .0009 indicate agreement between the public and private sector rankings. This value for Rho is supported by the fact that many of the large and small public sector ranks are paired respectively with large and small private sector ranks, which is evidence of a direct relationship. Agreement in the rankings leads to a rejection of the null hypothesis and therefore provides evidence for a direct association in the perceived challenges faced by public and private sector CIOs in the sample. The p-value is the probability of incorrectly rejecting the null hypothesis, also known as Type I error. The low p-value for this test indicates that there is a low probability of incorrectly rejecting the conclusion that no association

exists. This low error rate provides further evidence to reject the null hypothesis and therefore that there is a statistically significant relationship between the two variables.

Kendall Tau Coefficient

The Kendall Tau coefficient is another measure of the association between two measured variables. Although calculated differently, the Kendall Tau statistic can be derived using the same inference situation as the Spearman Rho statistic. However, instead of measuring the actual discrepancy between the ranks of two variables, the Kendall Tau coefficient measures the discrepancy between the actual observed ranks and the ranks that the two orders would produce in a perfect association between the ranks of the two variables (Gibbons, 1976). A description of how this coefficient is calculated is described previously in chapter 3. A Kendall Tau correlation coefficient was calculated using the public and private sector ranks of the CIO challenges obtained in part 1 of the survey in order to provide additional evidence for the results of the Spearman Rho results. The ranks of the results of part 1 of the survey and the results from the CIO challenges section of AFFIRM's (2001) survey were loaded in to JMP IN® version 5.0 to derive the value of the Kendall Tau coefficient. The results of the Kendall Tau calculations, followed by an explanation of the coefficient's meaning, are displayed below in tables 17 and 18 respectively.

Table 17: Kendall Tau Results for how Public and Private Sector Chief Information Officers Ranked the Challenges they Face

Variable	by Variable	Kendall Tau	p-value
Public Sector CIO Challenges Ranks	Private Sector CIO Challenges Ranks	0.4678	0.0016

Table 18: Kendall's Tau Coefficient Meanings for CIO Challenges

Value of Kendall Tau	Type of Association	Type of Agreement
T = 1	Direct	Perfect Agreement
T = 0	None	Neither Agreement or Disagreement
T = -1	Inverse	Perfect Disagreement

The Kendall Tau coefficient can be interpreted as a measure of disarray between rankings. For this study, the Kendall Tau value of .4678 and p-value of .0016 indicate a direct association as well as an agreement between the public sector and private sector rankings. As previously stated in chapter three, the Spearman Rho statistic usually produces a larger value than the Kendall Tau statistic when each is calculated on the same sample set. Although each test statistic is computed differently, the association indicated by each test should agree when performed on identical sampling sets (Gibbons, 1976). Further, the Tau statistic approaches normality more quickly than Spearman's Rho. Thus in moderately sized samples, a p-value based upon Kendall's Tau is more reliable than one based upon Spearman's Rho in moderately sized sample (Gibbons, 1976). The positive value for Tau warrants a rejection of the null hypothesis as well as provides evidence for a direct association between the perceived challenges faced by the public and private sector CIOs in the sample. The low p-value for this test indicates that there is a low probability of incorrectly rejecting the conclusion that no association exists. This low error rate provides further evidence to reject the null hypothesis and therefore

that there is a statistically significant association between the two variables. Therefore, when all of the CIO challenges rankings are considered simultaneously, the public and private sector CIOs can be considered statistically consistent in their rankings.

Analysis of Part 2: Critical Technologies

Part 2 of the survey asked participants to select the five technologies that are most critical to their organization's operations from a list of thirty existing technologies deemed to be the most critical to public sector chief information officers as determined by the AFFIRM organization's (2001) Federal Chief Information Officer Challenges and Critical Technologies Survey. Each item from part 2 of the survey, the number of private sector participants who selected the item (private sector score), and the rank of that item in relation to the rest of the sample (private sector rank) is displayed below in Table 19. The ranks were derived by summing the number of respondents that chose each respective item in part 2 of the survey. Additionally, the table displays the public sector score and rank for each survey item as collected in part 2 of AFFIRM's (2001) sixth annual Federal Chief Information Officer Challenges and Critical Technologies survey. Table 19 is sorted according to the rank that each item received by Federal (public sector) CIOs in the 2001 AFFIRM survey.

Table 19: Comparison of how the Public and Private Sector Chief Information Officer Participants Ranked the Technologies Perceived as Critical for their Organization's Operations in Section Two of the Survey, based on the number of Respondents that Selected each Item (Denoted by the Public and Private Sector Score Columns)

Technologies	Private Sector Score (N=150)	Public Sector Score (N=80)	Private Sector Rank	Public Sector Rank
Security Infrastructure	98	55	1	1
Internet / Intranet / Web infrastructure	53	34	4	2
Knowledge management	17	24	16	3
E-Mail	24	23	12	4
Internet/ Intranet/ Web applications	62	21	3	5
Remote and mobile computing incl. PDAs	22	20	13	6
Data warehousing/data mining	82	19	2	7
Security Applications	13	15	17	8
Virtual Private Networks	11	14	19	9
Wireless technology	31	12	9	10
Records management	11	11	20	11.5
Executive information and DSS	49	11	5	11.5
Data, voice and video convergence	19	10	15	13.5
Storage and storage networks	33	10	7	13.5
Video solutions (distance learn/virtual office)	2	9	28	15
Workflow	20	8	14	16.5
Portal technologies	32	8	8	16.5
Training technology and applications	4	7	25	18.5
COTS applications including ERP/CRM/SCM	49	7	6	18.5
Middleware	31	6	10	20
Online analytical processing (OLAP)	10	5	21	21
Electronic Commerce/EDI	29	4	11	22
IT accommodation–disability access solutions	0	4	29	23
Relational databases	12	3	18	24
Next generation Internet	3	2	27	25
Voice integration	0	2	30	26
Groupware	4	2	26	27
Application Service Provider (ASP)	5	1	24	28
Imaging	8	1	22	29
LINUX	7	0	23	30

(Public Sector Score/Rank data from Association for Federal Information Resource Management, 2001)

The data contained within Table 19 is used to compare the private sector responses from this study with the public sector responses from AFFIRM's (2001) study. The goal of part two of the analysis is to discover whether there is an association in the rankings public sector and private sector CIOs assigned to technologies that they perceive as critical to their organization's operations. This section presents the statistical analysis of the ranks of these responses. Two rank sum statistics, the Spearman coefficient of rank correlation and the Kendall Tau coefficient, are used to test the following hypothesis:

$H2_o$: There is no association between the technologies that public sector and private sector CIOs perceive as critical to their organization's operations

$H2_a$: There is an association between the technologies that public sector and private sector CIOs perceive as critical to their organization's operations

Spearman Coefficient of Rank Correlation

A Spearman coefficient of rank correlation was calculated using the public and private sector ranks of the technologies that the respondents' perceived as critical to their respective organization as obtained in part 2 of the survey. The ranks of the results from part 2 of the survey and the results from the CIO critical technologies section of AFFIRM's (2001) survey were loaded into JMP IN® version 5.0 to determine the value of the Spearman coefficient of rank correlation. The results of the Spearman Rho calculations are displayed below in Table 20.

Table 20: Spearman Rho Results for how Public and Private Sector Chief Information Officers Ranked the Technologies they Perceive as Critical to their Organization's Operations

Variable	by Variable	Spearman Rho	p-value
Public Sector Critical Technologies Ranks	Private Sector Critical Technologies Ranks	.6595	0.0001

The Spearman Rho value of .6595 and p-value of .0001 indicate agreement between the public and private sector rankings. This value for Rho is supported by the fact that many of the large and small public sector ranks are paired respectively with large and small private sector ranks, which is evidence of a direct relationship. Agreement in the rankings leads to a rejection of the null hypothesis and therefore provides evidence for a direct association of the technologies perceived as critical by public and private sector CIOs in the sample. The low p-value for this test indicates that there is a low probability of incorrectly rejecting the conclusion that no association exists. This low error rate provides further evidence to reject the null hypothesis and therefore that there is a statistically significant association between the two variables.

Kendall Tau Coefficient

A Kendall Tau correlation coefficient was calculated using the public and private sector ranks of the technologies perceived as critical to each respondent's organization as obtained in part 2 of the survey. This statistic was calculated in order to provide additional evidence for the Spearman Rho results measuring the association between critical technologies. The ranks of the results of part 2 of the survey and the results from the critical technologies section of AFFIRM's (2001) survey were loaded in to JMP IN®

version 5.0 to derive the value of the Kendall Tau coefficient. The results of the Kendall Tau calculations are displayed below in Table 21.

Table 21: Kendall Tau Results for how Public and Private Sector Chief Information Officers Ranked the Technologies they Perceive as Critical to their Organization's Operations

Variable	by Variable	Kendall Tau	p-value
Public Sector Critical Technologies Ranks	Private Sector Critical Technologies Ranks	0.4642	0.0003

The Kendall Tau value of .4642 and p-value of .0003 support a direct association and therefore agreement between the public sector and private sector rankings of critical technologies. The positive Tau value indicates a rejection of the null hypothesis and therefore provides evidence for a direct association between the rankings of the technologies that the public sector and private sector CIOs in the sample perceived as critical to their respective organization's operations. The low p-value for this test indicates that there is a low probability of incorrectly rejecting the conclusion that no association exists. This low error rate provides further evidence to reject the null hypothesis and therefore that there is a statistically significant association between the two variables. Therefore, when all of the critical technologies rankings are considered simultaneously, the public sector and private sector CIOs can be considered statistically consistent in their rankings of technologies perceived as critical to their organizations.

Summary

This chapter presented an analysis of the data collected for this study as well as a brief discussion of the findings for each hypothesis. Spearman's R and Kendall's Tau

describe the association between two variables as expressed by a sample, which is an estimate of the association within the population (Gibbons, 1976). The results of these tests of the sample data indicate the existence of agreement between the perceived challenges faced by public sector and private sector CIOs in this sample as well as a direct association between the technologies that each perceive as critical to their respective organization's operations. Therefore, both $H1_o$ and $H2_o$ were rejected indicating an agreement between the public and private sector responses to both parts 1 and 2 of the survey. The next chapter presents a discussion of the statistical analysis results, the limitations of this study, and areas of future research.

V. Discussion

Overview

This chapter presents a discussion of the results obtained in chapter four along with the limitations of this study and some suggestions for future research. The focus of this study was to measure the degree of association in the challenges and technologies perceived as critical by public and private sector CIOs. Public sector CIOs were surveyed in 2001 by the Association for Federal Resource Information Management using their annual CIO Challenges instrument that returned 80 useable responses. FORTUNE 1000 CIOs were then surveyed using the same instrument that returned 150 usable responses comprising the private sector sample for this study. Each challenge and critical technology was given a rank score in each of the organizational sectors. How each item was ranked in its respective category formed the basis for how the following two hypotheses were analyzed:

H1: There is no association between the challenges that public sector and private sector CIOs perceive to face.

H2: There is no association between the technologies that public sector and private sector CIOs perceive as critical to their organization's operations

Discussion of CIO Challenges

The findings of this study provide evidence for the existence of an association between the challenges perceived to be faced by the public and private sector Chief Information Officers in the study. This association does not imply causation by any one variable and may indeed be the result of many variables not measured in this study. The

following conclusions are therefore not intended to be interpreted as statically rigorous. They are simply observations based upon the survey data and the literature review.

Most of the CIO challenge survey items ranked very closely between the organizational sectors. The number one ranked challenge in the public sector, "using IT to improve service to customers and stakeholders," ranked number two in the private sector. This is not surprising since the purpose of any organization is to serve some form of customer regardless of their sector affiliation. Other highly ranked (top ten) challenges in both sectors included "obtaining funding for IT programs and projects," "preventing unauthorized system intrusions," and "formulating and implementing an organizational IT architecture." These challenges appear to be common issues that are attracting much attention from strategic IRM leaders regardless of sector affiliation.

Although the sector rankings were in overall agreement, a few of the survey items received sharply different rankings. The number two challenge as ranked by public sector CIOs was "making the necessary business/cultural changes necessary for full e-Government transformation." This challenge was edited to read "making the necessary business/cultural changes necessary for full e-Business transformation" in the private sector survey where it ranked tenth. Although the Internet can trace its roots to the original government sponsored Defense Advanced Research Projects Agency Network (ARPANET), the public sector has lagged the private sector in e-business transformation. In addition, e-Government implementation was a major focus of the 1998 Government Paperwork Elimination Act which would provide some validity for the public sector CIOs ranking it as a top challenge. The literature review also provides some evidence that the private sector has been quicker to seize upon the potential of the Internet for e-

business application. However, no direct causation can be claimed based upon the data collected.

Three other challenges received high rankings by one sector but lower rankings in the other. "Simplifying business processes to maximize the benefits of technology" was the number one ranked challenge by private sector CIOs while receiving a ninth ranking in the public sector. Although not a top ten challenge in either sector, "managing or replacing legacy systems" was ranked eleventh in the private sector but nineteenth in the public sector. Both of these rank differences may be explained by the divergent emphasis on the challenge "aligning IT and organizational mission goals" which ranked fourth in the private sector while eleventh in the public sector. Although no direct causation can be claimed given the data set, the researcher hypothesizes that managing business processes and legacy systems may be related to the level of organizational commitment placed on IRM and the degree of empowerment given to IRM leadership.

Discussion of Critical Technologies

The findings of this study provide evidence for the existence of an association between the technologies perceived as critical to an organization's operations by the public and private sector Chief Information Officers in the study. Again, this association does not imply causation by any one variable and may indeed be the result of many variables not measured in this study. The following conclusions are therefore not intended to be interpreted as statically rigorous. They are simply observations based upon the survey data and the literature review.

Most of the critical technologies ranked very closely between the organizational sectors. The number one ranked critical technology in the public sector, "security infrastructure," was also ranked number one in the private sector. The other top critical technologies that received similar rankings in both the public and private sector samples include "Internet/Intranet/Web infrastructure," "Internet/Intranet/Web applications," and "wireless technology." These technologies have become critical to most organizations in the United States to operate regardless of sector affiliation.

Although many of the individual survey item rankings were in agreement between the sectors, a few of the critical technologies received very different rankings from each measured sector. "Knowledge management" was ranked third in the public sector but sixteenth in the private sector. "Security applications" was ranked eighth in the public sector but seventeenth in the private sector. "Executive information and decision support systems" was ranked fifth in the private sector but twelfth in the public sector. In fact, most of the top ten technologies perceived as critical by one sector did not even make the top ten list of the other sector.

The overall statistical strength of the association between the ranks in each sector comes from the technologies that were ranked lowest by each sector. This is most apparent when the rankings for "email" as a technology critical for operations are considered. "Email" was ranked third in the public sector but received a sixteenth ranking in the private sector. The rankings for email may reveal a limitation in the critical technologies section of this study. One possible explanation for the email ranking disparity is that the survey instructions were not clear in relaying the meaning of a "technology critical for an organization's operations." Some of the participants may have

interpreted this to mean a cutting edge technology. More likely, some may have interpreted a critical technology as one that creates a competitive advantage for an organization and is therefore critical to maintaining a competitive posture. Since email is a common technology in all of the organizations in the sample, many may not have viewed it as creating any advantage over their competitors. Since private sector organizations are more oriented towards direct economic competition with other businesses than are public sector agencies, the lower ranking of email in the private sector lends some support to a possible flaw in the survey's wording. Another possible explanation for the email rankings is that email may be taken for granted as a critical technology. Email has revolutionized the way people communicate in the workplace and has become an ingrained part of everyday life in Federal agencies and FORTUNE 1000 firms. This may be the problem. It is so ingrained that many people may have forgotten how processes used to be undertaken before email. There is no evidence to support this explanation. It is only an observation since the data does not allow for a declaration of causation.

Limitations

In nearly all research efforts, factors often emerge that may introduce uncertainty and therefore decrease the reliability of the study's results. In this research effort, the most significant limiting factor was not being able to collect the public and private sector data simultaneously. This limitation has several implications. First, the public sector data was collected in 2001 by the Association for Federal Information Resource Management while the private sector data was collected by the researcher in 2002. It is

difficult to know whether this one year difference had any impact on the study results.

There are two major events that need to be considered concerning the data collection time periods. The first is that the public sector data was collected two months after September 11, 2001. The events of September 11 had a significant impact on all organizations, but particularly on Federal agencies such as those representing the public sector for this study. The private sector data was also collected after September 11, 2001. However, it is difficult to measure what effects the events of September 11th continued to have on private sector organizations when this data was collected one year later. The second major event that occurred during the data collection period was the unusually high number of corporate investigations and bankruptcies that occurred in the summer of 2002. Many of these incidents directly involved organizations within the private sector survey population. For example, several of the businesses on the 2002 FORTUNE 1000 list are no longer in existence. It is impossible to determine what impact these events may have had on any of the results of this study.

Another limitation of this study is the possibility that many of the surveys may never have reached their intended recipient. There are several reasons for this belief. First, because the companies in the FORTUNE 1000 are very large, comprise many physical corporate locations, and because the CIOs in the population's names and exact locations were unknown prior to survey administration, the exact address for each company's CIO office could not be confirmed. Therefore, a survey was sent to each organization's headquarters address, as published by FORTUNE, in the hopes that the instrument would eventually get to its intended recipient. The limitation of this method is clear in that the researcher cannot be sure that the intended recipient was located at the

headquarters address or that the intended senior executives would even receive mail not specifically addressed to them. Next, the researcher could not confirm that the addresses provided by FORTUNE were accurate, and therefore that every survey would ever arrive at its intended organization. Evidence of this situation was reflected in the twenty-eight responses that were eventually returned to sender by the postal service due to irresolvable addresses. Finally, several of the organizations in the population were under investigation for various charges during the private sector data collection period. The activities surrounding these investigations may have overwhelmed non-core activities such as participating in academic research. Therefore, it is difficult to account for the number of surveys that never made it to the intended organization, never made it past an organization's mail department, were lost while being sent between locations en route to its intended recipient, were overshadowed by other priorities, or were never replied to due to organizational policy against participating in surveys.

Another limitation of this study concerns the use of the AFFIRM developed instrument to collect the private sector data. The Association for Federal Information Resource Management developed the CIO Challenges survey in order to measure Federal CIO responses. Although the goal of this study is to compare public and private sector responses to the same survey items, a few of the survey items had to be modified in order to provide relevance to the private sector participants. Chapter three of this thesis contains a detailed description of these modifications.

Using web pages for online data collection is still a relatively new method of survey administration and therefore may discourage those that have reservations about using computers from participating. One concern during this research effort was

establishing credibility with the population and thus a trust that the data collected would be kept anonymous and that measures would be taken to keep electronic copies of the data secure. These limitations were addressed during the survey administration phase by sending all surveys via official business mail with the option of submitting a paper version of the completed survey by mail. Ninety-four of the one hundred fifty returned private sector surveys were submitted via mail. Next, given that the population for this study was composed of executive level information resource managers whose jobs center on making strategic decisions often involving their organization's technology, unfamiliarity with technology is not considered to be a major limitation of this study. Finally, it is impossible to know how many participants attempted to complete the survey but were prevented due to technical problems with the web version of the survey or the infrastructure that was supporting it.

Recommendations for Future Research

The goal of this research was to test for the existence of an association between the rankings that public and private sector Chief Information Officers assigned to challenges they face and to technologies they perceive as critical to their respective organization's operations. Results from this study provide a starting point from which future public and private sector information resource management research can expand.

As addressed in the limitations section, sampling the two populations simultaneously would provide an important data set with which to compare the results of this study. Expanding this data collection over time (as the AFFIRM organization already does in the pubic sector) would provide further evidence for the existence or

absence of an association of the challenges faced by, and the technologies perceived as critical, by Chief Information Officers in each organizational sector.

Instead of testing between the two extremes of organizational publicness, future research could introduce hybrid organizations as a third sector variable. This research could test how the challenges and critical technologies may agree or disagree among organizations across the publicness scale. These results would add to the existing body of publicness research as well as provide a more complete sampling of all organizations with varying degrees of publicness.

Although the overall association analysis provides evidence for the existence of agreement between the rankings in both sections of this study, there exists significant disagreement between the rankings assigned to some of the individual challenges and critical technologies. An analysis of variance between the sectors in each survey section should be conducted to measure the strength of the agreement between sectors for the individual survey items in both the CIO challenges and critical technologies sections.

Conclusions

The analysis in section one reveals that the pubic and private sector Chief Information Officers in this study are faced with similar challenges in their role as the senior information resource manager in their organization. Although there existed some significant variances in a few of the individual challenge ranks in each sector, the analysis supports an overall agreement in the ranks of the public and private sector CIO challenges. Therefore, when all of the CIO challenges rankings are considered

simultaneously, the public and private sector CIOs were consistent in their rankings, despite the inconsistencies in some of the individual item rankings.

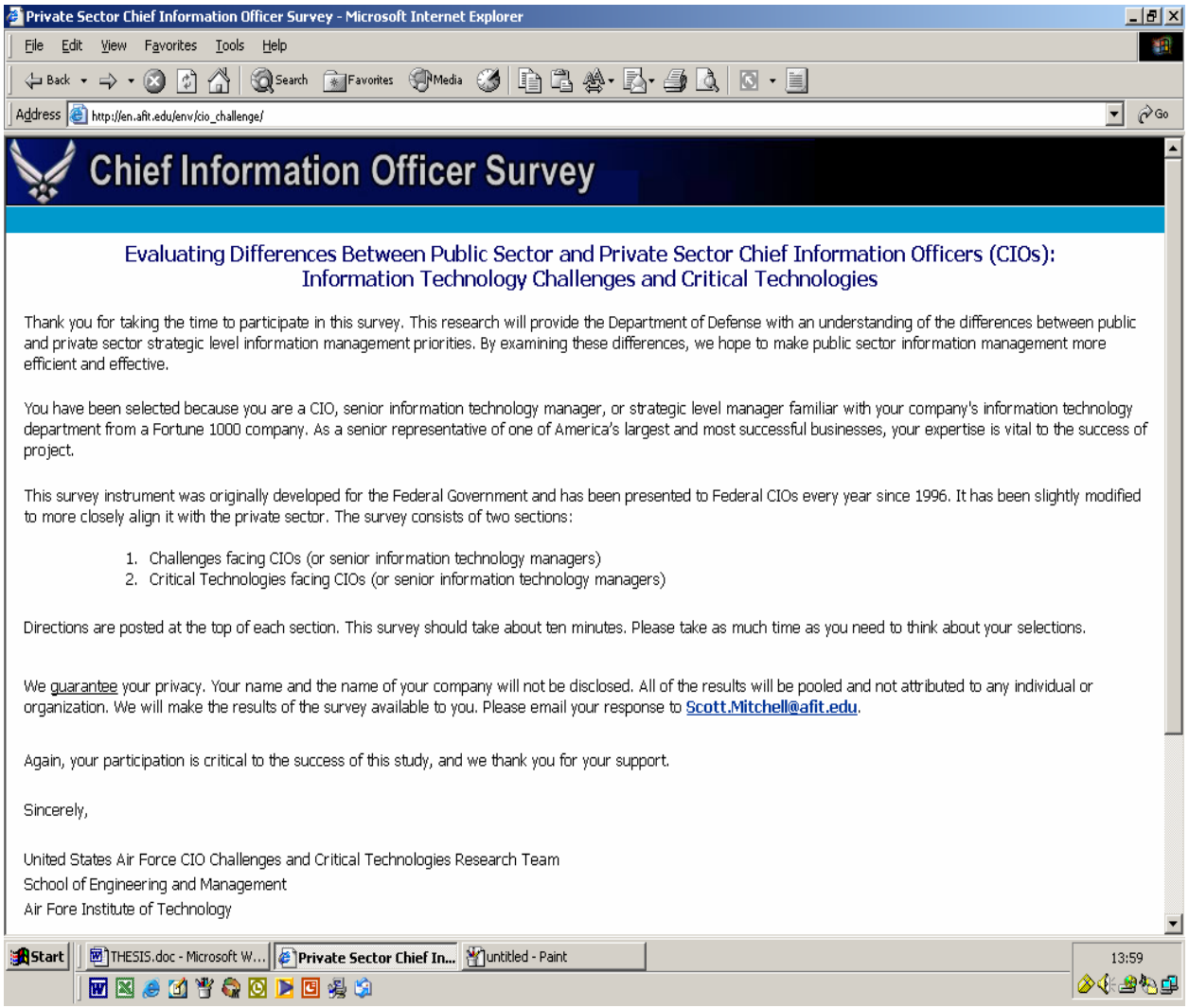
The analysis revealed similar findings in section two of the study. Despite some significant differences in the ranks of a few critical technologies, the overall agreement in the rankings provides support for an association in the technologies that public and private sector CIOs perceive as critical to their organization's operations. Similarly, when all of the critical technologies rankings are considered simultaneously, the public and private sector CIOs can be considered consistent in their rankings, despite similar inconsistencies in some of the individual item rankings.

The results from this study suggest that an association exists between the ranks of the public and private sector CIO challenges and also the technologies that public and private sector CIOs perceived as critical to their respective organization's operations. Gibbons (1976:294) defines a statistical association as "a description of the relationship between variables; the existence of a significant association provides no evidence of causality between the variables." The data does not make it possible to make a claim of causality concerning the association between the public and private sector ranks in this study. The association may be attributed to one or many factors not measured by this study or may not be identifiable at all. The purpose of this study was to test only for the existence of an association in the public and private sector ranks. Given that the world is complex, further research that controls for variables other than organizational sector is required to study causality for the association between public and private sector CIO challenges and critical technologies.

Appendix A

Screenshots of the Survey Instrument

Cover Page



Background Information

Please provide your company's name, your position/title, and how long you have been in your current position. Please do not provide your name or any other personal information.

Company Name:

Position/Title in Company:

Length in Position(Years): Please Choose Length From List

Chief Information Officer Survey (Part 1)

CIO Challenges

Directions:

With the rapid advances in information technology, Chief Information Officers are faced with many corporate challenges. Twenty four of the top challenges faced by Federal Chief Information Officers are listed below.

Please review all of the challenges first. Then use your computer's mouse to select the **FIVE** greatest CIO challenges faced by your company.

- ☐ Using IT to improve service to customers/stakeholders/citizens
- ☐ Making the business and cultural changes necessary for full e-Business transformation
- ☐ Hiring and retaining skilled professionals
- ☐ Obtaining adequate funding for IT programs and projects
- ☐ Preventing unauthorized system intrusions (hackers, terrorists, etc.)
- ☐ Formulating or implementing an organization IT architecture
- ☐ Building effective relationships in support of IT initiatives with your organization's senior executives (CEO, CFO, etc.)

- ☐ Capturing, organizing and making accessible organizational knowledge and expertise (knowledge management)
- ☐ Simplifying business processes to maximize the benefits of technology
- ☐ Unifying “islands of automation” within lines of business
- ☐ Aligning IT and organizational mission goals
- ☐ Implementing e-business solutions
- ☐ Providing effective IT infrastructure and related services (not including the desktop)
- ☐ Implementing IT capital planning and investment management across the organization
- ☐ Assessing and developing organization IT competence (training and education)
- ☐ Measuring and reporting past performance
- ☐ Ensuring public access to information vs. the need for system security
- ☐ Controlling IT budgets
- ☐ Managing or replacing legacy systems
- ☐ Developing organization-wide IT accountability
- ☐ Identifying and reporting specific CIO/Information Resource Management measures/outcomes.
- ☐ Implementing Commercial Off The Shelf solutions (ERP, CRM, etc.)

- Planning and implementing IT disability access solutions into existing and new IT systems

- Responding to outsourcing requirements

Chief Information Officer Survey (Part 2)

CIO Critical Technologies

Directions:

Thirty of the top critical technologies faced by Federal Chief Information Officers are listed below. Please review all of the critical technologies first. Then use your computer's mouse to select the **FIVE** most critical technologies faced by your company.

- ☐ Security Infrastructure
- ☐ Internet / Intranet / Web infrastructure
- ☐ Knowledge management
- ☐ E-Mail
- ☐ Internet/ Intranet/ Web applications
- ☐ Remote and mobile computing including personal digital assistants
- ☐ Data warehousing/data mining
- ☐ Security Applications
- ☐ Virtual Private Networks

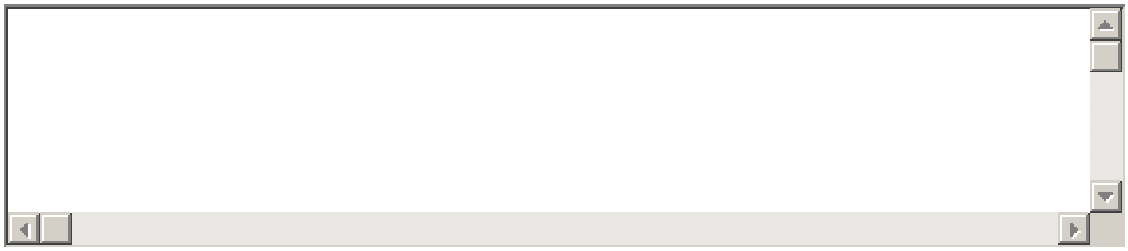
- ☐ Wireless technology
- ☐ Records management
- ☐ Executive information and decision support systems
- ☐ Data, voice and video convergence (was voice and data integration)
- ☐ Storage and storage networks
- ☐ Video solutions (distance learning, virtual office, desktop)
- ☐ Workflow
- ☐ Portal technologies
- ☐ Training technology and applications
- ☐ Commercial Off The Shelf applications including Enterprise Resource Planning, CRM, SCM, etc.
- ☐ Middleware
- ☐ Online analytical processing (OLAP)
- ☐ Electronic Commerce/Electronic Data Interchange
- ☐ IT accommodation – disability access solutions
- ☐ Relational databases
- ☐ Next generation Internet
- ☐ Voice integration
- ☐ Groupware

☐ Application Service Provider (ASP)

☐ Imaging

☐ LINUX

Comments: You may input any feedback that you have in the space provided below. Please feel free to offer any additional comments that may be beneficial to this research including other critical technologies or challenges faced by your organization that are not listed in either Part I or Part II as choices.



The survey is now complete. Please ensure that you have selected exactly FIVE choices in Part I and exactly FIVE choices in Part II. Selecting more or less than FIVE choices in either section will invalidate the survey results.

Please press the button below to submit your final selections. Again, thank you for your help. Your inputs are extremely important to this research effort and to the United States Air Force.

Sincerely,

AFIT CIO Challenges Research Team

Submit

Appendix B

2002 FORTUNE 1000 List

Rank	Company	Rank	Company
1	WAL MART STORES INC	501	HUGHES SUPPLY INC
2	EXXON MOBIL CORPORATION	502	VULCAN MATERIALS COMPANY
3	GENERAL MOTORS CORPORATION	503	UNIVERSAL CORPORATION
4	FORD MOTOR COMPANY	504	AUTO OWNERS INSURANCE
5	ENRON CORP	505	THE NEIMAN MARCUS GROUP INC
6	GENERAL ELECTRIC COMPANY	506	3COM CORPORATION
7	CITIGROUP INC	507	H&R BLOCK INC
8	CHEVRON TEXACO	508	REEBOK INTERNATIONAL LTD
9	INTERNATIONAL BUSINESS MACHINES CORPORATION	509	ROSS STORES INC
10	PHILIP MORRIS COMPANIES INC	510	TRIGON HEALTHCARE INC
11	VERIZON COMMUNICATIONS INC	511	UNIFIED WESTERN GROCERS INC
12	AMERICAN INTERNATIONAL GROUP INC	512	PAYLESS SHOESOURCE INC
13	AMERICAN ELECTRIC POWER COMPANY INC	513	TRUSERV CORPORATION
14	DUKE ENERGY CORPORATION	514	PIONEER STANDARD ELECTRONICS INC
15	AT&T CORP	515	KNIGHT RIDDER INC
16	THE BOEING COMPANY	516	ACE HARDWARE CORPORATION
17	EL PASO CORPORATION	517	UNITED RENTALS INC
18	THE HOME DEPOT INC	518	FISHER SCIENTIFIC INTERNATIONAL INC
19	BANK OF AMERICA CORPORATION	519	HASBRO INC
20	FANNIE MAE	520	KPMG CONSULTING INC
21	J P MORGAN CHASE & CO	521	CHARTER ONE FINANCIAL INC
22	THE KROGER CO	522	THERMO ELECTRON CORPORATION
23	CARDINAL HEALTH INC	523	UNIVERSAL HEALTH SERVICES INC
24	MERCK & CO INC	524	A G EDWARDS INC
25	STATE FARM INSURANCE COMPANIES	525	TRANSOCEAN INC
26	RELIANT ENERGY INCORPORATED	526	ROCKWELL COLLINS INC
27	SBC COMMUNICATIONS INC	527	SOLUTIA INC
28	HEWLETT PACKARD COMPANY	528	PACTIV CORPORATION
29	MORGAN STANLEY DEAN WITTER & CO	529	WACKENHUT CORRECTIONS CORPORATION
30	DYNEGY INC	530	PENTAIR INC
31	MCKESSON CORPORATION	531	ROADWAY CORPORATION
32	SEARS ROEBUCK AND CO	532	ALLIANT ENERGY CORPORATION
33	AQUILA INC	533	APACHE CORPORATION
34	TARGET CORPORATION	534	RUDDICK CORPORATION
35	THE PROCTER & GAMBLE COMPANY	535	THE RYLAND GROUP INC
36	MERRILL LYNCH & CO INC	536	CROMPTON
37	AOL TIME WARNER INC	537	LUTHERAN BROTHERHOOD
38	ALBERTSON S	538	IMC GLOBAL INC
39	BERKSHIRE HATHAWAY INC	539	SPHERION CORPORATION
40	KMART CORPORATION	540	BEVERLY ENTERPRISES INC
41	FREDDIE MAC	541	MARSHALL & ILSLEY CORPORATION

42	WORLDCOM	542	GUIDANT CORPORATION
43	MARATHON OIL CORPORATION	543	TORCHMARK CORPORATION
44	COSTCO WHOLESALE CORPORATION	544	MANOR CARE INC
45	SAFEWAY INC	545	QUALCOMM
46	COMPAQ COMPUTER CORPORATION	546	WPS RESOURCES CORPORATION
47	JOHNSON & JOHNSON	547	BOSTON SCIENTIFIC CORPORATION
48	CONOCO INC	548	TRIAD HOSPITALS INC
49	PFIZER INC	549	POLYONE CORPORATION
50	J C PENNY	550	STARBUCKS CORPORATION
51	METROPOLITAN LIFE INSURANCE COMPANY	551	TECO ENERGY INC
52	MIRANT CORPORATION	552	SOVEREIGN BANCORP INC
53	DELL COMPUTER CORPORATION	553	THE PANTRY INC
54	GOLDMAN SACHS GROUP	554	NACCO INDUSTRIES INC
55	UNITED PARCEL SERVICE INC	555	THE STANLEY WORKS
56	MOTOROLA INC `	556	NVR INC
57	THE ALLSTATE CORPORATION	557	HERCULES INCORPORATED
58	TXU CORP	558	SONOCO PRODUCTS COMPANY
59	UNITED TECHNOLOGIES CORPORATION	559	STRYKER CORPORATION
60	THE DOW CHEMICAL COMPANY	560	TELEPHONE AND DATA SYSTEMS INC
61	CONAGRA FOODS INC	561	EARTHGRAINS
62	PRUDENTIAL PLC	562	M & T BANK CORP
63	PEPSICO INC	563	STATER BROS HOLDINGS INC
64	WELLS FARGO & COMPANY	564	CITIZENS COMMUNICATIONS COMPANY
65	INTEL CORPORATION	565	GENESIS HEALTH VENTURES INC
66	INTERNATIONAL PAPER COMPANY	566	POPULAR INC
67	DELPHI CORPORATION	567	CINCINNATI FINANCIAL CORPORATION
68	SPRINT FON GROUP	568	HENRY SCHEIN INC
69	NEW YORK LIFE INSURANCE COMPANY	569	NATIONAL SERVICE INDUSTRIES INC
70	E I DU PONT DE NEMOURS	570	NICOR INC
71	GEORGIA PACIFIC GROUP	571	AGCO CORPORATION
72	MICROSOFT CORPORATION	572	UNITRIN INC
73	THE WALT DISNEY COMPANY	573	FLEETWOOD ENTERPRISES INC
74	AETNA INC	574	MICHAELS STORES INC
75	INGRAM MICRO INC	575	INTERNATIONAL MULTIFOODS CORPORATION
76	LUCENT TECHNOLOGIES INC	576	AMERICAN GREETINGS CORPORATION
77	LOCKHEED MARTIN CORPORATION	577	THE READER S DIGEST ASSOCIATION INC
78	WALGREEN CO	578	ADVANCE AUTO PARTS INC
79	BANK ONE CORP	579	SCIENTIFIC ATLANTA INC
80	TIAA CREF	580	SERVICE CORPORATION INTERNATIONAL
81	PHILLIPS PETROLEUM COMPANY	581	POTOMAC ELECTRIC POWER COMPANY
82	BELLSOUTH CORPORATION	582	PETSMART
83	HONEYWELL INTERNATIONAL INC	583	ALBERTO CULVER COMPANY
84	UNITEDHEALTH GROUP INCORPORATED	584	THE PENN TRAFFIC COMPANY
85	VIACOM INC	585	DURA AUTOMOTIVE SYSTEMS INC
86	SUPERVALU	586	BRINKER INTERNATIONAL
87	PG&E CORPORATION	587	SABRE HOLDINGS
88	ALCOA INC	588	UGI CORPORATION

89	AMERICAN EXPRESS COMPANY	589	TOWER AUTOMOTIVE
90	WACHOVIA CORP	590	MANDALAY RESORT GROUP
91	LEHMAN BROTHERS HOLDINGS INC	591	FOOTSTAR
92	CISCO SYSTEMS INC	592	USFREIGHTWAYS
93	CVS CORPORATION	593	FIRST TENNESSEE NATIONAL CORP
94	LOWE S COMPANIES INC	594	U S INDUSTRIES
95	SYSCO	595	ROBERT HALF INTERNATIONAL
96	BRISTOL MYERS SQUIBB COMPANY	596	BOWATER INCORPORATED
97	ELECTRONIC DATA SYSTEMS CORPORATION	597	HUNTINGTON BANCSHARES INCORPORATED
98	CATERPILLAR INC	598	THE TIMKEN COMPANY
99	THE COCA COLA COMPANY	599	COMMERCIAL METALS COMPANY
100	ARCHER DANIELS MIDLAND COMPANY	600	CELLSTAR CORPORATION
101	AUTONATION INC	601	EXIDE TECHNOLOGIES
102	QWEST COMMUNICATIONS INTERNATIONAL INC	602	WM WRIGLEY JR COMPANY
103	FEDEX CORPORATION	603	ADOLPH COORS COMPANY
104	MASSACHUSETTS MUTUAL LIFE INSURANCE COMPANY	604	BURLINGTON COAT FACTORY WAREHOUSE CORPORATION
105	PHARMACIA CORPORATION	605	THE PHOENIX COMPANIES INC
106	FLEETBOSTON FINANCIAL CORPORATION	606	THE WASHINGTON POST COMPANY
107	CIGNA CORPORATION	607	ADC TELECOMMUNICATIONS INC
108	AMR CORPORATION	608	CONSTELLATION BRANDS
109	LOEWS CORPORATION	609	BED BATH & BEYOND INC
110	SOLECTRON CORPORATION	610	ERIE INSURANCE GROUP
111	JOHNSON CONTROLS INC	611	WENDY S INTERNATIONAL INC
112	SUN MICROSYSTEMS INC	612	OLD REPUBLIC INTERNATIONAL CORPORATION
113	HCA INC	613	MCCORMICK & COMPANY INCORPORATED
114	VISTEON CORPORATION	614	OM GROUP INC
115	SARA LEE CORPORATION	615	MOLEX INCORPORATED
116	WASHINGTON MUTUAL INC	616	LOUISIANA PACIFIC CORPORATION
117	TECH DATA CORPORATION	617	FRANKLIN RESOURCES
118	FEDERATED DEPARTMENT STORES INC	618	ECOLAB INC
119	RAYTHEON	619	PNM RESOURCES INC
120	XEROX CORPORATION	620	BORGWARNER INC
121	U S BANCORP	621	ADELPHIA COMMUNICATIONS CORPORATION
122	TRW INC	622	L 3 COMMUNICATIONS HOLDINGS INC
123	ABBOTT LABORATORIES	623	WEATHERFORD INTERNATIONAL INC
124	NORTHWESTERN MUTUAL	624	PRECISION CASTPARTS
125	UAL CORPORATION	625	CONVERGYS CORPORATION
126	3M: MINNESOTA MINING & MANUFACTURING	626	URS CORPORATION
127	AMERISOURCEBERGEN CORPORATION	627	PENNZOIL QUAKER STATE
128	COCA COLA ENTERPRISES INC	628	VALUE CITY
129	FLEMING COMPANIES INC	629	BEMIS COMPANY INC
130	EMERSON ELECTRIC CO	630	KELLWOOD COMPANY
131	BEST BUY CO INC	631	BELK INC
132	RITE AID CORPORATION	632	ANALOG DEVICES INC
133	PUBLIX SUPER MARKETS INC	633	WHOLE FOODS MARKET
134	THE HARTFORD FINANCIAL SERVICES GROUP INC	634	PEOPLES ENERGY

135	EXELON	635	MAIL WELL
136	NATIONWIDE	636	REPUBLIC SERVICES
137	XCEL ENERGY INC	637	LA Z BOY
138	VALERO ENERGY CORPORATION	638	RYERSON TULL
139	MCDONALD S CORPORATION	639	CHIQUITA BRANDS INTERNATIONAL
140	WEYERHAEUSER COMPANY	640	CONSOLIDATED FREIGHTWAYS
141	KIMBERLY CLARK CORPORATION	641	HERMAN MILLER
142	LIBERTY MUTUAL INSURANCE COMPANIES	642	BUDGET GROUP
143	THE MAY DEPARTMENT STORES COMPANY	643	BJ SERVICES
144	THE GOODYEAR TIRE & RUBBER COMPANY	644	TOLL BROTHERS
145	WYETH	645	POLO RALPH LAUREN
146	OCCIDENTAL PETROLEUM CORPORATION	646	NABORS INDUSTRIES
147	HOUSEHOLD INTERNATIONAL INC	647	MDU RESOURCES GROUP
148	DELTA AIR LINES INC	648	PILGRIM S PRIDE
149	THE GAP INC	649	LABORATORY CORP OF AMERICA
150	LEAR CORPORATION	650	TELLABS
151	NORTHROP GRUMMAN CORPORATION	651	WESTERN RESOURCES
152	AMERADA HESS CORPORATION	652	PEP BOYS MANNY MOE & JACK
153	HALLIBURTON COMPANY	653	EQUITY RESIDENTIAL PROPERTIES
154	DEERE & COMPANY	654	LANDAMERICA FINANCIAL GROUP
155	EASTMAN KODAK COMPANY	655	VECTREN
156	CMS ENERGY CORPORATION	656	CINTAS
157	CIRCUIT CITY GROUP	657	OMNICARE
158	CINERGY CORP	658	MAXXAM
159	ANHEUSER BUSCH COMPANIES INC	659	ALASKA AIR GROUP
160	WINN DIXIE STORES INC	660	AMERICAN NATIONAL INSURANCE
161	AVNET INC	661	ALLEGHENY TECHNOLOGIES
162	WELLPOINT HEALTH NETWORKS INC	662	OUTBACK STEAKHOUSE
163	SUNOCO INC	663	MDC HOLDINGS
164	TEXTRON INC	664	SUN HEALTHCARE GROUP
165	EDISON INTERNATIONAL	665	CENTURYTEL
166	GENERAL DYNAMICS CORPORATION	666	NATIONAL SEMICONDUCTOR
167	TENET HEALTHCARE	667	SWIFT TRANSPORTATION
168	UNION PACIFIC CORPORATION	668	CUNA MUTUAL GROUP
169	PACIFICARE HEALTH SYSTEMS INC	669	HARSCO
170	FARMLAND INDUSTRIES INC	670	HILLENBRAND INDUSTRIES
171	ELI LILLY AND COMPANY	671	WYNDHAM INTERNATIONAL
172	WASTE MANAGEMENT INC	672	KLA TENCOR
173	OFFICE DEPOT INC	673	MONY GROUP
174	THE WILLIAMS COMPANIES INC	674	NATIONAL FUEL GAS
175	TOYS R US INC	675	J B HUNT TRANSPORT SERVICES
176	ORACLE CORPORATION	676	WILLIAMS SONOMA
177	TYSON FOODS INC	677	SNAP ON
178	STAPLES INC	678	MARINER POST ACUTE NETWORK
179	THE TJX COMPANIES INC	679	INSIGHT ENTERPRISES
180	DOMINION RESOURCES INC	680	NORTEK
181	COMPUTER SCIENCES CORPORATION	681	PEOPLESOFT

182	MANPOWER INC	682	SYNOVUS FINANCIAL CORP
183	DANA CORPORATION	683	ZALE CORPORATION
184	ANTHEM INC	684	AMERICA WEST HOLDINGS
185	ALLEGHENY ENERGY INC	685	AFFILIATED COMPUTER SERVICES
186	WHIRLPOOL CORPORATION	686	E TRADE GROUP
187	HUMANA INC	687	SIMON PROPERTY GROUP
188	SOUTHERN COMPANY	688	NEW JERSEY RESOURCES
189	MARRIOTT INTERNATIONAL INC	689	SIEBEL SYSTEMS
190	MBNA CORPORATION	690	STORAGE TECHNOLOGY
191	ARROW ELECTRONICS INC	691	QUANTA SERVICES
192	HEALTH NET INC	692	ZIONS BANCORP
193	MARSH & MCLENNAN COMPANIES INC	693	COMPUWARE
194	NORTHWEST AIRLINES CORPORATION	694	RPM INC
195	PUBLIC SERVICE ENTERPRISE GROUP INCORPORATED	695	BELL MICROPRODUCTS
196	SCHERING PLOUGH CORPORATION	696	GENERAL CABLE CORPORATION
197	ILLINOIS TOOL WORKS INC	697	VOLT INFORMATION SCIENCES
198	COMCAST CORPORATION	698	METALDYNE
199	CONSOLIDATED EDISON INC	699	CHARMING SHOPPES
200	ENTERGY CORPORATION	700	WEIS MARKETS
201	THE AES CORPORATION	701	DOLLAR TREE STORES
202	AFLAC INCORPORATED	702	BECKMAN COULTER
203	NISOURCE INC	703	PROTECTIVE LIFE
204	NIKE	704	CBRL GROUP
205	UNUMPROVIDENT	705	SCHOLASTIC
206	H J HEINZ COMPANY	706	HARRIS CORPORATION
207	COLGATE PALMOLIVE COMPANY	707	WESTERN DIGITAL
208	THE LIMITED INC	708	INGLES MARKETS
209	JOHN HANCOCK FINANCIAL SERVICES INC	709	ABM INDUSTRIES
210	EXPRESS SCRIPTS INC	710	W R BERKLEY
211	BURLINGTON NORTHERN SANTA FE CORPORATION	711	SILGAN HOLDINGS
212	AGILENT TECHNOLOGIES INC	712	WGL HOLDINGS
213	NATIONAL CITY CORPORATION	713	TRAVELCENTERS OF AMERICA
214	FLUOR	714	SOUTHERN UNION
215	UNITED SERVICES AUTOMOBILE ASSN	715	SUNGARD DATA SYSTEMS
216	CONTINENTAL AIRLINES INC	716	CASEY S GENERAL STORES
217	CENDANT CORPORATION	717	SAFEGUARD SCIENTIFICS
218	THE ST PAUL COMPANIES INC	718	BROWN FORMAN
219	GUARDIAN LIFE INSURANCE COMPANY OF AMERICA	719	CH2M HILL
220	KELLOGG COMPANY	720	WALTER INDUSTRIES
221	PRINICPAL FINANCIAL	721	VALSPAR
222	SCI SYSTEMS	722	FLOWSERVE
223	THE BEAR STEARNS COMPANIES INC	723	TELEFLEX
224	R J REYNOLDS TOBACCO	724	TRINITY INDUSTRIES
225	ASHLAND INC	725	OHIO CASUALTY
226	FPL GROUP INC	726	COMPASS BANCSHARES
227	PROGRESS ENERGY INC	727	FURNITURE BRANDS INTERNATIONAL

228	THE PEPSI BOTTLING GROUP INC	728	FISERV INC
229	SUNTRUST BANKS INC	729	SENTRY INSURANCE GROUP
230	DILLARD S INC	730	DYNCORP
231	SMURFIT STONE CONTAINER CORPORATION	731	FRONTIER OIL
232	ANADARKO PETROLEUM CORPORATION	732	ALPINE GROUP
233	MASCO CORPORATION	733	CORN PRODUCTS INTERNATIONAL
234	US AIRWAYS GROUP INC	734	HEALTH MANAGEMENT ASSOCIATES
235	GENUINE PARTS COMPANY	735	MARSH SUPERMARKETS
236	TEXAS INSTRUMENTS INCORPORATED	736	LITHIA MOTORS
237	PPG INDUSTRIES INC	737	MAGELLAN HEALTH SERVICES
238	CSX CORPORATION	738	SILICON GRAPHICS
239	CONSECO INC	739	METRIS
240	GILETTE	740	CARLISLE COMPANIES INCORPORATED
241	SEMPRA ENERGY	741	LUBRIZOL
242	FIRSTENERGY CORP	742	INTL FLAVORS & FRAGRANCES
243	CLEAR CHANNEL COMMUNICATIONS INC	743	FREEPORT MCMORAN COPPER & GOLD
244	CENEX HARVEST STATES COOPERATIVES	744	JACK IN THE BOX
245	DTE ENERGY COMPANY	745	WORTHINGTON INDUSTRIES
246	ARAMARK CORPORATION	746	BRIGHTPOINT
247	AON CORPORATION	747	LINENS N THINGS
248	BAXTER INTERNATIONAL INC	748	COLLINS & AIKMAN
249	THE CHUBB CORPORATION	749	PSS WORLD MEDICAL
250	ALLTEL CORPORATION	750	AMERCO
251	CALPINE CORPORATION	751	TEREX
252	NEXTEL COMMUNICATIONS INC	752	MCLEODUSA
253	KOHL S CORPORATION	753	GOLD KIST INC
254	THE PROGRESSIVE CORPORATION	754	RENT A CENTER
255	AMERICAN STANDARD COMPANIES INC	755	KENNAMETAL
256	BOISE CASCADE CORPORATION	756	MID ATLANTIC MEDICAL SERVICES
257	KEYCORP	757	BEAZER HOMES USA
258	APPLIED MATERIALS INC	758	SEABOARD
259	EATON CORPORATION	759	MINNESOTA LIFE INSURANCE
260	CAPITAL ONE FINANCIAL CORPORATION	760	HON INDUSTRIES
261	THE BANK OF NEW YORK COMPANY INC	761	PACKAGING CORP OF AMERICA
262	CROWN CORK & SEAL COMPANY INC	762	LSI LOGIC
263	EMC CORPORATION	763	DOW JONES
264	GENERAL MILLS INC	764	WESTPOINT STEVENS INC
265	ADVANCEPCS INC	765	EQUITABLE RESOURCES
266	AUTOMATIC DATA PROCESSING INC	766	DIEBOLD
267	SAFECO	767	W R GRACE
268	TRICON GLOBAL RESTURAUNTS	768	BROWN SHOE
269	PNC FINANCIAL SERVICES GROUP	769	SEQUA
270	NEWELL RUBBERMAID INC	770	POTLATCH
271	KEYSPAN CORPORATION	771	SCOTTS COMPANY
272	OMNICOM GROUP INC	772	NATIONAL OILWELL
273	NORTHEAST UTILITIES	773	PRIMEDIA
274	PLAINS ALL AMERICAN PIPELINE	774	HOVNANIAN ENTERPRISES

275	ARVINMERITOR INC	775	SOUTHERN STATES COOP
276	ONEOK INC	776	PAYCHEX
277	AVAYA INC	777	HAWAIIAN ELECTRIC INDUSTRIES
278	UNOCAL CORPORATION	778	GREENPOINT FINANCIAL
279	THE INTERPUBLIC GROUP OF COMPANIES INC	779	HARMAN INTL INDUSTRIES
280	NAVISTAR INTERNATIONAL CORPORATION	780	BAUSCH & LOMB
281	CENTEX CORPORATION	781	CONCORD EFS INC
282	CAMPBELL SOUP COMPANY	782	CABOT
283	FIFTH THIRD BANCORP	783	THE DIAL CORPORATION
284	FIRST DATA CORPORATION	784	ENERGIZER HOLDINGS
285	PREMCOR INC	785	COMMUNITY HEALTH SYSTEMS
286	LINCOLN NATIONAL CORPORATION	786	INTEGRATED ELECTRICAL SERVICES
287	GANNETT CO INC	787	WALLACE COMPUTER SERVICES
288	SONIC AUTOMOTIVE INC	788	ALLERGAN
289	CORNING INCORPORATED	789	METALS USA
290	DEAN FOODS COMPANY	790	EGL INC
291	BB&T CORPORATION	791	ALLETE
292	UNITED AUTO GROUP INC	792	RELIANCE STEEL & ALUMINUM
293	NORFOLK SOUTHERN CORPORATION	793	DST SYSTEMS
294	SCIENCE APPLICATIONS INTERNATIONAL CORPORATION	794	VIAD
295	PACCAR	795	XILINX
296	GATEWAY INC	796	RAYMOND JAMES FINANCIAL
297	SAKS	797	NEWMONT MINING
298	LENNAR CORPORATION	798	VISHAY INTERTECHNOLOGY
299	AVISTA CORPORATION	799	EOG RESOURCES
300	UNISYS CORPORATION	800	EXPEDITORS INTL OF WASHINGTON
301	OWENS ILLINOIS INC	801	DAVITA
302	AVON PRODUCTS INC	802	D&K HEALTHCARE RESOURCES
303	PARKER HANNIFIN CORPORATION	803	APPLERA
304	NCR CORPORATION	804	UST INC
305	SMITHFIELD FOODS INC	805	FLOWERS FOODS
306	ROHM AND HAAS COMPANY	806	AIRGAS
307	CONECTIV	807	APPLIED INDUSTRIAL TECHNOLOGIES
308	THE SERVICEMASTER COMPANY	808	QUINTILES TRANSNATIONAL
309	PPL CORPORATION	809	TIFFANY & CO
310	AIR PRODUCTS AND CHEMICALS INC	810	CIENA
311	CUMMINS INC	811	PERKINELMER
312	IDACORP INC	812	GREAT LAKES CHEMICAL
313	STATE STREET CORPORATION	813	MILLENNIUM CHEMICALS
314	NORDSTROM INC	814	CRANE
315	CAREMARK RX INC	815	STANCORP FINANCIAL
316	ALLIED WASTE INDUSTRIES INC	816	MAXIM INTEGRATED PRODUCTS
317	SOUTHWEST AIRLINES CO	817	AGWAY
318	MEDTRONIC INC	818	NOBLE AFFILIATES
319	PROVIDIAN FINANCIAL CORPORATION	819	JO ANN STORES
320	VF CORPORATION	820	LANDS END
321	FEDERAL MOGUL CORPORATION	821	COOPER CAMERON

322	EASTMAN CHEMICAL COMPANY	822	BLACK HILLS
323	BAKER HUGHES INCORPORATED	823	STILWELL FINANCIAL
324	PULTE HOMES INC	824	PERINI
325	APPLE COMPUTER INC	825	THOMAS & BETTS
326	DOLLAR GENERAL CORPORATION	826	IMPERIAL SUGAR
327	FORTUNE BRANDS INC	827	MPS GROUP
328	R R DONNELLY & SONS	828	CHAMPION ENTERPRISES
329	USA NETWORKS INC	829	GRANITE
330	THE CHARLES SCHWAB CORPORATION	830	NATIONAL COMMERCE FINANCIAL
331	BJ S WHOLESALE CLUB INC	831	SYSTEMAX
332	IKON OFFICE SOLUTIONS	832	COMFORT SYSTEMS USA
333	TRIBUNE COMPANY	833	GREIF BROS
334	TRANSMONTAIGNE	834	ASTORIA FINANCIAL
335	TESORO PETROLEUM CORPORATION	835	SHAW GROUP
336	PRAXAIR INC	836	DI GIORGIO
337	AMERICAN FAMILY INSURANCE GROUP	837	EQUIFAX
338	ENGELHARD CORPORATION	838	LEGG MASON
339	THE SHERWIN WILLIAMS COMPANY	839	ACT MANUFACTURING
340	GOODRICH CORPORATION	840	LEVEL 3 COMMUNICATIONS
341	RYDER SYSTEM INC	841	RGS ENERGY GROUP
342	CNF	842	UNIVERSAL FOREST PRODUCTS
343	BARNES & NOBLE INC	843	WORLD FUEL SERVICES
344	GRAYBAR ELECTRIC COMPANY INC	844	UNOVA
345	COUNTRYWIDE CREDIT INDUSTRIES INC	845	ARKANSAS BEST
346	AUTOZONE INC	846	GATX
347	MATTEL INC	847	LAM RESEARCH
348	RADIOSHACK CORPORATION	848	AMKOR TECHNOLOGY
349	OWENS CORNING	849	PRIDE INTERNATIONAL
350	W W GRAINGER INC	850	POLARIS INDUSTRIES
351	ADAMS RESOURCES & ENERGY INC	851	DEL MONTE FOODS
352	PITNEY BOWES INC	852	MERCURY GENERAL
353	DOLE FOOD COMPANY INC	853	MARTIN MARIETTA MATERIALS
354	ITT INDUSTRIES INC	854	US ONCOLOGY
355	KB HOME	855	BANKNORTH GROUP
356	THE MCGRAW HILL COMPANIES INC	856	BMC SOFTWARE
357	OFFICEMAX INC	857	FERRO
358	PARK PLACE ENTERTAINMENT CORPORATION	858	VERITAS SOFTWARE
359	SIERRA PACIFIC RESOURCES	859	ARCH COAL
360	ESTEE LAUDER	860	CDI
361	MAYTAG CORPORATION	861	GENCORP
362	HERSHEY FOODS CORPORATION	862	HIBERNIA CORP
363	PINNACLE WEST CAPITAL CORPORATION	863	SIERRA HEALTH SERVICES
364	DOVER CORPORATION	864	ATMEL
365	MICRON TECHNOLOGY INC	865	AIMCO
366	AMEREN CORPORATION	866	GREAT PLAINS ENERGY
367	MURPHY OIL CORPORATION	867	E W SCRIPPS
368	D R HORTON INC	868	BANTA

369	WILLAMETTE INDUSTRIES INC	869	SYMBOL TECHNOLOGIES
370	QUANTUM CORPORATION	870	TMP WORLDWIDE
371	GOLDEN WEST FINANCIAL CORPORATION	871	OSHKOSH TRUCK
372	OXFORD HEALTH PLANS INC	872	UNISOURCE ENERGY
373	CABLEVISION SYSTEMS CORPORATION	873	ATMOS ENERGY
374	HEALTHSOUTH CORPORATION	874	ROCK TENN COMPANY
375	FOOT LOCKER INC	875	TERADYNE
376	ADMINISTAFF INC	876	QUESTAR
377	THE BLACK & DECKER CORPORATION	877	AMERICAN WATER WORKS
378	JABIL CIRCUIT INC	878	CSK AUTO
379	THE MUTUAL OF OMAHA COMPANIES	879	CKE RESTAURANTS
380	ROCKWELL INTERNATIONAL CORPORATION	880	AMERICAN POWER CONVERSION
381	GOLDEN STATE BANCORP INC	881	PHILLIPS VAN HEUSEN
382	LONGS DRUG STORES CORPORATION	882	CADENCE DESIGN SYSTEMS
383	LEVI STRAUSS & CO	883	SPORTS AUTHORITY
384	KELLY SERVICES INC	884	PIER 1 IMPORTS
385	NORTHWESTERN CORPORATION	885	FAIRCHILD SEMICONDUCTOR INTL
386	COOPER INDUSTRIES INC	886	KEMET
387	COMPUTER ASSOCIATES INTERNATIONAL INC	887	BURLINGTON INDUSTRIES
388	COMERICA INCORPORATED	888	DREYER S GRAND ICE CREAM
389	TEMPLE INLAND INC	889	DIMON
390	LEXMARK INTERNATIONAL INC	890	STEWART & STEVENSON SERVICES
391	NUCOR CORPORATION	891	TECUMSEH PRODUCTS
392	HORMEL FOODS CORPORATION	892	MARKEL
393	SPX CORPORATION	893	SOUTHWEST GAS
394	LEGGETT & PLATT INCORPORATED	894	LANDSTAR SYSTEM
395	NASH FINCH COMPANY	895	ADVANTICA
396	JONES APPAREL GROUP INC	896	NATIONAL RURAL UTILITIES COOPERATIVE
397	COX COMMUNICATIONS INC	897	TRANS WORLD ENTERTAINMENT
398	MELLON FINANCIAL CORPORATION	898	METRO GOLDWYN MAYER
399	SANMINA SCI CORPORATION	899	CYTEC INDUSTRIES
400	REGIONS FINANCIAL CORPORATION	900	STANDARD PACIFIC
401	DARDEN RESTAURANTS INC	901	HOLLYWOOD ENTERTAINMENT
402	PATHMARK STORES	902	GENTIVA HEALTH SERVICES
403	AMGEN INC	903	AMERICAN EAGLE OUTFITTERS
404	MGM MIRAGE	904	ONEAMERICA FINANCIAL
405	THE PITTSTON COMPANY	905	NVIDIA
406	PHELPS DODGE CORPORATION	906	GEMSTAR TV GUIDE INTERNATIONAL
407	ECHOSTAR COMMUNICATIONS	907	ACTERNA
408	GROUP 1 AUTOMOTIVE INC	908	ABERCROMBIE & FITCH
409	AK STEEL HOLDING CORPORATION	909	BELO
410	AUTOLIV INC	910	MGIC INVESTMENT
411	MEADWESTVACO CORPORATION	911	TORO
412	ENCOMPASS SERVICES CORPORATION	912	KNIGHTS OF COLUMBUS
413	STARWOOD HOTELS & RESORTS WORLDWIDE INC	913	ST JUDE MEDICAL
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430	AVERY DENNISON CORPORATION	930	PETCO ANIMAL SUPPLIES
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432	DANAHER CORPORATION	932	ANNTAYLOR
433	ENERGY EAST CORPORATION	933	FIRST NATIONAL OF NEBRASKA
434	NTL INCORPORATED	934	DQE INC
435	BECTON DICKINSON AND COMPANY	935	PACIFIC CENTURY FINANCIAL
436	HOST MARRIOTT CORPORATION	936	DELUXE
437	THE FIRST AMERICAN CORPORATION	937	BENCHMARK ELECTRONICS
438	SOUTHTRUST CORPORATION	938	AMTRAN
439	PACIFIC MUTUAL HOLDING COMPANY	939	H B FULLER
440	HARRAH S ENTERTAINMENT INC	940	MENS WEARHOUSE
441	BALL CORPORATION	941	STEWART INFORMATION SERVICES
442	BRUNSWICK CORPORATION	942	OLIN
443	FAMILY DOLLAR STORES INC	943	WERNER ENTERPRISES
444	WESCO INTERNATIONAL	944	COMVERSE TECHNOLOGY
445	AMES DEPARTMENT STORES INC	945	VARCO INTERNATIONAL
446	KERR MCGEE CORPORATION	946	AUDIOVOX
447	QUEST DIAGNOSTICS INCORPORATED	947	AMICA MUTUAL INSURANCE
448	SMITH INTERNATIONAL INC	948	MILACRON
449	SPARTAN STORES INC	949	INTUIT
450	USA EDUCATION INC	950	KIMBALL INTERNATIONAL
451	INTERSTATE BAKERIES CORPORATION	951	XO COMMUNICATIONS
452	ROUNDY S INC	952	DOMINOS
453	SCANA CORPORATION	953	OCEAN ENERGY
454	LIZ CLAIBORNE INC	954	MASSEY ENERGY
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459	EMCOR GROUP	959	UNION CENTRAL LIFE
460	FOSTER WHEELER LTD	960	PHAR MOR
461	BORDERS GROUP INC	961	WATSCO
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472	USG	972	MASTEC
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479	AIRBORNE INC	979	SOFTWARE SPECTRUM
480	COMDISCO INC	980	VIASYSTEMS GROUP
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13. SUPPLEMENTARY NOTES

14. ABSTRACT The office of the Chief Information Officer is still new within public sector organizations. Private sector organizations have a valuable knowledge base from their CIO office implementation efforts and subsequent operations. This private sector knowledge could offer public sector CIOs invaluable insight into successful information resource management practices. However, public and private managers must take great care in deciphering which IRM prescriptions are relevant to their organizational situation.

The goal of this research is to discover if public and private sector CIOs are faced with the same challenges and view the same technologies as critical for their organization's operations. The results of an annual survey of public sector CIOs and senior IRM managers are compared with data collected from FORTUNE 1000 CIOs using the same instrument. Findings from this study provide evidence that public and private sector CIOs do perceive to be faced with many of the same challenges and also view many of the same technologies as critical to their organization's operations. It is hoped that the results of this research will help public and private IRM managers to understand sector similarities and differences in the application IRM prescriptions.

15. SUBJECT TERMS

Chief Information Officer, Information Resource Management, Information Technology, Public Sector, Private Sector, Publicness

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