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**AN UPDATE ON ANALYZING DIFFERENCES BETWEEN PUBLIC AND PRIVATE  
SECTOR INFORMATION RESOURCE MANAGEMENT: STRATEGIC  
INFORMATION TECHNOLOGY CHALLENGES AND CRITICAL TECHNOLOGIES**

THESIS

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AFIT/GIR/ENV/04M-17

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AFIT/GIR/ENV/04M-17

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TECHNOLOGIES

THESIS

Presented to the Faculty

Department of Systems and Engineering Management

Graduate School of Engineering and Management

Air Force Institute of Technology

Air University

Air Education and Training Command

In Partial Fulfillment of the Requirements for the  
Degree of Master of Science in Information Resource Management

James R. Orlovsky, BA  
Master Sergeant, USMC

June 2004

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### **Abstract**

Change is a constant within our contemporary IRM environment. The rapid development of information and communication technologies has been the most predominant among the many agents of change that are forcing a reevaluation of the role of the IRM professional. Few studies to date have compared public and private sector CIO perceptions concerning the IRM challenges and critical technologies faced by their organization. An earlier study concluded that the sectors' CIOs do perceive to be faced with many of the same challenges and also view many of the same technologies as critical to the organization's operations. A limiting factor identified in that study was the temporal separation of sector sampling. Any conclusions comparing the public and private sectors were based on survey responses separated by almost one year.

The goal of this research is to validate if public and private sector senior IRM managers perceive to still be faced with the same challenges and view the same technologies as being critical to an organization's IRM requirements. The results of a 2002 annual survey of public sector CIOs and senior IRM managers are compared with data collected from 2002 private sector CIOs. This research concluded that performing an analysis on datasets obtained from both sectors during the same time period provided a more appropriate comparison between sectors. Findings from this study provide sufficient evidence that both sectors have developed a closer correlation than was previously concluded.

*In memory of my Father. Rest in peace Dad.*

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# AN UPDATE ON ANALYZING DIFFERENCES BETWEEN PUBLIC AND PRIVATE SECTOR INFORMATION RESOURCE MANAGEMENT: STRATEGIC INFORMATION CHALLENGES AND CRITICAL TECHNOLOGIES

## I. Introduction

### Overview

The revolution of information technology (IT) has been compared to the industrial revolution in terms of its potential scope and impact on society (Alberts and Papp, 1997; Castells, 1996; Freeman et al., 1995; and Kranzberg, 1989). Few other modern advances in technology have had the capacity to affect so fundamentally the way people work, live, learn, play, communicate, and govern themselves. The information revolution is not new. The United States began moving toward an information-based economy in the 1957, as information intensive services began to grow. At that time, computers were used mostly in the research and development community and in the offices of large companies and agencies.

In the past two decades; however, IT has become increasingly pervasive in society. It has spread to a point that nearly everyone uses some form of IT every day. Also during this time, information and its management, has become one of the most important resources in the public and private sectors (Bretschneider, 1990). For nearly two decades, the federal government has embraced information resource management as a philosophy, policy initiative, and management practice (Government Information Quarterly, 1997).

Since its origin in the 1970s, information resource management (IRM) has been defined in differing ways. The Office of Management and Budget (1993) defines IRM as “. . . planning, budgeting, organizing, directing, training, and administrative control associated with government resources.” It goes on to further define IRM in that “The term encompasses both information itself and the related resources, such as personnel, equipment, funds, and information technology.” This definition lumps together the management of information and the management of IT. Judged on the grounds of clarity from an enterprise-wide view, and for the purposes of this research, the term information resource management will be defined as “the process of managing information resources to accomplish agency missions to improve agency performance” (United States Code, Title 44, 1997). This definition of IRM translates more clearly to both the public and private sectors.

Citizens and policy makers have long made assumptions about the differences between public and private sector information resource management (Rocheleau and Wu, 2002). Additionally, research has also tested a variety of propositions concerning differences in both sectors (Rainey et al., 1976). To date; however, this researcher knows of only one evaluation that has compared both the public and private sector’s IRM practices from a strategic management perspective (Mitchell, 2002). This research concluded that the public and private sectors do perceive to be faced with the same challenges and technologies viewed to be critical to their organization’s operations. It therefore appears that the application of IRM practices in the public and private sectors are similar, with possible regular crossover between the sectors. A limitation noted in the Mitchell study was that the data gathering from the sectors occurred in different time

periods, with as much as a one year separation between the datasets (Mitchell, 2002). This limitation is significant due to the rapidly evolving nature of IT and the related application. Therefore, the datasets obtained and analyzed in the earlier study may not be directly comparable.

Today, enterprises are being challenged to do things faster, better, and more cost-effectively in order to remain competitive and to support their missions. Moreover, the complex and ever-changing environments in which public and private organizations find themselves in are faced with rapidly evolving technology. This evolving atmosphere offers both sectors substantial challenges to effective IRM strategies. As such, this research attempts, through replication of the Mitchell 2002 study, to determine if the public and private sectors are still in agreement with each other. This research is focused on contributing to existing IRM theory by validating the public and private sector senior IRM managers' perceptions concerning strategic IRM challenges and critical technologies.

## **Background**

This background provides a brief description of the context for information resource management, particularly within the federal government. The policy environment that affects the management of information resources within the federal government expanded rapidly between 1993 - 1996. The notion of IRM has developed and evolved into a range of federal positions beyond those traditionally labeled as IRM. Information resource management in the federal government has had a relatively short history of only some 20-plus years (Government Information Quarterly, 1997).



IRM was first addressed by the Paperwork Reduction Act of 1980. IRM was presented as a means to assist agencies in managing information resources through an information life-cycle approach (Heron, 1994). Recent federal government information technology, information management initiatives, and legislation are redefining federal IRM, both in concept and in practice (Information Technology Reform Act, 1996; Government Performance and Results Act, 1993; Paperwork Reduction Act, 1995; and Executive Order 13001, 1993).

While these laws and policy instruments redefine IRM through performance-based initiatives and strategic agency function, there are some key questions that remain about the future of IRM in an enterprise:

- Can IRM assist the enterprise to meet the challenges of providing more government and/or services with fewer resources?
- Will an enterprise view IRM as a strategic enabler, rather than administrative overhead function, to assist them in making key IT investments and management decisions?
- Is IRM evolving into a broader, more ill-defined set of responsibilities and activities, than had previously been ascribed to in the past?

Perhaps the greatest challenges facing both public and private IRM policy makers and practitioners is how to contend with the current IRM strategic informational technology and operating environments. There has been an extensive amount of policy change affecting IRM, IT management, and assessment of the success of IT programs during the mid 1990s. As a result of those initiatives and the evolving nature of IT in general, agencies within the federal government are still trying to get their “houses in order.”

The current emphasis seems to focus on managing information resources and IT as a business, conducting performance reviews of these programs, and trying to change agency culture to accept this new perspective. A variety of these issues were among the top 10 challenges identified in an annual survey conducted by the Association for Federal Information Resources Management as affecting Chief Information Officers (AFFIRM, 1996).

### **Problem Statement**

Change is a constant within our contemporary IRM environment, and the forces for change are many. The rapid development of information and communication technologies has been the most predominant among the many agents of change that are forcing a reevaluation of the role of the information resource management professional (Myburgh, 2002). Additionally, organizations today face more competition than was the case even a decade ago. As was identified earlier, a significant limitation of the previous study's comparison between private and public sector IRM views was temporal in nature. It was a comparison that was made using sectoral datasets that were separated by almost one year. Considering this, one might argue that it is worthwhile to study these sectors once again. Performing an analysis on datasets obtained from both sectors during the same time period should provide a more accurate comparison between those sectors.

Information and its management have provided work for a diverse collection of professionals, from computer scientists and data retrievalists, librarians, all under the control of the organization's IRM manager or chief information officer. Each of these professionals carries their own IRM perspectives and paradigms. As a result of the rapid

information and communications technologies and their associated management paradigms, both public and private sector information managers continue to encounter numerous challenges and need to identify the critical technologies to enhance an organization's information resource needs.

### **Research Focus**

Mitchell's 2002 work posited that there are close associations between public and private sector strategic IRM managers. However, there have been no longitudinal studies to validate whether the passing of time has changed those views. Additionally, most public and private organizations may not be able to demonstrate a close relationship in numerous aspects relating to IT challenges and critical technologies in general because of the complex and often conflicting nature of their goals (Rocheleau and Wu, 2002). The temporal limitation of the Mitchell 2002 study, coupled with the enormous changes that have occurred in IT and its management since this earlier study began, makes replication of the identified study warranted.

The goal of this research is to discover and/or validate if public and private sector senior IRM managers perceive they are still being faced with the same challenges and view the same technologies as being critical to an organization's information resource management needs. It is hoped that the results of this research will be of some value to both sector's IRM managers in aiding them to determine if they need to refocus their efforts in order to improve effectiveness and efficiencies within their enterprise.

This research will use the same private sector business dataset gathered during the Mitchell 2002 study. This dataset was representative as reflected 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). The public sector data set that will be used for analysis will be the results obtained by the Association for Federal Information Resources Management (AFFIRM) Emerging Issues Forum, 2002. For the past seven years, AFFIRM's Emerging Issues Forum has conducted annual surveys of the senior federal IT community to determine the most critical challenges and technologies facing the federal chief information officer (CIO). The participants in these AFFIRM surveys represent a broad spectrum of executive and management levels in the federal IT community. As such, the results of this latest AFFIRM survey do not solely represent the thinking of only federal CIOs, but rather are a reflection of the broader federal IT community (AFFIRM 2002).

### **Thesis Overview**

Chapter one has provided an introduction to this thesis which included an overall outlook of the evolving nature of information technologies and the related management of information used as a key organizational resource. Background information relevant to the evolving nature of the IRM context was also provided. Chapter two delves deeper into the differences and similarities of public and private sector IRM domains by reviewing the associated literature. Next, chapter three presents the methodology used to obtain the data and information needed to determine if an association still exists between public and private sector in their views of strategic information challenges and critical technologies. Chapter four presents the results of carrying out that methodology.

Finally, chapter five discusses conclusions drawn from the research, limitations of the current study, and directions for possible future research in this area.

## 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. Citizens and policy makers have long made assumptions about the differences between public and private organizations. Researchers have tested a variety of propositions concerning differences in public and private organizations (Rainey et al., 1976) based on a number of differences including environmental factors (e.g., higher degree of market exposure for private organizations), greater legal constraints and political influences for public organizations, organization environment transactions (e.g., greater scrutiny of public organizations), and internal structures and processes (e.g., greater complexity of objectives and fewer incentives for performance in public organizations).

For example, due to the fishbowl effect and demands for accountability, public organizations are expected to be more cautious and more involved in red tape, whereas private organizations are expected to take more risks (Bozeman and Kingsley, 1998; Rainey et al, 1995). Several studies have also focused on purported differences in workers in the two sectors concerning, for example, job satisfaction, motivation, and commitment (Buchanan, 1974; Rainey, 1983). Recently, Nutt (1999) found differences in their approaches to decision making.

In 1986, Bozeman and Bretschneider drew from this literature to propose a framework for public management information systems (PMIS) that argued there were important underlying differences between public and private management information

systems. In particular, the public sector systems necessarily give much more attention to concerns such as accountability, openness, and representativeness than do those of the private sector. Also, they stated that a PMIS will have a greater focus on external and vertical linkages than will private sector organizations. Consequently, they develop a number of prescriptions that argue that a PMIS often needs to be structured and managed in different ways than does a private sector system. For example, Bozeman and Bretschneider, (1986) argue that a PMIS head should not function at the top of the executive structure to insulate information technology from political interference. They argue that planning for a PMIS should be incremental rather than holistic. They point out that budgeting and other constraints on purchasing make it impossible for more comprehensive approaches to work well. They also state that whereas private sector organizations often have to act quickly, PMIS errors can affect a much larger body of people in harmful ways (e.g., cutting off Social Security or welfare benefits, or failing to identify known or suspected terrorists at airports). Thus, it appears that public systems need more deliberate development and more extensive testing.

Bozeman and Bretschneider (1986) do not seem to dispute the fact that there are many similarities between information systems in public and private agencies, but they argue that most of the research has ignored these important differences. Despite the importance of the topic, there have been few studies (Mitchell, 2002) that have researched differences between public and private sector information systems and their related IRM practices. There also have not been any articles that have reviewed and updated the issues. This literature review will discuss the body of research that has compared public and private systems.

## **Underlying Differences in Public and Private Sectors**

This section of the literature review will revisit the seminal views and explanations of what composes public and private sector organizations. Among the research topics that have shaped the development of public and private sector information management, one topic that continues to draw the interest of scholars is the debate concerning similarities and differences between public and private organizations. Scott and Falcone (1998) identified general questions that may only be answered after an understanding of the underlying principles between the public and private sectors are recognized. For example, (1) Are public sector organizations different from private sector organizations, and if so, what is it that makes them unique? (2) Do such differences have any implications with respect to managerial/information resource management strategies; modes of organization; methods of operation and/or ways of dealing with employees, customers, or clients? (3) What do such differences imply with respect to the transferability of managerial skills, techniques, and technologies across sectors?

Through the conduct of this research, studies were found which have attempted to answer these questions by conducting empirical comparisons of public and private organizations. The findings have been mixed and even contradictory. The next sections of this review of the literature will address these studies. Although the evidence has yet to resolve the debate over differences between public and private organizations, three underlying conceptual frameworks have emerged from the recent studies: the generic approach, the core approach, and more recently, the dimensional approach (Bozeman and Bretschneider, 1994). Each of these approaches represents a fundamentally different



orientation about the public/private question, and each provides different insights into our understanding of organizational behavior as well.

### ***The Generic Approach***

As its name indicates, the generic approach discounts the importance of possible differences between public, private, and other (e.g., hybrid) organizations. This framework suggests that management functions, organizational processes, and managerial values are essentially identical across sectoral boundaries (Lau et al., 1980; Murray, 1975). Proponents of the generic approach dismiss the long standing argument that decision making in private organizations is fundamentally different from decision making in public organizations. This argument states that decisions in private firms are guided by the criteria of economic efficiency and monetary profit, whereas in public organizations, decisions are characterized by bargaining, compromise, uncertainty, and the accommodation of competing political interests (Murray, 1975). The generic approach suggests, instead, that all organizational decisions are subject to a cost-benefit analysis of one form or another to a variety of competing inputs. Generic proponents also regard as simplistic the notion that private organizations are driven exclusively by the bottom-line criterion of monetary profit. Private sector decision making is composed of an array of criteria, of which monetary profit is but one.

Proponents of the generic approach also point to recent trends, such as the growing number of hybrid organizations (e.g., government sponsored enterprises, government corporations), the increasing reliance by government on private and not-for-profit firms for providing public services, and the transferability of management innovations (e.g., total quality management, business process reengineering) to the public

sector. Last, proponents point to the pervasiveness of the revolving door phenomenon among senior level political employees as evidence that executive skills are easily transferable between the public and private sectors (Scott and Falcone, 1998). In sum, the generic approach assumes that sectoral distinctions are neither important nor preferable to other competing classification schemes. Even if the ends may ultimately differ between sectors, the means of achieving them are essentially the same (Murray, 1975).

### *The Core Approach*

In contrast to the generic approach, research from several disciplines have emphasized fundamental differences between public and private organizations. Although advocates for the core approach generally ground their arguments in a manner that parallels their respective research traditions, they consistently suggest that organizations can be distinguished by virtue of their formal, legal status. Similarities may be found among some managerial processes or organizational tasks across public and private sectors. However, it has been noted that the inherent differences are, by far, more fundamental.

Scott and Falcone (1998) suggest that there are core distinctions between public and private organizations. The core distinctions they propose concern property rights theory and public choice theory. They suggest that public and private organizations can be distinguished according to the presence or absence of market structures, externalities, and ownership transferability. For example, property rights theorists suggest that private managers have direct rights to the economic returns of the organization. Thus, providing a strong incentive to increase their personal gain by efficient use of resources in the

organization. In similar fashion, public choice theorists suggest that public organizations lack important market signals to serve as indicators for setting production levels of public goods and services. Without such signals, public organizations are compelled to rely on budgetary increases, staff growth, and other nonmarket indicators as criteria for success, assuring that government organizations will always produce more goods and services than will be allocationally efficient (1998).

Research also suggests other core distinctions between public and private organizations. For example, it has been suggested that the nature of management differs between sectors because public and private organizations receive their support from different subsectors of society (Fottler, 1981). This in turn, places differential constraints on management in responding to these influences. Other research (Rainey et al., 1976) attributes differences between public and private sectors to the presence of legal and political constraints placed on government agencies by the courts, legislatures, executive oversight agencies, and constituent groups. These constraints result in greater oversight, less autonomy, and reduced authority among public managers, and they lead to higher levels of formalization, red tape, and bureaucratization.

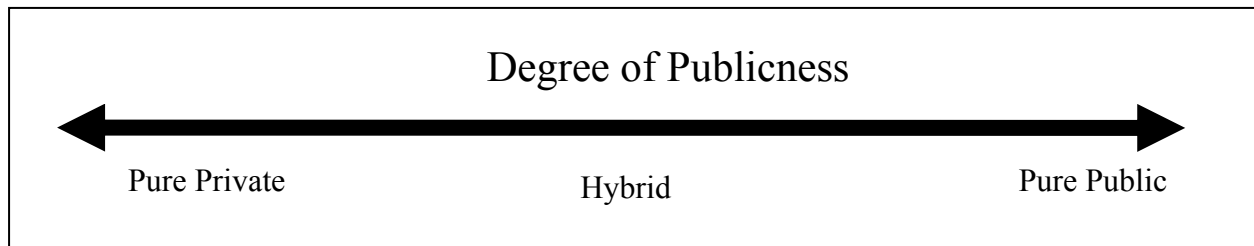
These core distinctions have been corroborated by several empirical studies. These studies have shown, for example, that public managers tend to perceive or experience less flexibility in terms of personnel procedures (Coursey and Rainey, 1989), less satisfaction with their jobs (Rainey, 1983), lower levels of job involvement (Buchanan, 1975), less linkage between rewards and performance (Rainey, 1983), and less authority over personnel actions (Coursey and Rainey, 1989). It has also been identified that because of such differences, public managers presumably experience

greater difficulty in developing incentives for effective performance and linking employee performance with rewards (Rainey et al., 1976). Public managers also differ along certain personality, value, and behavioral dimensions, such as placing a lower valuation on monetary incentives. Additionally, personnel systems in the public sector tend to be more centralized and externally controlled, and marked by higher levels of formalization and complexity (Coursey and Rainey, 1989). Because of these differences, public organizations have been characterized as less innovative, less performance orientated, and more risk adverse than private sector organizations (Drucker, 1973).

### ***The Dimensional Approach***

A third and more recent approach to the public/private classification question distinguishes organizations according to a net outcome of political and economic authority influences. Building on earlier concepts set forth by Wamsley and Zald (1973), Bozeman (1987) suggests that organizations can be considered along several dimensions of “publicness” that are independent of each other and of an organization’s formal, legal status. For example, some of these dimensions include resource acquisition, composition of output, diversity of mission, and environmental transactions (Bozeman and Bretschneider, 1994). All organizations can thus be considered as more public along some dimensions and more private along other dimensions, based on the extent to which they exercise or are constrained by political and economic authority. Additionally, organizations having a similar mix of political and economic authority will exhibit relatively similar patterns of behavior, regardless of their sectoral identification. Bozeman (1987) asserts that the dimensional approach is useful because it helps identify political aspects of business organizations and economic aspects of government

organizations. In addition, the dimensional approach permits the comparative study of entities, such as government corporations, government-sponsored enterprises, and other types of organizations that tend to defy conventional classification (i.e., classification that is based on an organization's formal, legal status). Figure 1 illustrates a "hypothetical sliding scale of publicness upon which organizations could fall," (Mitchell, 2002).



**Figure 1. Scale of the Range of Publicness Level for an Organization (Mitchell, 2002:15)**

Few empirical studies exist that demonstrate the utility of the dimensional approach. For example, Bozeman et al., (1992) show that the dimensional approach was effective in explaining the presence of red tape within an organization, although results vary according to the levels of administrative control exerted on the organization examined. In a study of decision making processes in the public and private sectors, Coursey and Bozeman (1990) found the dimensional approach useful in accounting for certain types of decision processes. In particular, the dimensional approach provided relatively strong explanations for participation in strategic decisions, although it provided somewhat weak explanations for related processes, such as decision flow and the time involved for strategic decisions. However, Rainey and Bozeman (2000), in an analysis of past research comparing public and private organizations, concluded that results in the field are converging and in many ways, which have led to a blurring of distinct

organizational boundaries that portray the classification of organizations as either public or private.

The conclusions of these studies of the different approaches of public and private organizational classification provide support for applying more than one framework when classifying an organization as public or private. As was mentioned in chapter one, this study is essentially a replication of an earlier study (Mitchell, 2002) to determine if the temporal component has caused the perceptions of the public and private sector senior information resource managers to shift. Therefore, this study will, as did the Mitchell study, utilize the aspects of the core and dimensional approaches in classifying the participating populations as public or private. The generic approach will not be used in this study because it disregards the findings of public/private differences. This study will use the same private sector sample data obtained in the Mitchell study. Although many of the participating organizations in the sample have some degree of publicness, they can still be classified as predominately core private organizations. It should be noted that the public organizations used in this study are noticeably public in nature. They are public organizations completely enclosed within the executive level of government.

### **Public Versus Private Sector Management Information Systems**

It became evident during the performance of this literature review, that the insights of Bozeman and Bretschneider (1986) have often been cited, and that many researchers present some of their points as assumptions. For example, the Center for Technology in Government, in its 1996 publication on making decisions on public sector IT, summarizes “risks inherent in the public sector environment” as follows: (a) extreme

risk distaste that makes public management information system less likely to invest in risky technologies that have not been tried out; (b) divided authority over IT decisions due to legal, civil service, and political constraints that makes it difficult to manage IT projects; (c) multiple stakeholders with competing goals; (d) one-year budgets that make it difficult to plan long-term and adopt IT innovations; (e) highly regulated procurement using competitive request for proposal process that makes it difficult to learn from experience; (f) many links between programs and organization, meaning that IT is often dependent on external agencies such as through budgets, legal requirements, and other connections that make it difficult to undertake changes without affecting these other agencies.

Many people would probably agree with the above assumptions about special problems of public management information systems and their associated challenges and critical technologies. However, they need to be empirically tested. First of all, as Bozeman (1987) has articulated, private organizations can have a degree of “publicness.” For example, some private organizations such as defense contractors have only the government as a client and thus may face the same kinds of constraints as public agencies. Bozeman argues that the degree of publicness of organizations is variable and that differences between public and private organizations are not absolute but rather a matter of degree. Certain specialized governmental agencies may have the mission and resources to undertake risky IT projects and may be innovation leaders. Good examples are the founding of the Internet based on the efforts of the Defense Applied Research Projects Agency and the key role of the National Science Foundation in encouraging its early spread (Norberg et al., 1996). Consequently, these assumptions are more likely to

hold if we restrict the generalizations to general purpose governments as opposed to private organizations that do not have governmental organizations as their primary clients.

Second, the nature, extent, and importance of computing and the associated management of the tremendous amount information that IT systems provide in public and private sector organizations have undergone fundamental changes over the past 20 years. Indeed, there are some key changes in the nature of public sector computing that are likely to alter its practices to be more similar to those of the private sector (Rocheleau and Wu, 2002). One major change is that governments at many different levels are attempting to implement “best practices” which are often modeled after those of the private sector (Caudle, 1996). Best practices now include giving governmental agencies much more control over purchasing decisions. The Brooks Act epitomized attention to a deliberate competitive process, but it has been replaced by a new law that emphasizes flexibility to speed up the process (Rocheleau, 2000).

Additionally, one of Bozeman and Bretschneider’s prescriptions is that the information leader should not be at the top of the organization. However, many federal and state and even some local organizations have now followed the practices of private sector organizations by creating a chief information officer (CIO) position, which is supposed to be at the top level of the agency and to be able to participate in making technology responsive to those in charge. For example, a recent study by Lee (2001) found that 42 of the 50 states have formally appointed a CIO. These changes in the purchasing and leadership structure suggest there may be growing convergence between public and private sector information systems and their associated IRM. Both public and



private information management has and continues to rapidly evolve, so research aimed at comparisons of both sectors from a strategic level should be revisited to identify any shifts between sectors.

### **Examining Differences Between Public and Private Information Management Practices**

A few studies that empirically examined the differences between public and private information management practices indicate a lack of consistency. Bretschneider (1990) surveyed top computer executives in the public and private sectors. His public sector sample contained people from state government and was based primarily in information from state representatives of the National Association of State Information Systems. His private sector sample was drawn from the directory of top computer executives. Bretschneider's survey responses supporting the hypothesis that there is greater organizational interdependence in the public sector, especially in the personnel and procurement areas. His study also found that government data processing tends to be placed lower in the hierarchy than it is in similar private organizations. This lower placement is in agreement with their prescription that the head of a public management information system should be insulated from politics. He confirmed that economic factors are less dominant in public sector IT procurement decisions. Bretschneider concluded by arguing that his study proves the importance of environmental factors. He noted that Bozeman and Bretschneider's (1986) model does not argue that public and private sectors are better, but that awareness of these differences will enable both public and private managers to be more effective in their own environments.

Caudle et al, (1991) conducted a survey of key IS issues for the public sector that contained a set of questions about priorities for computing that were similar to those that had been asked of private sector officials in previous surveys. Their survey was sent to all executive branch officials at the federal level who were designated information resource managers based on a general services administration directory. They sent surveys to 50 state officials in charge of data processing centers. Additionally, they sent surveys to all counties with populations exceeding 250,000 and to a sample of counties with populations less than 250,000.

Some of Caudle et al.'s key findings are as follows: (a) middle managers were critical for public systems, whereas top managers dominated in private systems; (b) there were differences between local governments that were focused on transaction processing computing and federal and state governments that were more interested in oversight missions; (c) public agencies were interested in technology transfer that shared applications, although this was not a priority issue for private sector agencies. However, Caudle et al., (1991) concluded that none of the top public sector issues identified as top priorities by public sector officials are uniquely "public" in nature. Technology transfer, the top rated issue as ranked by public sector officials, was ranked only 14<sup>th</sup> by the private sector. They also noted that the issues rated at the top by the public sector, such as end-user computing, tended to be issues that had already peaked and were on the decline in the private sector. This may suggest that public sector information management priorities tend to lag behind those of private sector management. Another finding was that different levels of government varied in importance assigned to issues. For example, the federal level was very interested in

issues regarding red tape, much more so than were the state and local agencies.

Management level also made a difference, with middle-level managers placing more importance on issues such as research and development and external data sources than did top-level managers.

Overall, Caudle et al.'s (1991) study suggests more similarities than differences, but it also emphasizes the difficulty of making generalizations concerning differences between public and private sector information management systems. Their results show that there is great variation in priorities within government organizations based on the level of government and the level of management that was studied. Consequently, statements about public versus private sector differences may have to be stated contingently based on key variables such as level of management in the government versus the private sector.

Bretschneider and Wittmer's (1993) study found that government organizations had adopted greater numbers of computers per employee than had private sector organizations. This study employed a sample similar to Bretschneider's (1990) previously discussed article. Bretschneider and Wittmer concluded that the size of the public sector investments was most likely due to the information intensive nature of government as well as to the use of computers as "side payments" to compensate personnel for low salaries. Bretschneider and Wittmer's study also found differences among subareas of the public and private sectors. For example, criminal justice and manufacturing areas consistently scoring high and low on numbers of computers per full-time equivalent, respectively.

Aggarwal and Mirani (1999) studied the use of decision support system (DSS) models in the public and private sectors. They sent surveys out to decision makers such as the top three or four people in federal agencies and asked them to distribute the survey to other decision makers in their agencies. Private sector users were selected from a corporate directory listing businesses in Maryland, Washington, D.C., and Virginia. It should be noted that only a small percentage of public or private organizations used DSS models at all. Their study concluded that private sector DSS use was greater. They also found that in public agencies, middle managers were the primary users of the models, whereas top managers were more likely to be DSS users in private agencies.

Elliot and Tevavichulada (1999) compared computer literacy in the public and private sectors. They sent questionnaires to human resource professionals in the public and private sectors. Their study was aimed at comparing computer literacy among human resource administrators in public and private agencies. Their public sector response rate was 54%, but they achieved only a 29% response rate from private sector organizations. They do not specify what their sampling design was. Overall, they found that the government and private sector agencies were similar in their use of programs. They argued that the “lack of differences” could be explained because of the ubiquitous nature of applications that are now used for the same personnel purposes. They found that governments gave more computing training (95% versus 82%) but that the frequency of “regular training” was higher in the private (40%) than in the public (30%) sectors. They also noted that most organizations, both public and private, waited for training to be specifically requested rather than proactively providing it.

## **Competition and Perceived Importance of Information Systems**

It can be concluded from the previously mentioned studies that although there are many similarities between public and private agencies, there are some important differences that can distinguish public from private sector information resource management practices and issues. In particular, whereas both types of organizations want to provide good services to their customers, competition makes it more likely that private sector organizations will consider IT and its related IRM practices to be crucial to their survival. Thus, they will be willing to invest more resources in it. The degree of competition faced by organizations was not emphasized in the earlier described studies.

Although this research has not discovered any empirical studies that show IT is viewed as more critical in the private sector, there is much anecdotal evidence available. As noted earlier, one of the defining aspects of public organizations concerns their willingness to share information about their computer systems. Indeed, the borrowing of government computer systems is often encouraged and sometimes even mandated. For example, the state of Florida was directed to use a modified version of the Ohio welfare system (Miller, 1994). Public officials are often willing to share the most intimate details of the systems of which they are most proud. As noted previously, public sector agencies are much more interested in technology transfer than are businesses in the private sector. State governments have created an online facility for sharing reusable software (Douglas, 2001). Public sector officials can gain prestige and professional opportunities by sharing such information (Rocheleau and Wu, 2002).

By way of contrast, since the mid 1980s, the theory has arisen that information systems can be strategic assets to businesses and can allow them to gain a competitive

advantage (Porter and Millar, 1985). Although the importance of IT as a competitive asset varies by industry, in many cases, it has become a central element, as a recent article noted:

Companies that have developed Web-based businesses are understandably nervous about revealing how these are put together or how they integrate with traditional transactional systems. After all, with Web business, the ecommerce architecture is the business—it is the company's competitive advantage. (Morgan, 1998:40)

Morgan goes on to illustrate this point by noting that his request to Amazon.com for basic information about the nature of their computer system was met with refusal, stating that “Amazon.com absolutely will not discuss the specifics of its Web computer architecture” (Morgan, 1998:40). Likewise, Yahoo has taken a similar position on refusing to provide any information concerning its databases:

Ralston [Vice President and general manager of Yahoo's communication groups] calls the central database that supports Yahoo's ability to provide universal logon for all of its services a “crown jewel” though he refuses to talk about it, or any of the multitudes of databases the company employs, in any detail. “They're not only mission-critical,” Ralston says, “in many cases, they're a competitive advantage.” (Whiting, 2000:50)

Another important difference between public and private sectors concerns their use of information systems in regards to their citizens or customers. In some cases, businesses such as banks are using IT as a way of deciding whether they want certain customers depending on the amount of profit the bank makes off these customers, and banks are sometimes using fees to discourage use by customers they view as drags on their profits (Wahl, 1998). Public organizations are not free to use IT to get rid of unprofitable citizens. This is a potentially important difference between the purposes for which systems are used. By allowing private organizations to achieve competitive

advantage and focus on the most productive customers, IT can contribute to profits and may even drive their competitors out of business. By way of contrast, programs such as Medicaid are aimed at many citizens who cannot pay for the full cost of the services received (Rocheleau and Wu, 2002).

There are other features that most likely distinguish public and private information systems and their related information resource management practices, such as the complexity of the goals for which they are used. Certainly, the importance attached to accountability, openness, and equity issues appears to distinguish the two types of systems. Nutt (1999) points out that sunshine laws make all discussions about public strategic decisions subject to disclosure, as follows:

Most public organizations do not have the luxury of keeping strategic decisions secret. Sunshine laws often force the conduct of business into the open . . . . Even when sunshine laws do not apply, mechanisms of accountability and oversight make all actions in public organizations, even contingency plans or hypothetical scenarios, subject to review and interpretation by outsiders. (Nutt, 1999:312)

Consequently, those engaged in designing public information systems need to employ accountability and openness as major organizing principles for their systems. In contrast, private sector organizations are expected to use them primarily for internal purposes that enhance their competitive positions in their market sectors (Rocheleau and Wu, 2002).

It may be surmised that due to the emergence of IT, and the management of information that these systems produce as a method to gain competitive advantage, makes IT and IRM likely to be viewed as much more important to private sector organizations. If IT means the difference between thriving versus going out of business,

then it may be assumed that private agencies will be willing to invest many more resources in IT. For many private sector agencies, investments in IT to improve services to clients are not just desirable (as they are in the public sector) but they are an absolute necessity.

This is not to deny that many public organizations are now beginning to view IT as a major asset. Bajjaly (1998) found a considerable amount of attention was given to strategic information systems concepts in state agencies. But Bajjaly also noted that public agencies use their strategic systems for the purpose of “cooperative advantage.” There are some forms of mild competition. For example, many public agencies are attempting to use Web pages and other information systems devices to attract business to their localities (Newcombe, 1996). Many Web-based approaches to attracting businesses are low cost and low risk for public agencies, and consequently, governments are willing to engage in these activities. Coursey and Killingsworth (2000) noted that government Website development was very innovative in the early years of the Web, whereas business Web innovation did not occur until substantial profit opportunities developed.

On the other hand, an argument could be made that competition is much less important in the public sector and as a result, public organizations will be much less willing to invest large amounts of money in IT when the private sector believes the investments could result in a competitive advantage. Nutt (1999) summarizes the literature on public-private differences by stating the following:

Competition for customers can be cumbersome or even prohibited for public and third-sector organizations. Public organizations often are expected to collaborate with each other when offering similar services. (Nutt, 1999:312)



Information technology is more often a cost cutting device for the public sector, a way of doing more with the same number of staff, and many public IT projects are aimed at providing access and are not crucial to an organizations' existence. To illustrate, a study noted that if a private consumer goods corporation overspends their budget but the overspending results in the doubling of profit, the corporation likely will be rewarded, but such overspending would not even be allowed in the public sector. Thus, they note that public agencies are less likely to invest in projects such as executive information systems:

Public sector organizations operate with fixed budgets and have little leeway to shift dollars from one category to another. In these circumstances, a risky project with [executive information systems] . . . is not likely to show up high on the MIS priority list. (Mohan et al., 1990:435)

Another example of the compelling force for private sector IT spending is provided by the following observation by the CIO of United Parcel Service (UPS):

A lot of CIO's feel that if they don't spend the money on leading-edge technology, they're going to be left behind. We've spent a lot of money just because we need to stay in the game. (Whiting and Davis, 1999:37)

The UPS CIO supported this statement with the example of how UPS is investing in voice recognition technology to explore the possibility of having customers speak phone numbers into a telephone headset, which could reduce time for customer requests.

If technology is affordable, many public managers are glad to use it to improve services to their customers too, but it is not mandatory for their survival and it would be hard to justify investment in risky technologies unless their central mission necessitates their use.

## **The Chief Information Officer**

The chief information officer (CIO) was first characterized as “the senior executive responsible for establishing corporate information policy, standards, and management control over all information resources,” (Synott and Gruber, 1981). Since this characterization of the CIO over two decades ago, IT has become integral to providing services and the management of information has moved out of the back office and off the mainframe into the home and office and onto the Internet. As the public and private sectors fully embrace e-commerce, e-government, and other leading-edge implementations of IT that benefit customers and citizens respectively, leadership in managing the information resources becomes of paramount importance (GAO, 2001). In 1996, responding to concerns about how the government was acquiring and managing IT, Congress passed the Clinger-Cohen Act (CCA). Senator William Cohen (R-ME) and Representative William Clinger (R-PA) were the congressional sponsors.

The CCA assigns a wide range of duties and responsibilities to CIOs, foremost of which are:

- Working with the agency head and senior program managers to implement effective information management to the agency’s strategic goals.
- Helping to establish a sound investment review process to select, control, and evaluate spending for IT.
- Promoting improvements to work processes used by the agency to carry out its programs.
- Increase the value of information resources by implementing an integrated agencywide technology architecture.

- Strengthening the knowledge, skills, and capabilities in order to effectively manage information resources, deal with emerging technology issues, and develop systems.

While there are various approaches on how best to use the CIO position to accomplish the above duties, legislative guidance and best practices experience with leading public organizations define common tenets for the public CIO. The efficient, effective, and innovative use of IT requires a level of leadership and focus that goes beyond what would be provided in a technical support function. An agency should place the CIO at a senior management level. This allows the CIO to work as an equal partner with senior decision making officials, especially on information management issues. According to Government Accounting Office, GAO/T-AIMD-98-22, (1997), agencies should specifically:

- Appoint a CIO with expertise and practical experience in technology management.
- Position the CIO as a senior partner reporting directly to the agency head.
- Ensure CIO primary responsibilities are for information management.
- The CIO should serve as a bridge between top management, line management, and information management support professionals, in order to ensure the effective acquisition and management of information resources to support agency missions.
- The CIO will develop strategies and specific plans for the hiring, training, and professional development of staff in order to build the capacity to develop and manage information resources.

- Support the CIO with an effective organization and management framework for implementing agencywide IT initiatives.

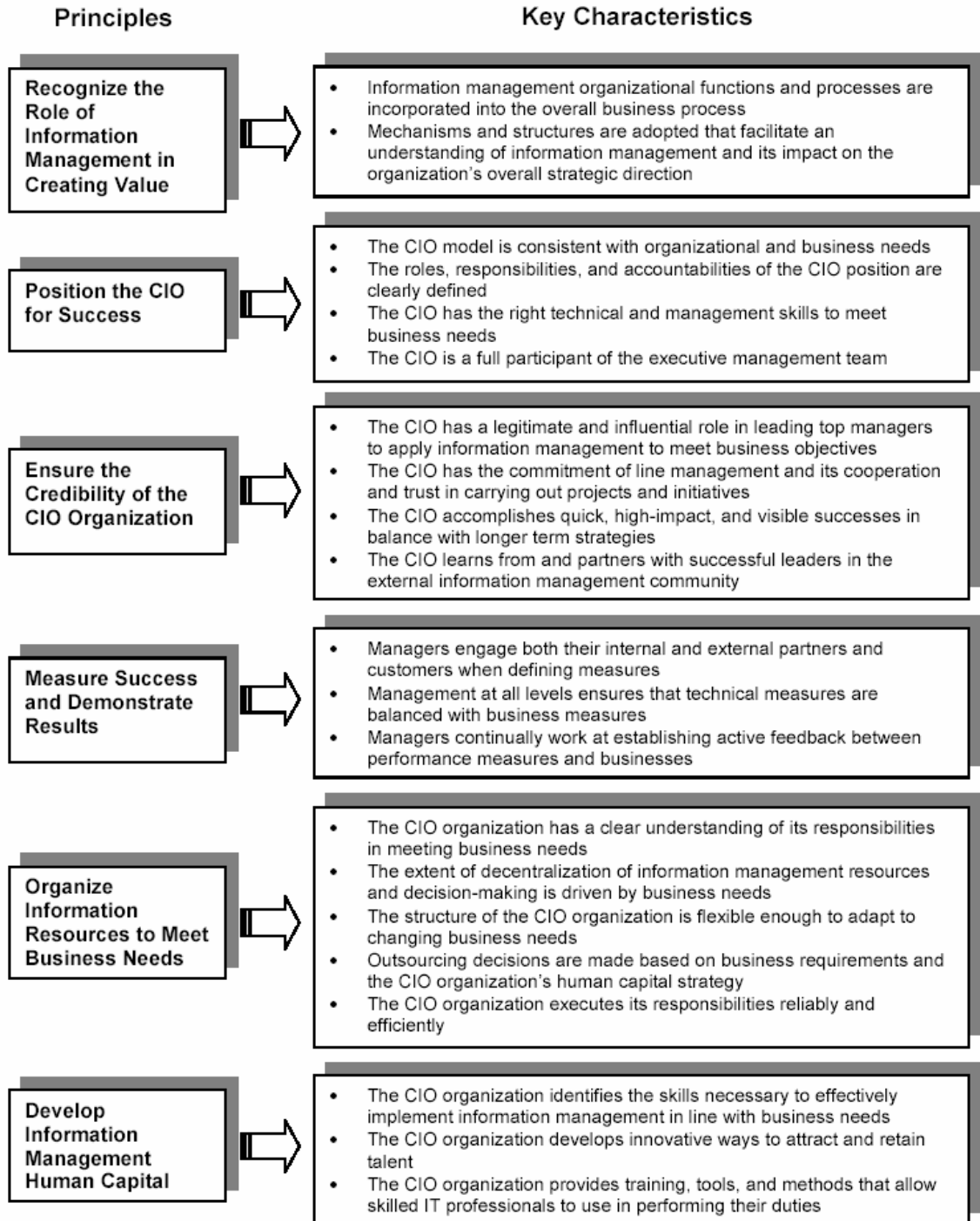
### ***CIO Best Practices***

Virtually all of the major executive agencies of the federal government have appointed CIOs, and many have taken positive steps toward the implementation of important information management processes specified by law. To reap the full benefits of information management reform, federal agencies must utilize the full potential of CIOs as information management leaders and active participants in the development of agency strategic plans and policies. The CIOs themselves must meet the challenges of building credible organizations, and developing and organizing information management capabilities to meet agency mission needs.

A guide was developed with the intent to assist federal agencies in maximizing the success of the CIO (Executive Guide, 2001). Principles and practices gleaned from the case studies and then presented in this guide offer concrete suggestions on what agency executives can do to ensure the effectiveness of their CIO organizations. The guide does not address all of the responsibilities which fall to federal agency CIOs; only those which have parallels in the private sector. Moreover, it was determined that practices used by federal agency CIOs tend to differ from those used by leading public organizations. These differences were not analyzed to determine the reasons for these deviations, but they were determined to likely result from the context in which federal CIOs operate.

Both operational and structural aspects of the CIOs environment can vary significantly in the federal sector versus the private sector. Rather than dwell on differences, this study reveals that there is much common ground between public and

private CIO organizations on which to build efforts for improvement. Figure 2 illustrates the principles and key characteristics of best practice CIO management.



**Figure 2. Six Principles and Key Characteristics of CIO Management in Leading Organizations (GAO-01-376G)**

The basis for the development of the CIO Executive Guide stemmed from the belief that federal agencies could benefit from examples set by a few leading organizations whose CIO organizations have gained a reputation for outstanding information management in their enterprises. This work was intended to provide realistic guidance that federal agencies can consider in determining how best to integrate CIO functions into their respective organizations. The target audience included senior federal executives and managers. Their observations can also provide insights for senior information management officials throughout the public and private sectors. Based on interviews with private sector and state CIOs and other research, a framework was developed that depicts critical success factors and leading principles. CIOs of leading organizations that were interviewed described a consistent set of key principles of information management that they believed contributed to the successful execution of their responsibilities. These principles touch on specific aspects of their organizational management such as formal and informal relationships among the CIO and others, business practices and processes, and critical CIO functions and leadership activities. The specific nature of these principles varied depending on the organization's mission, size, culture, and other factors. However, each underlying key principle was consistently observed. The CIOs interviewed considered these principles instrumental because they address critical organizational and operational aspects of the CIO's role. Particularly, the principles address senior executive's responsibility for creating an effective management context for the CIO, as well as their responsibilities for building credibility, and organizing information technology, and management to meet business needs. Although the practices are not new ideas in the general management of organizations, they are the

application of well founded principles in the maturing area of information technology and management. These principles are most effective when implemented together in a mutually reinforcing manner. As ad hoc efforts, each individual principle addresses a single aspect that is necessary, but is not sufficient for success by itself. The failure to execute a single principle may render the others less effective. Further more, although there is no precedence among the principles, organizational conditions may make it more feasible to address one principle before another. For example, the chief executive officer may position the CIO for success in advance of hiring a new CIO while the other principles await the CIO's attention.

### ***CIO Challenges***

The rapid pace of technological change and innovation in the current information age poses wide ranging opportunities for improved information management and enhanced performance in achieving agency missions and goals. At the same time; however, the proliferation of technology has created a range of difficult issues concerning the management and integration of complex processes, computer equipment, and telecommunication networks. In their oversight role, Congress has established a series of laws which define the role of information management in government and mandate basic processes to manage government IT investment.

The federal government's management of information resources to date has produced mixed results. Consistent with reform legislation, agencies have taken constructive steps to implement modern IT strategies, systems, management practices and policies directed toward achieving cost savings, increasing productivity, and improving the timeliness and quality of federal service delivery.



Over the past few years, the IT community has been faced with the enormous challenge of global terrorism as well as a seemingly struggling economy. Since 1996, the Association for Federal Information Resources Management (AFFIRM) has conducted annual surveys of the senior federal IT community to determine the most critical challenges facing the federal CIO. Additionally, AFFIRM has also asked what technologies are considered most critical to implementing IT based solutions. AFFIRM is an organization that was founded in 1979 with the goal of advancing the management of federal IRM (AFFIRM, 2002:i). AFFIRM's focus is on senior information management issues of interest to the federal government. Tables 1 and 2, excerpts from AFFIRM's 2002 *Seventh Annual Top Ten Challenges Survey*, shows the results of that survey.

**Table 1: CIO Challenges - 2002 Survey Responses and Prior Year Comparisons (AFFIRM, 2002)**

2002 Votes	2002 Ranking	DESCRIPTION	2001 Ranking	2000 Ranking	1999 Ranking	1998 Ranking	1997 Ranking
44	1	Formulating or implementing an enterprise architecture	6	6	7	3	1
34	2	Making the business and cultural changes necessary for full E-Government transformation	2	--	--	--	--
33	3	Hiring and retaining skilled professionals	3	1	1	13	--
33	3	Aligning IT and organizational mission goals	11	12	11	5	5
32	5	Obtaining adequate funding for IT programs and projects	4	4	5	--	--
32	5	Implementing IT capital planning and investment management across the agency	14	5	5	4	2
30	7	Unifying "islands of automation" within lines of business (across agencies)	10	--	--	--	--
29	8	Simplifying business processes to maximize the benefit of technology	9	10	13	10	9
24	9	Using IT to improve service to customers/stakeholders/citizens	1	8	5	6	7
23	10	Building effective relationships in support of IT initiatives with agency senior executives (agency head, CFO, etc.)	7	7	15	9	12
22	11	Capturing, organizing and making accessible Agency knowledge and expertise (knowledge management)	8	8	10	10	--
22	11	Developing agency-wide IT accountability	21	18	12	13	8
19	13	Assessing and developing agency IT competence (training and education)	15	9	8	9	11
17	14	Managing or replacing legacy systems	20	11	12	9	12
16	15	Balancing public access to information with the need for information security	18	13	9	8	--
15	16	Providing effective IT infrastructure and related services	13	11	9	10	6
14	17	Implementing E-Government solutions	12	2	3	--	--
14	17	Measuring and reporting past performance	17	15	12	--	--
12	19	Preventing unauthorized system intrusions (hackers, terrorists, etc.)	5	3	2	--	--
10	20	Implementing COTS solutions (ERP, CRM, etc.)	23	19	15	--	--
7	21	Controlling IT expenditures	19	17	11	7	13
5	22	Implementing solutions in support of Government Paperwork Elimination Act (GPEA)	16	--	--	--	--
4	23	Developing effective strategic business partnerships	--	--	--	--	--
4	23	Responding to competitive sourcing goals	25	--	--	--	--
3	25	Planning and implementing IT disability access solutions into existing and new IT systems	24	20	--	--	--

**Table 2: CIO Critical Technologies – 2002 Survey Responses and Prior Year Comparisons (AFFIRM, 2002)**

2002 Votes	2002 Rankings	DESCRIPTION	2001 Ranking	2000 Ranking	1999 Ranking	1998 Ranking	1997 Ranking
50	1	Security Infrastructure	1	1	14	1	2
34	2	Internet/ Intranet/ Web applications	5	2	1	2	1
30	3	Knowledge management	3	3	5	3	--
29	4	Data warehousing/data mining	7	6	2	4	3
26	5	XML and/or web services	--	--	--	--	--
25	6	Internet / Intranet / Web infrastructure	2	2	1	2	1
25	6	Wireless technology	10	--	--	--	--
25	6	Records management/electronic document management systems	11	--	--	--	--
25	6	Executive information and decision support systems	12	10	6	15	10
22	10	Portal technologies	17	--	--	--	--
21	11	Content management	--	--	--	--	--
17	12	Workflow	16	7	5	10	6
16	13	E-Mail	4	14	11	13	8
16	13	Security Applications	8	1	14	1	2
16	13	Data, voice and video convergence (was voice and data integration)	13	4	10	12	12
16	13	Storage and storage networks	14	--	--	--	--
15	17	Remote and mobile computing including personal digital assistants	6	5	4	9	*
14	18	Virtual Private Networks	9	--	--	--	--
14	18	Electronic Commerce/EDI	22	8	3	5	5
12	20	Training technology and applications	18	--	--	--	--
11	21	COTS applications including ERP, CRM and SCM (was COTS development S/W)	19	14	11	11	8
10	22	IT accommodation – disability access solutions	23	11	12	--	--
7	23	Next generation Internet	25	9	11	8	--
6	24	Video solutions (distance learning, virtual office, desktop)	15	13	7	--	--
6	24	Online analytical processing (OLAP)	21	19	13	14	10
5	26	Middleware	20	16	9	14	11
3	27	Groupware	27	21	11	8	9
3	27	Imaging	29	18	10	12	7
2	29	Relational databases	24	16	11	14	9
0	30	LINUX	30	19	14	--	--

Federal government agencies are facing new dynamics and accelerating rates of change (AFFIRM, 2003). Policies, laws, and requirements of citizens—all are in constant flux. New agendas, such as “The President’s Management Agenda” calls for performance with results, not just process. This means government agencies must have mission agility, the ability to turn on a dime as programs and needs change. The events of September 11, 2001 and subsequent terrorist threats to this country have demonstrated the importance of accurate, timely information and the need for strong leadership in integrating and managing this information across a government enterprise. The results of AFFIRM’s annual surveys reveal the progression of views of the senior federal IT community toward the challenges they have been faced with from a strategic standpoint.

As noted earlier in chapter one, only one study has been identified with the aim of comparing public and private sector senior information resource professional with the goal of discovering whether both sectors perceive they are faced with the same challenges and view the same technologies as critical for their organization’s operations (Mitchell, 2002). The study provided evidence that public and private sector information managers do perceive to be faced with many of the same challenges and critical technologies.

However, the most significant limiting factor identified in the Mitchell 2002 study was the temporal separation of sector sampling. The public sector survey data was collected two months after September 11, 2001 and was reported in December 2001’s AFFIRM Survey; the private sector survey data was collected during September through December 2002 timeframe. This one year time difference may be significant given that

IT and its associated information systems and resource management tend to evolve rapidly, over relatively short periods of time.

### **Research Focus**

The goal of this research is to replicate the earlier study by Mitchell (2002) to discover and validate if in fact, public sector and private sector senior information resource management professionals are faced with the same challenges and view the same technologies as critical for organization operations. Review of the literature indicates that there exist both differences and agreements between the public and private sectors regarding some strategic aspects of the challenges faced by both sectors. It appears that both a divergence and convergence exists between the sectors; however, the most current research comparing these sectors has shown a close union between them. Consequently, the ambiguity as to whether differences in the challenges faced by senior information resource management personnel or in the technologies that they perceive as critical to their organization's operations exist. Hence, based on the latest research comparing both sectors, the researcher proposes the following hypotheses are proposed for this study:

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

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

## Summary

This literature review provided information about the underlying differences between the public and private sector from generic, core, and dimensional approaches. The generic approach downplays the existence of differences between public, private, and hybrid organizations. Supporters of the core approach assert that there exist fundamental differences that allow organizations to be uniquely classified by sector. The dimensional approach suggests that differences between the two can be made based upon how an organization is controlled or biased by external political and economic authority.

Next, research focusing on the public and private sector management information systems (MIS) shows that there still exists differences between the sectors' MIS systems. However, there has been a convergence in some aspects due to the blurring of sectoral boundaries. Then, differences between public and private sector information management practices was reviewed and still yet, indicated that there are both differences and similarities between the sectors, but that it appears from a strategic level, that similarities do exist. Finally, the role of the CIO, their practices and challenges, were reviewed to indicate that there does seem to be a close agreement, from a strategic view, that both the private and public sector senior information resource management professional do identify to be faced with many of the same challenges and many of the same critical technologies related to their organization's operations success.

With both a seminal and current understanding of the public and private sectors management information systems and information management practices between organizations is illuminated, and the practices and challenges facing the CIO explained,

the researcher can now establish a methodology in which to address the research focus.

The next section, chapter three, presents the methodology used for this study.

### III. Methodology

#### Overview

The focus of chapter two was to review the literature dealing with the underlying differences between the public and private sectors from a generic, core, and dimensional approaches. These contrasting models provided a baseline perspective on how one can view the differences between the public and private sectors from an organizational view. Additionally, the literature review covered aspects on the public and private sector management information systems, which indicated that there exists both differences and agreements between the sectors' views on MIS. Then, differences between public and private sector information management practices was reviewed and still yet, indicated that there is both differences and similarities between the sectors, but that it appears from a strategic level, that similarities do exist. This seems to indicate that there exists a blurring of sectoral boundaries in these information management views. Lastly, the role of the CIO, their practices and challenges, were reviewed to indicate that there does seem to close agreement from a strategic view that, both the private and public sector senior information resource management professional do identify to be faced with many of the same challenges and many of the same critical technologies related to their organization's operations success.

This chapter will outline the methodology applied to validate if public and private sector senior IRM managers perceive the same challenges and view the same technologies as being critical to their organization's information resource management needs. Also described is a description of the population under study, the survey



instrument design used for data collection, and the statistical techniques used to analyze the data.

### **Approach**

The methodology applied in this research will mirror the methodology used during the Mitchell (2002) study. As was noted in previous chapters, the most significant limiting factor to the Mitchell study (2002) was the temporal separation of survey responses between the public and private sector data. There was in effect, a one-year separation between the collection of data; the public sector data was collected in 2001 by the Association for Federal Information Resources Management (AFFIRM) while the private sector data was collected by Mitchell in the later part of 2002. From a strategic viewpoint, the temporal disparity may have an effect on any inference when comparing perceptions between the public and private sector. Hence, the study will compare the results of a surveys that were collected during the same time period (2002) to assess CIO/senior information managers IRM views from a strategic viewpoint.

When data is analyzed, new insights can emerge. At the same time, new problems demand further research. Data are not only elusive but can also be transient. Data collected during research is merely a glimpse that exists for what seems like only a split second. Tomorrow, next week, next year—what we thought we had “discovered” may have changed completely (Leedy and Ormrod, 2001:95). This research will utilize the Mitchell (2002) private sector dataset collected during 2002 and the public sector 2002 dataset collected by AFFIRM.

## **Research Approval**

Permission to conduct this research was granted in accordance with Air Force Instruction (AFI) 40-402. An exemption to AFI 40-402 was requested and approved by the Wright Site Institutional Review Board on 16 December, 2003, and the Air Force Research Laboratory Chief of Aerospace Medicine on 23 December, 2003. This research was assigned Protocol 04-22-E.

## **Population**

Two populations were selected for this replication study. The public sector is represented by participants from a broad spectrum of executive and management levels in the federal IRM community. As such, the results from this population do not solely represent the thinking of only federal CIOs, but rather are a reflection of the broader federal IRM community. Survey responses obtained from this public population were obtained from AFFIRM's 2002 *Federal CIO Seventh Annual Top Ten Challenges Survey*.

The private sector is represented by the senior information resource management professionals (CIO or equivalent) from among America's highest ranking businesses as measured by the 2002 FORTUNE 1000 index, based solely upon net income. This same public sector dataset obtained during the Mitchell (2002) study will be used during this analysis. By choosing the FORTUNE 1000 index, Mitchell (2002) determined that a better representation between a broad spectrum of private sector businesses from many different industries would be achieved. Additionally, it was thought that the population of public sector managers would represent similar strategic level views of federal agencies and departments, due to the fact that their budgets have parity with or surpass

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 (Mitchell, 2002). For his study, Mitchell polled the entire population of FORTUNE 1000 CIOs (or equivalent title). “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).

### **Survey Instrument**

The survey instrument used for the Mitchell (2002) study was designed by the Association for Federal Information Resources Management (AFFIRM). 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.

There are two sections within the survey instrument. The first version of this instrument was designed in 1996. It was designed in order to assess what challenges were being faced by the newly formed office of the CIO among various federal agencies, in support of the Information Technology reform Act of 1996. The first section of the instrument wanted to determine the greatest challenges faced by federal CIOs, as viewed by senior federal IRM managers. The second section of the survey wanted to identify the technologies viewed by federal CIOs as being most critical in performing their IRM function over the course of the upcoming year. Each section provided 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 that similarities existed 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 are provided in Appendix 1.

Since 1996, the AFFIRM annual survey instrument has evolved. Each AFFIRM annual survey uses the previous year's responses in conjunction with government publications, research from private industry and academia which alter the survey instrument to reflect current IRM philosophies. For example, any dated technologies or challenges that were ranked consistently low since 1996 were dropped from the AFFIRM lists of choices and were replaced by newer technologies and challenges that were more reflective of current research from the IRM community. When a side-by-side comparison between 1996's and 2002's AFFIRM survey is conducted, it is relatively easy to see how the views of senior federal IRM professional have evolved over time in their views regarding CIO challenges and critical technologies (see Tables 1 and 2 respectively).

The survey instrument used for this research effort is the same instrument used by AFFIRM to conduct their 2002 CIO challenges study. This instrument represented the most accurate and current realities in IRM research during 2002; the same year that the public sector dataset was obtained. Therefore, a same-year/same timeframe comparison between the public and private sectors will more appropriately be achieved. A copy of

the original Mitchell (2002) survey instrument used to collect the 2002 public sector dataset is presented in Appendix 2. The original 1996 AFFIRM list of challenges and critical technologies is listed in Appendix 1. In order to illustrate how perceptions have changed during the period between 2001 and 2002, the CIO challenges and critical technologies from AFFIRM's 2002 survey are listed in Tables 3 and 4 respectively.

**Table 3: CIO Challenges (AFFIRM, 2002)**

2002 Ranking	DESCRIPTION	2001 Ranking
1	Formulating or implementing an enterprise architecture	6
2	Making the business and cultural changes necessary for full E-Government transformation	2
3	Hiring and retaining skilled professionals	3
3	Aligning IT and organizational mission goals	11
5	Obtaining adequate funding for IT programs and projects	4
5	Implementing IT capital planning and investment management across the agency	14
7	Unifying "islands of automation" within lines of business (across agencies)	10
8	Simplifying business processes to maximize the benefit of technology	9
9	Using IT to improve service to customers/stakeholders/citizens	1
10	Building effective relationships in support of IT initiatives with agency senior executives (agency head, CFO, etc.)	7
11	Capturing, organizing and making accessible Agency knowledge and expertise (knowledge management)	8
11	Developing agency-wide IT accountability	21
13	Assessing and developing agency IT competence (training and education)	15
14	Managing or replacing legacy systems	20
15	Balancing public access to information with the need for information security	18
16	Providing effective IT infrastructure and related services	13
17	Implementing E-Government solutions	12
17	Measuring and reporting past performance	17
19	Preventing unauthorized system intrusions (hackers, terrorists, etc.)	5
20	Implementing COTS solutions (ERP, CRM, etc.)	23
21	Controlling IT expenditures	19
22	Implementing solutions in support of Government Paperwork Elimination Act (GPEA)	16
23	Developing effective strategic business partnerships	--
23	Responding to competitive sourcing goals	25
25	Planning and implementing IT disability access solutions into existing and new IT systems	24

Table 4: CIO Critical Technologies (AFFIRM, 2002)

2002 Rankings	DESCRIPTION	2001 Ranking
1	Security Infrastructure	1
2	Internet/ Intranet/ Web applications	5
3	Knowledge management	3
4	Data warehousing/data mining	7
5	XML and/or web services	--
6	Internet / Intranet / Web infrastructure	2
6	Wireless technology	10
6	Records management/electronic document management systems	11
6	Executive information and decision support systems	12
10	Portal technologies	17
11	Content management	--
12	Workflow	16
13	E-Mail	4
13	Security Applications	8
13	Data, voice and video convergence (was voice and data integration)	13
13	Storage and storage networks	14
17	Remote and mobile computing including personal digital assistants	6
18	Virtual Private Networks	9
18	Electronic Commerce/EDI	22
20	Training technology and applications	18
21	COTS applications including ERP, CRM and SCM (was COTS development S/W)	19
22	IT accommodation – disability access solutions	23
23	Next generation Internet	25
24	Video solutions (distance learning, virtual office, desktop)	15
24	Online analytical processing (OLAP)	21
26	Middleware	20
27	Groupware	27
27	Imaging	29
29	Relational databases	24
30	LINUX	30

## **Data Collection Method**

Mitchell (2002) used both a paper-based and a web-based version of the same survey instrument given to the 2002 public sector testing population. Those participants were notified by mail with an envelope addressed to the CIO or Senior Information Technology Manager at each respective company. As was noted in this study, the letters mailed to the public sector test population were not addressed exclusively to the organization's CIO because of the variability of titles such as Vice President used by companies to denote their senior IRM executive (Brumm, 1988). The reader is referred to the Mitchell (2002) study for any further related details on the data collection employed.

## **Pilot Study**

Pilot testing of the Mitchell (2002) survey instrument was carried out during the month of June 2002.

## **Survey Modification**

With adjustments made to the original 2001 CIO challenges dataset based on a pilot study, the 2002 CIO challenges dataset, and the 2002 CIO critical technologies dataset are presented below in Tables 5, 6 and 7 respectively.



**Table 5: Modifications made to the CIO Challenges 2001 AFFIRM Survey Dataset (2002:54)**

<b>Original Wording</b>	<b>Revised Wording in Final Instrument</b>
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	Eliminated
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

**Table 6: Modifications made to the CIO Challenges 2002 AFFIRM Survey Dataset**

<b>Description</b>	<b>Modification</b>
Formulating or implementing an agency IT architecture	None
Making the business and cultural changes necessary for full e-Government transformation	None
Hiring and retaining skilled professionals	None
Aligning IT and organizational mission goals	None
Obtaining adequate funding for IT programs and projects	None
Implementing IT capital planning and investment management across the agency	None
Unifying “islands of automation” within lines of business	None
Simplifying business processes to maximize the benefit of technology	None
Using IT to improve service to customers/stakeholders/citizens	None
Building effective relationships in support of IT initiatives with agency senior executives (agency head, CFO, etc.)	None
Capturing, organizing and making accessible Agency knowledge and expertise (knowledge management)	None
Developing agency-wide IT accountability Implementing e-business/e-government solutions	None
Assessing and developing agency IT competence (training and education)	None
Managing or replacing legacy systems	None
Ensuring (balancing) public access to information vs. the need for system security	None
Providing effective IT infrastructure and related services	None
Implementing E-Government solutions	None
Measuring and reporting past performance	None
Preventing unauthorized system intrusions (hackers, terrorists, etc.)	None
Implementing COTS solutions (ERP, CRM, etc.)	None
Controlling IT budgets	None
Implementing solutions in support of Government Elimination Act (GPEA)	Eliminated
Developing effective strategic business partnerships	Eliminated
Responding to competitive sourcing goals	None
Planning and implementing IT disability access solutions into existing and new IT systems	None

**Table 7: Modifications to the CIO Critical Technologies 2002 AFFIRM Survey Dataset**

<b>Description</b>	<b>Modification</b>
Security Infrastructure	None
Internet/Intranet/Web applications	None
Knowledge Management	None
Data warehousing/data mining	None
XML and/or web services	Eliminated
Internet/Intranet/Web infrastructure	None
Wireless technology	None
Records management/electronic document management systems	None
Executive information and decision support systems	None
Portal technologies	None
Content management	Eliminated
Workflow	None
E-Mail	None
Security Applications	None
Data, voice and video convergence (was voice and data integration)	None
Storage and storage networks	None
Remote and mobile computing including personal digital assistants	None
Virtual Private Networks	None
Electronic Commerce/EDI	None
Training technology and applications	None
COTS applications including ERP, CRM and SCM (was COTS development S/W)	None
IT accommodation-disability access solutions	None
Next generation Internet	None
Video solutions (distance learning, virtual office, desktop)	None
Online analytical processing (OLAP)	None
Middleware	None
Groupware	None
Imaging	None
Relational databases	None
LINUX	None

## **Survey Administration**

In the Mitchell (2002) study, survey notification was made on August 30, 2002 by United States mail. Survey packages were addressed to the CIO or Senior Information Technology Manager at each company on the 2002 FORTUNE 1000 index (Mitchell, 2002:55). A copy of the survey package including the cover letter is provided in Appendix 2. A total of 28 mailings were rejected due to incorrect addresses that could not be resolved.

Responses were stored in a database hosted at the Air Force Institute of Technology. Mitchell 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 survey results were manually entered into the results database by the researcher. The researcher attempted to ensure the accuracy of the database survey inputs by having several Air Force officers examine the database.

## **Data Analysis**

As was the case in the earlier study, the data analysis in this study will focus on describing the association between the perceptions of public and private sector CIOs so that an updated view can be obtained. A statistical association can be described as:

“... the inclination of two events to occur simultaneously. Two variables that are associated are correlated, whereas two variables that are not associated (independent) are said to be uncorrelated. Association does not imply causation, whereas causation does imply association. Statistical

evidence alone can be used to demonstrate association; however, causation must be established using strict experimental design, logic, and statistical evidence,” (Zegeer and Parker, 1984).

The datasets will be designed as matched pairs of rankings that measure CIO perceptions of challenges faced and technologies critical for operations. Because the survey results will be treated as matched pairs of rankings, nonparametric statistical techniques will be employed to measure association (McCall, 2001). Nonparametric methods are uniquely useful for testing nominal (categorical) and ordinal (ordered) scaled data; situations where parametric tests are not generally available.

As was the case in the earlier study, the two non-parametric tests employed in this replication study are Spearman’s Rho rank-order correlation coefficient and Kendall’s Tau coefficient. Although these statistical techniques reflect the degree of association between the rank of responses obtained in the datasets of the public and private sector surveys, they only 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). This section presents an explanation and comparison of each of these techniques.

### ***Spearman’s Rho Correlation***

Practical situations often require tests that do not assume normality. Rank tests are often used in this case. Spearman’s Rho rank-order correlation coefficient (R) is a nonparametric measure of the linear relationship between two variables. It is used when

the researcher wishes to determine whether two sets of rank-ordered data are related. Spearman's Rho is a measure of association that is historically more commonly discussed in statistical textbooks. Its computation is a natural extension of the most popular parametric measure of association, Pearson's product-moment correlation. Spearman's Rho is simply the Pearson's product-moment correlation coefficient computed using the ranks of the two variables instead of their values (Gibbons, 1976).

When using Spearman's Rho, 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. The magnitude of the response for each item is first ranked within each set. For example, each item within the challenges section of the survey results will be 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 in Table 8.

**Table 8: Examples of Rank Orders needed to Produce Perfect Agreement or Disagreement values of Spearman's Rank Correlation Coefficient (Mitchell, 2002:58)**

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 ranges from -1 to 1. When  $R = 0$  there is no association and; therefore, no agreement or disagreement between the overall rank comparisons. Likewise, when  $R = -1$  or  $R = 1$ , there is either perfect disagreement or perfect agreement respectively between the overall rank comparisons. It should be noted that 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:

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

Hence, 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 (Mitchell, 2002).

### ***Kendall's Tau Correlation***

Kendall's Tau rank-order correlation coefficient ( $\tau$ ) is another way to measure the degree of association between a set of ranked observations. If you have a pair of ranks for each of several things, e.g., public/private sectors, the tau statistic can be used to express the degree of relationship between those ranks (Bruning and Kintz, 1987). 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-order correlation coefficient, the observations do not have to be ranked to perform the test. According to Gibbons (1976), the test statistic ( $\tau$ ) 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 8. Gibbons 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 (Gibbons, 1976:297).

To compute the tau test statistic, first arrange the observations into pairs by survey instrument item. For example, in this study, the pairs consist of the public sector rank and the private sector rank for each survey questionnaire item. The pairs will 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 T statistic indicates the direction of association, not the strength of association (Conover, 1980).

### **Summary**

The purpose this chapter was to described the research design, and methodologies to be used within this research effort. It included a description of the population(s) under study, the survey instrument used to collect datasets, and statistical techniques to be used to analyze the data. The goal of this research is to discover and/or validate, if public and private sector senior IRM managers are still being faced with the same challenges and view the same technologies as being critical to their organization's information resource management requirements. An improved analysis toward answering the research goal is thought to be achieved when the survey datasets for the public and private sectors are collected during the same timeframe. It is hoped that a truer picture of an association or the lack there of, between the sectors will be obtained by doing so.

The following chapter provides the analysis and discusses the survey results between the datasets from senior IRM officials/professional within public and private sectors. Next, chapter five will discuss the results of the analysis along with the limitations, implications, and suggestions for future research.

## IV. Data Analysis

### Overview

The previous chapters outlined the problem statement, reviewed the literature pertaining to the overarching differences and similarities between public and private sectors, and aspects of their IRM perspectives that seem to be both converging and diverging depending on the circumstances being faced by each sector. As was stated previously, the goal of this research is to discover and/or validate, if public and private sector senior IRM managers are still being faced with the same challenges and view the same technologies as being critical to their organization's information resource management needs. This chapter examines the results of this updated analysis between the public and private sectors and provides a comparison between the earlier survey results (Mitchell, 2002) and the updated survey results. The first section restates information obtained in the Mitchell (2002) study concerning the survey response rate, and the demographic analysis of the survey respondents. Finally, analysis 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. Appendix 2 is the original survey that was sent to the private sector test population.

### Survey Response Rate

Mitchell determined that the total number of usable responses received from FORTUNE 1000 CIOs was 150. The survey participants had two options for completing the public sector survey, a web-based survey which was accessible to from August 30, 2002 through October 18, 2002, and a paper-based survey, in which the participants were

asked to have return 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. With 150 initial usable survey responses, an initial response rate of 15 percent was achieved. It was noted that 28 surveys were determined have never reached their intended recipient because of irresolvable addresses, and that 5 members reported that they could not respond due to their organization's policies against participating in surveys (Mitchell, 2002:63).

### Demographic Information

Respondent demographic information collected during the earlier public sector survey is presented in Table 9. The purpose for collecting this information was to aid in ensuring that the public sector sample was representative of the population as well as for providing demographic information for any future research.

**Table 9: Experience Serving as CIO/Senior IT Manager in Public Sector (Mitchell, 2002)**

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%

Insights provided by this demographic information reveal that 53 percent of the survey respondents have been the CIO/senior IT manager in their respective organization for between one and five years. Also gleaned from this demographic information is that 31

percent of the respondents have been in their current position for between six months and one year and that 37 percent have been in their current position for less than one year.

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 12.

The title of chief information officer was the most frequently claimed by survey respondents. Out of 150 respondents, 113 (75 percent) identified themselves with the words “Chief Information Officer” in their job title. Forty (27 percent) stated that the title of Chief Information Officer was their only role. The remaining 73 (49 percent) stated having additional titles, as is shown in Table 10.

The 2002 public sector test population represented businesses that averaged gross revenues of \$3.1 billion in 2001. Additionally, the results displayed in the demographic responses in Table 12 reveal that the survey respondent sample appears to be made up of executive level managers from some of the United States’ largest firms. It is therefore concluded that the public sector survey respondents appear to operate at the “same level” as those in the public sector. Thus, a comparison between public and private sector information resource management, at the executive level, can be accomplished.

**Table 10: Organizational Titles of Survey Participants (Mitchell, 2002:67)**

<b>Title</b>	<b>Quantity</b>	<b>% of Sample</b>
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
<b>sum</b>	<b>150</b>	<b>100</b>

## **Hypothesis 1 Analysis: CIO Challenges**

In part one of the survey, recipients were asked to select five items from a list of twenty-four challenges that they considered the most important to the public CIO in performing the CIO function, as outlined in the AFFIRM 2002 Federal Chief Information Officer Challenges and Critical Technologies Survey. The results of the original survey are displayed in Table 13 below. Each sector's rank for a particular challenge was determined by that sector's score, i.e., "using IT to improve service to customers/stakeholders" was ranked 1<sup>st</sup> in the public sector because it received 29 votes. Note that the Table 11 shows both sectors, and their related scoring and ranking of the challenges faced by sector CIO/senior information professionals.

The results of the updated analysis between the public and private sectors are presented in Table 14 below. As stated earlier, both survey responses were obtained in the same time period, i.e., the latter part of 2002. As was the case for the previous survey, each sector's rank for a particular challenge was determined by that sector's score.

**Table 11: Ranked Public (2001) and Private (2002) Sector Survey Results of the Challenges Faced by CIOs in Section One of Survey (Mitchell, 2002)**

<b>Challenges</b>	<b>2002 Private Sector Score (N=150)</b>	<b>2001 Public Sector Score (N=80)</b>	<b>2002 Private Sector Rank</b>	<b>2001 Public Sector Rank</b>
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)

**Table 12: Ranked Public (2002) and Private (2002) Sector Survey Results of the Challenges Faced by CIOs in Section One of Survey**

<b>Challenges</b>	<b>2002 Private Sector Score (N=150)</b>	<b>2002 Public Sector Score (N=101)</b>	<b>2002 Private Sector Rank</b>	<b>2002 Public Sector Rank</b>
Formulating/implementing organization IT architecture	40	44	7	1
Making the business/cultural changes for e-Business	31	43	10	2
Hiring and retaining skilled professionals	16	33	17	3.5
Aligning IT and organizational mission goals	55	33	4	3.5
Obtaining adequate funding for IT programs and projects	47	32	5	5.5
Implement IT capital planning/investment mgmt across org.	38	32	8	5.5
Unifying "islands of automation" w/in lines of business	30	30	12	7
Simplify business processes to maximize benefits of technology	73	29	1	8
Using IT to improve service to customers/stakeholders	71	24	2	9
Building effective relationships w/ senior executives	67	23	3	10
Capturing/organizing/accessibility org. knowledge	27	22	15	11.5
Developing organization-wide IT accountability	37	22	9	11.5
Assessing/developing org. IT competence (training/edu)	16	19	18	13
Managing or replacing legacy systems	31	17	11	14
Balancing public access to info vs. need for sys. security	8	16	22	15
Providing effective IT infrastructure and related services	30	15	13	16
Implementing e-business solutions	12	14	10	17.5
Measuring and reporting past performance	10	14	21	17.5
Preventing unauthorized system intrusions	40	12	6	19
Implementing COTS solutions (ERP, CRM, etc.)	29	10	14	20
Controlling IT expenditures	23	7	16	21
Responding to outsourcing requirements	3	4	23	22
Planning/implementing IT disability access solutions	0	3	24	23

(Public Sector Score and Rank data from Association for Federal Information Resource Management, 2002)

The data presented in Table 12 is used in this research to compare the private sector 2002 responses from the original Mitchell (2002) study, with the public sector 2002 responses from AFFIRM's (2002) study in order to validate, if public and private sector senior IRM managers are still being faced with the same challenges relating to organizational information resource management requirements. The following 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:

**H<sub>1o</sub>**: There is no relationship between the challenges that public sector and private sector CIOs perceive to face.

**H<sub>1a</sub>**: There is a relationship between the challenges that public sector and private sector CIOs perceive to face.

***Spearman Coefficient of Rank Correlation***

The Spearman coefficient of rank correlation (R) was calculated using the public and private sector ranks of the CIO challenges obtained in part one of the 2002 public/private survey dataset. As identified in chapter three, the Spearman coefficient is a measure of how closely the ranks of the public sector and private sector responses agree. The ranks of the results of part one of the updated public survey dataset from AFFIRM’s 2002 CIO challenges section were loaded in to the statistical software package JMP IN<sup>®</sup> version 5.0 to determine the value of the Spearman coefficient of rank correlation. A description of how this test statistic is derived was presented in chapter three. The results of this test, followed by an explanation of the coefficient’s meaning, are displayed below in Tables 13 and 14 respectively.

**Table 13: Spearman Rho Results for Public (2002) and Private (2002) Sector CIO Challenges**

<b>Variable</b>	<b>by Variable</b>	<b>Spearman Rho</b>	<b>p-value</b>
Public Sector CIO Challenges Ranks	Private Sector CIO Challenges Ranks	0.6058	0.0022

**Table 14: Spearman's Rho Coefficient Meanings for CIO Challenges (Mitchell, 2002)**

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

With a level of statistical significance ( $\alpha$ ) of 0.05, the Spearman Rho value of 0.6058 and p-value of .0022 indicate a relationship between the public and private sector rankings. (As was noted and identified in chapter three, modifications were made to both datasets so that a more accurate one-to-one comparison could be achieved when analyzing the results from the Mitchell (2002) study, and this research. Mitchell's non-adjusted Rho for this test was 0.6319. Running this test with the modified dataset resulted in a Rho of 0.5988.) Due to the positive difference (increase) between this study's Rho of 0.6058 and the earlier study's adjusted Rho of 0.5988 indicates there is a relationship in the rankings. On this basis, the null hypothesis is rejected. This test statistic has provided sufficient evidence to conclude a relationship exists in the perceived challenges faced by public and private sector CIOs. The p-value is the probability of incorrectly rejecting the null hypothesis, or committing Type I error. The statistically significant p-value indicates there is a low probability of incorrectly rejecting the null hypothesis: that no relationship exists.

#### ***Kendall Tau Coefficient***

The Kendall Tau coefficient was also used in the Mitchell study to provide an additional statistical measure of the relationship between two measured variables. While

it is calculated differently, the Kendall Tau statistic can be derived using the paired ranking in the same manner as the Spearman Rho statistic. Instead of measuring the actual discrepancy between the ranks of two variables, the Kendall Tau coefficient measures the discrepancy between the actual observed rank and the rank that the two orders would produce in a perfect relationship between the ranks of the two variables (Gibbons, 1976). A Kendall Tau correlation coefficient was calculated using the 2002 public and private sector ranks of the CIO challenges obtained in part one of the survey dataset with the goal of providing additional evidence to support the results of the Spearman Rho statistics. The rank of the results of part one of the 2002 public sector survey and the results from the CIO challenges section of AFFIRM's (2002) survey were imported into JMP IN<sup>®</sup> version 5.0 to calculate 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 in tables 15 and 16 respectively.

**Table 15: Kendall Tau Results of Ranked Public (2002) and Private (2002) Sector CIO Challenges**

Variable	by Variable	Kendall Tau	p-value
Public Sector CIO Challenges Ranks	Private Sector CIO Challenges Ranks	0.4582	0.0024

**Table 16: Kendall's Tau Coefficient Meanings for CIO Challenges (Mitchell, 2002)**

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

With a 0.05 level of significance, the Kendall Tau value of 0.4582 and p-value of 0.0024 indicate a relationship between public and private sector rankings. (As was noted and identified in chapter three, modifications were made to both datasets so that a more appropriate one-to-one comparison could be achieved when analyzing the results from the Mitchell (2002) study to this research. Mitchell's non-adjusted Tau for this test was 0.64678. Running this test with the modified dataset resulted in a Rho of 0.4308.) The positive difference (increase) between this study's Tau of 0.4582 and the earlier study's adjusted Tau of 0.4308 indicates there is a relationship in the rankings. On this basis, the null hypothesis is rejected. This test statistic has provided sufficient evidence to conclude a relationship exists in the perceived challenges faced by public and private sector CIOs. The p-value is the probability of incorrectly rejecting the null hypothesis, or committing Type I error. The statistically significant p-value indicates there is a low probability of incorrectly rejecting the null hypothesis: that no relationship exists. Hence, when all of the CIO challenges rankings are considered simultaneously, the 2002 public and private sector CIOs survey responses can be considered statistically consistent in their rankings.

### **Hypothesis 2 Analysis: CIO Critical Technologies**

In part two of the survey, recipients were asked to select five items from a list of thirty technologies and solutions that they viewed as being most important to a public CIO in performing the CIO function, as determined by the AFFIRM organization's 2002 Federal Chief Information Officer Challenges and Critical Technologies Survey. The results of the original survey are displayed in Table 17. Each sector's rank for a particular technology was determined by that sector's score, i.e., "Security Infrastructure"

was ranked 1<sup>st</sup> in the public sector because it received 55 votes. Note that the Table 19 shows both sectors, and their related scoring and ranking of the challenges faced by sector CIO/senior information professionals.

For comparison's sake, the results of the updated analysis between the public and private sectors are presented in Table 18. As was the case for part one of the survey, the public and private sector survey responses were obtained in the same time period, i.e., the latter part of 2002. Furthermore, each sector's rank for a particular challenge was determined by that sector's score.

**Table 17: Ranked Public (2002) and Private (2001) Sector Survey Results of Perceived Critical Technologies (Mitchell, 2002)**

Technologies	2002 Private Sector Score (N=150)	2001 Public Sector Score (N=80)	2002 Private Sector Rank	2001 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)

**Table 18: Ranked Public (2002) and Private (2002) Sector Survey Results of Perceived Critical Technologies**

Technologies	2002 Private Sector Score (N=150)	2002 Public Sector Score (N=101)	2002 Private Sector Rank	2002 Public Sector Rank
Security Infrastructure	98	50	1	1
Internet / Intranet / Web applications	62	43	3	2
Knowledge management	17	30	16	3
Data warehousing/data mining	82	29	2	4
Internet/ Intranet/ Web infrastructure	53	25	4	5.5
Wireless technology	31	25	9	5.5
Records management	11	25	20	5.5
Executive information and DSS	49	25	5	5.5
Portal technologies	32	22	8	9
Workflow	20	17	14	10
E-Mail	24	16	12	11.5
Security Applications	13	16	17	11.5
Data, voice and video convergence	19	16	15	11.5
Storage and storage networks	33	16	7	11.5
Remote and mobile computing incl. PDAs	22	15	13	15
Virtual Private Networks	11	14	19	16.5
Electronic Commerce/EDI	29	14	11	16.5
Training technology and applications	4	12	24	18
COTS applications including ERP/CRM/SCM	49	11	6	19
IT accommodation–disability access solutions	0	10	28	20
Next generation Internet	3	7	26	21
Video solutions (distance learning, virtual office, desktop)	2	6	27	22.5
Online analytical processing (OLAP)	10	6	21	22.5
Middleware	31	5	10	24
Groupware	4	3	25	25.5
Imaging	8	3	22	25.5
Relational databases	12	2	18	27
LINUX	7	0	23	28

(Public Sector Score/Rank data from Association for Federal Information Resource Management, 2002)

The data in Table 18 is used in this research to compare the private sector 2002 responses from the original Mitchell (2002) study, with the public sector 2002 responses from AFFIRM's (2002) study in order to discover and/or validate, if public and private sector senior IRM managers still view the same technologies as being critical to their organization's information resource management needs. The following 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:

**H<sub>2o</sub>**: There is no relationship between the technologies that public sector and private sector CIOs perceive as critical to their organization's operations.

**H<sub>2a</sub>**: There is a relationship between the technologies that public sector and private sector CIOs perceive as critical to their organization's operations.

#### ***Spearman Coefficient of Rank Correlation***

As was the case in the earlier study, the Spearman coefficient of rank correlation (R) was calculated using the public and private sector ranks of the CIO critical technologies obtained in part one of the 2002 public/private survey dataset. The ranks of the results of part one of the updated public survey dataset from AFFIRM's 2002 CIO critical technologies section were loaded in to the statistical software package JMP IN<sup>®</sup> version 5.0 to determine the value of the Spearman coefficient of rank correlation. The results of this test are displayed in Table 19.



**Table 19: Spearman Rho Results for how Public (2002) and Private (2002) Sector Chief Information Officers Ranked the Technologies Perceive Critical to their Organization's Operations**

Variable	by Variable	Spearman Rho	p-value
Public Sector Critical Technologies Ranks	Private Sector Critical Technologies Ranks	.6878	< 0.0001

With a 0.05 level of significance, the Spearman Rho value of 0.6878 and p-value of < 0.0001 indicate a positive correlation between the public and private sector rankings. Prior to modification of the original Mitchell dataset, as described earlier in the Rho challenge tests, there existed a Rho of 0.6595. After modifying that dataset to reflect a more accurate one-to-one comparison, a Rho of 0.6037 was calculated. Due the positive difference (increase) between this study's Rho of 0.6878 and the earlier study's adjusted Rho of 0.6037, indicates there is a relationship in the rankings. On this basis, the null hypothesis is rejected. This test statistic has provided sufficient evidence to conclude a relationship exists in the perceived critical technologies faced by public and private sector CIOs. The p-value is the probability of incorrectly rejecting the null hypothesis, or committing Type I error. The statistically significant p-value indicates there is a low probability of incorrectly rejecting the null hypothesis: that no relationship exists.

#### ***Kendall Tau Coefficient***

A Kendall Tau correlation coefficient was calculated using the 2002 public and private sector ranks of the technologies perceived as critical to each respondent's organization as obtained in part two 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 two of the survey and the results from the critical technologies section of AFFIRM's (2002) survey were loaded in

to JMP IN<sup>®</sup> version 5.0 to derive the value of the Kendall Tau coefficient. The results of the Kendall Tau calculations are displayed below in Table 20.

**Table 20: Kendall Tau Results for how Public (2002) and Private (2002) Sector Chief Information Officers Ranked Technologies Perceived Critical to their Organization's Operations**

Variable	by Variable	Kendall Tau	p-value
Public Sector Critical Technologies Ranks	Private Sector Critical Technologies Ranks	0.5028	0.0002

With a 0.05 level of significance, the Kendall Tau value of 0.5028 and p-value of 0.0002 indicate a positive correlation between public and private sector rankings. (As was noted and identified in chapter three, modifications were made to both datasets so that a more appropriate one-to-one comparison could be achieved when analyzing the results from the Mitchell (2002) study to this research. Mitchell's non-adjusted Tau for this test was 0.4642. Running this test with the modified dataset resulted in a Tau of 0.4286.) The positive difference (increase) between this study's Tau of 0.5028 and the earlier study's adjusted Tau of 0.4286 indicates there is a relationship in the rankings. On this basis, the null hypothesis is rejected. This test statistic has provided sufficient evidence to conclude a relationship exists in the perceived critical technologies faced by public and private sector CIOs. The p-value is the probability of incorrectly rejecting the null hypothesis, or committing Type I error. The statistically significant p-value indicates there is a low probability of incorrectly rejecting the null hypothesis: that no relationship exists. Hence, when all of the CIO challenges rankings are considered simultaneously, the 2002 public and private sector CIOs survey responses can be considered statistically consistent in their rankings.

## Summary

Table 21 below summarizes the outcomes of the earlier Mitchell (2002) study and this study after analysis of the research datasets. A comparison between the adjusted Mitchell test statistics (Rho and Tau) and this study's test statistics indicates that there was a positive difference reflected in the survey responses when the datasets were analyzed from the same timeframes. Therefore, both  $H1_0$  and  $H2_0$  were rejected indicating an increased level of agreement between the public and private sector responses to both parts of the survey instrument. As such, this study's results show that these agreements are even stronger than those shown in the earlier study. The next chapter provides a discussion of these results, the limitations of this study, and areas of future research.

**Table 21: Study Comparisons**

<b>IRM Views</b>	<b>Test Statistic (TS)</b>	<b>Non Adjusted Mitchell</b>	<b>Adjusted Mitchell</b>	<b>Difference</b>	<b>This Study (TS/p-value)</b>	<b>Difference</b>
<i>Challenges</i>	Rho	0.6318	0.5988	-	0.6058/0.0022	+
	Tau	0.4687	0.4308	-	0.4582/0.0024	+
<i>Critical Technologies</i>	Rho	0.6595	0.6037	-	0.6878/<0.0001	+
	Tau	0.4642	0.4286	-	0.5028/0.0002	+

## V. Discussion, Limitations, and Recommendations

### Discussion

Chapter four presented the findings of this research effort. This chapter presents a discussion of the results achieved in chapter four along with the limitations of this research and some recommendations for future research. The goal of this research effort was to discover and/or validate if public and private sector senior IRM managers are still being faced with the same challenges and view the same technologies as being critical to their organization's information resource management needs. It is believed that the major limitation identified in the earlier study concerning that of not being able to collect the public and private sector data simultaneously has been overcome through this research. This research was able to analyze the datasets from both sectors collected during the latter part of 2002. As was described in chapter three, the public sector CIO/senior information professional datasets were obtained from the 2002 by the Association for Federal Resources Information Management using their annual *Top Ten Challenges Survey*. That survey instrument contained 101 responses. The private sector CIO/senior information professional datasets were collected in the earlier study from the FORTUNE 1000. That study utilized the same survey instrument, with minor modifications, in its collection of the private sector datasets. It achieved 150 usable responses from the private sector sample. The earlier study concluded that there was an association between the challenges and technologies view as being critical by public and private sectors CIOs. Therefore, this study analyzed the following hypotheses

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

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

### ***CIO Challenges***

As was supported by the results of the statistical analysis presented in chapter four, the private and public sectors views of CIO challenges have converged even closer than was the case in the Mitchell study. It was interesting to note that when comparing Mitchell's results with this research, the 2001 public sector number 1 ranked challenge of the public CIO/senior information professional community was "Using IT to improve service to customers/stakeholders," and barely made it into the "top 10" ranking at number 9. Conversely, the private sector ranked the same challenge at number 2. This disparity between the sectors may be due to the public sector respondents who selected "Making the business/cultural changes for E-Business" transformation considered it to encompass "Using IT to improve service to customers/stakeholders."

As would be expected, "Formulating/implementing an organizational enterprise architecture" was selected as the number one challenge in the public sector as compared to the seventh ranking in the private sector. As a result of the enormous challenge of global terrorism as well as a seemingly struggling economy, it is no surprise that the public sector's emphasis appears to be placed on the federal/public enterprise architecture. This seems to also be the case for the private sector, since this challenge was in its "top 10" ranking. Additionally, the development of an enterprise architecture would permit cross-agency functional interoperability, aid in the implementation of E-

Business initiatives, and provide the right security infrastructure. This is agreed to be of the utmost importance currently. It is believed that they will continue to be so for a while.

“Hiring and retaining skilled professionals” was ranked number 3 in the public sector and number 17 in the private sector. This ranking did not change when a comparison between the Mitchell study’s dataset was made with this study’s dataset. It is the researcher’s perception that, as was evidenced by the public sectors number one 2002 ranking emphasizing the need for an enterprise architecture, and the related cross-agency business functions and initiatives which will require interoperability, this would be a prime area of concern for a skills/knowledge gap to exist within. CIO/senior information professionals are being asked to do more in this area with dwindling human capital resources.

Also of interest was the challenge of “Preventing unauthorized system intrusions,” e.g., hackers, terrorists, etc., was ranked at number 19 in the public sector and number 6 in the private sector. Although IT security is still of utmost importance, it is apparent that other aspects of security in the public sector are more important at this point in time. Additionally, from the public sector respondent’s ranking of this challenge, it appears that a good portion of the public IT infrastructure has become more secure in the years following the events of September 11<sup>th</sup>; at least it is hoped that it would be.

Lastly, it was interesting to note that the 2002 challenge of “Responding to outsourcing requirements” was not a challenge that was a concern to either sector, as is evidenced by its ranking of 22 and 23 in the public and private sectors respectively. It would be interesting to see how this challenge would be ranked in a more current study;

given that fact that many companies and government agencies have already outsourced many of these services “offshore.”

### ***Critical Technologies***

As was also substantiated by the statistical analyses in chapter four, the private and public sectors have converged closer in their views of CIO critical technologies perceived to be important to their organization’s success. It was interesting to note that both sectors number one ranked top technology was “Security Infrastructure.” This was also the case in the earlier study. It appears that security related technologies remain prevalent to both sectors. Interestingly, the apparently related “Security Applications” technology ranked 17<sup>th</sup> in the private sector and fell from its 8<sup>th</sup> ranking in the earlier study (2001) to a ranking on 12<sup>th</sup> in this study. This divergence between related technologies may indicate an understanding that the protection of information resources requires a comprehensive approach to security and a strong security infrastructure, and that security cannot be assured solely by paying attention to security at the level of applications.

Also noted, “Internet/Intranet/Web infrastructure and Web applications” and “Knowledge management” have both been in the “top 5” rankings in both the earlier study and this study. “Data warehousing/data mining” placed in the “top 5” in both sectors. This likely reflects an increased awareness of the need to extract information from disparate databases to enable the effective and timely analysis of intelligence data, the development of performance measurement systems, and the consolidation of duplicate citizen data in both sectors.

“Wireless technology” placed in the “top 10” for both sectors possibly as a reflection of the CIO’s/senior information professional’s increased appreciation of the benefits of these applications to the organization’s mission/success. The need to improve the ability to analyze and present information in support of decision making is reflected in both sectors ranking “Executive information and DSS” in the “top 10” critical technologies.

Lastly, “Remote and mobile computing including PDAs” dropped from its 6<sup>th</sup> ranking in the 2001 study to a ranking of 15<sup>th</sup> in this 2002 study for the public sector. It also appears that the private sector is in close agreement as reflected by their ranking of 13<sup>th</sup>. This is somewhat surprising from the perspective of the public sector (and its DoD/Intel agencies) in light of its importance to the warfighter. A possible cause for this perceived low ranking may be due to both sector’s responders either do not work in an area of IT and IRM related to providing this capability, or they both considered this critical technology to be within their “Wireless technology” response.

### **Limitations**

One limitation of correlation research is that it cannot imply or prove causation. In the case of this research, there appears to be a positive correlation between public and private sector CIOs/senior information professionals, as to their views on the challenges and technologies viewed as being critical to their organization’s success. One can only guess as to why this agreement exists.

Another limitation to the research performed stemmed from the fact that an accurate one-for-one matching of survey items between the public and private sectors



was not achieved. When comparing the datasets and survey category items between the earlier study's 2002 private sector datasets and the datasets obtained from the 2002 AFFIRM survey instrument, it was realized that some items on one survey instrument were not included on the other, and visa versa. Therefore, modifications were required in order to make a more appropriate comparison and analysis between the datasets.

Finally, a limitation to the research performed revolves around the data used in this study. The researcher's only perceptions of truth are various layers of truth-revealing fact. Thus, the layer of fact closest to the truth is the layer where primary data exist. The best data which may provide the most validity and aid in illuminating truth is generated from primary data. The conclusions reached in this research effort stemmed from both secondary and third-party data. The secondary dataset was obtained through the analysis of the 2002 public sector survey responses. Third-party dataset was derived from utilizing the existing datasets obtained during the course of the earlier Mitchell (2002) study. That being the case, the datasets used in this research were at a layer that was once removed from the realm of absolute truth.

### **Recommendations for Future Research**

The goal of this research effort was to discover and/or validate if public and private sector senior IRM managers still being perceive if the same challenges and the same technologies as being critical to their organization's information resource management requirements after minimizing the temporal disparity. Results from this study provide sufficient evidence that both sectors have developed a closer correlation than was previously concluded in the Mitchell study. The test statistics in this study have

supported that conclusion. This research can therefore provide a baseline from which future public and private sector information resource management research can expand from.

As noted in the limitations section, modifications were made to the 2002 public and private sector datasets in order to compare “apples to apples” and “oranges to oranges.” It is therefore recommended that future research between the public and private sectors deploy the same survey instrument so that no data is removed from either sector’s datasets. By doing so, it is believed that a more valid and appropriate analysis can be achieved. Additionally, it is further recommended that research in this area be continued every two to three years so that a clearer picture can be obtained which could provide further evidence for the existence or absence of a correlation of the challenges faced by, and the technologies perceived as critical, by Chief Information Officers in each organizational sector.

## **Conclusions**

This research indicates and confirms the earlier study, in that, public and private sector CIOs/senior information managers perceive similar challenges in their role as the senior information resource manager in the organization. This correlation makes sense, since the U.S. has experienced the shift from an industrial-based economy to a knowledge-based economy in which knowledge has become the main driver of value and creation of wealth. Additionally, this new knowledge-based economy presents complex IRM issues that require input from multiple institutions at different levels of the public as well as from with private sectors.

It is hoped that this research will prove useful to individual CIOs/senior information managers in understanding the key challenges and technologies to be faced with at this time. It is hoped that future similar follow-on studies will be forthcoming so as to advance the state of knowledge and practice in managing both private and public information resources. Based on new findings in that research stream, new IRM policies may be gleaned with a view to the strategic integration of information resources and development goals. As such, a proper understanding of information resource management and its evolution increases, as does the opportunities for future growth.

## Appendix 1

### Original AFFIRM 1996 Survey Responses

#### CIO Challenges:

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

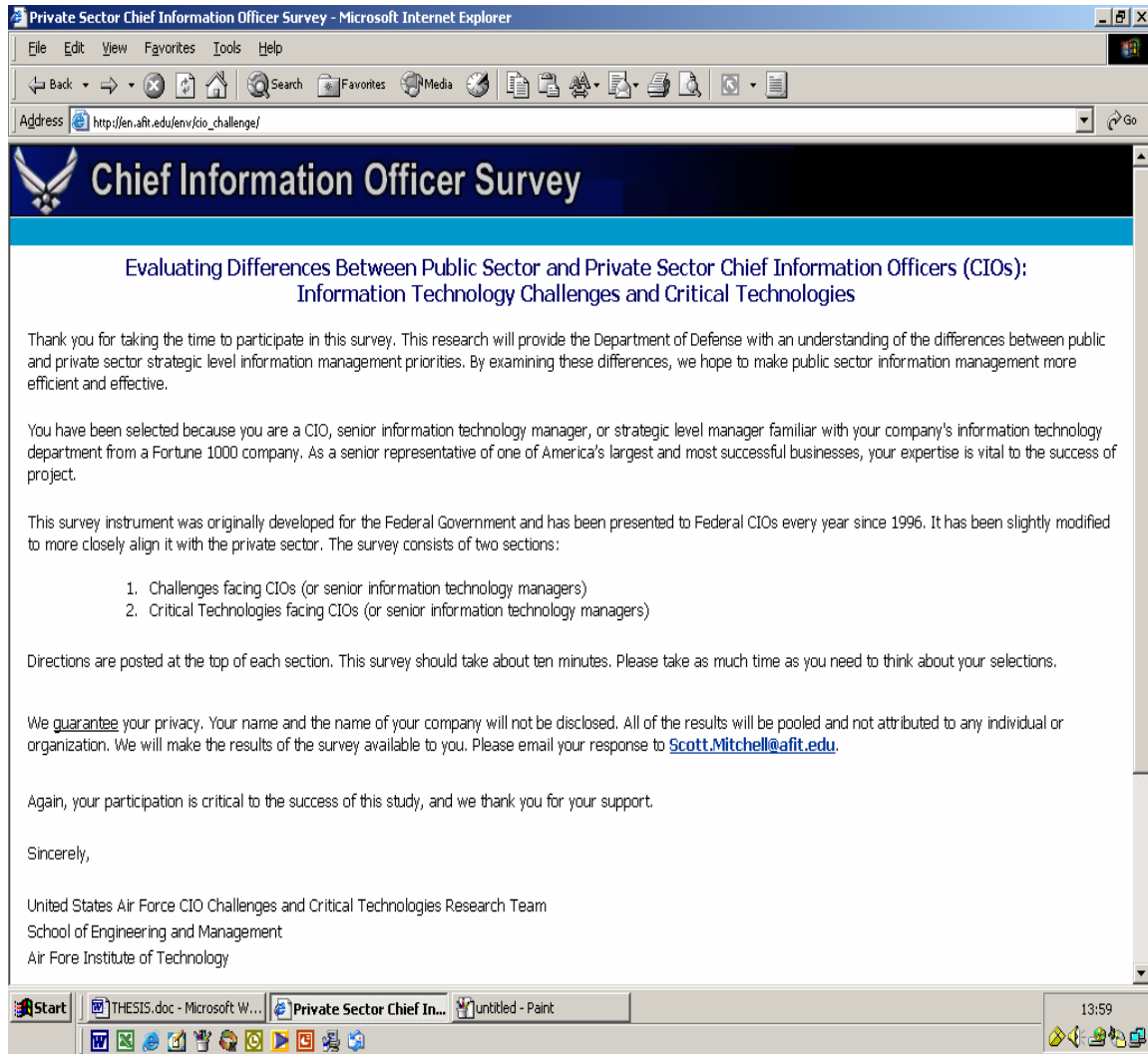
#### CIO Technologies:

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

## Appendix 2 (Mitchell, 2002)

### Screenshots of the Survey Instrument

#### Cover Page





## Chief Information Officer Survey

### **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

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# 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 3 (Mitchell, 2002)

#### 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	SOLETRON CORPORATION	610	ERIE INSURANCE GROUP
111	JOHNSON CONTROLS INC	611	WENDY S INTERNATIONAL INC OLD REPUBLIC INTERNATIONAL CORPORATION
112	SUN MICROSYSTEMS INC	612	MCCORMICK & COMPANY INCORPORATED
113	HCA INC	613	OM GROUP INC
114	VISTEON CORPORATION	614	MOLEX INCORPORATED
115	SARA LEE CORPORATION	615	LOUISIANA PACIFIC CORPORATION
116	WASHINGTON MUTUAL INC	616	FRANKLIN RESOURCES
117	TECH DATA CORPORATION	617	ECOLAB INC
118	FEDERATED DEPARTMENT STORES INC	618	PNM RESOURCES INC
119	RAYTHEON	619	BORGWARNER INC
120	XEROX CORPORATION	620	ADELPHIA COMMUNICATIONS CORPORATION
121	U S BANCORP	621	L 3 COMMUNICATIONS HOLDINGS INC
122	TRW INC	622	WEATHERFORD INTERNATIONAL INC
123	ABBOTT LABORATORIES	623	PRECISION CASTPARTS
124	NORTHWESTERN MUTUAL	624	CONVERGYS CORPORATION
125	UAL CORPORATION	625	URS CORPORATION
126	3M: MINNESOTA MINING & MANUFACTURING	626	PENNZOIL QUAKER STATE
127	AMERISOURCEBERGEN CORPORATION	627	VALUE CITY
128	COCA COLA ENTERPRISES INC	628	BEMIS COMPANY INC
129	FLEMING COMPANIES INC	629	KELLWOOD COMPANY
130	EMERSON ELECTRIC CO	630	BELK INC
131	BEST BUY CO INC	631	ANALOG DEVICES INC
132	RITE AID CORPORATION	632	

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	PEOPLESFT
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 PUBLIC SERVICE ENTERPRISE GROUP INCORPORATED	694	RPM INC
195		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	GILLETTE	740	CARLISLE COMPANIES INCORPORATED
241	SEMPRA ENERGY	741	LUBRIZOL
242	FIRSTENERGY CORP	742	INTL FLAVORS & FRAGRANCES
243	CLEAR CHANNEL COMMUNICATIONS INC	743	FREEMONT 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	PREMCO 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 STARWOOD HOTELS & RESORTS WORLDWIDE INC	912	KNIGHTS OF COLUMBUS
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## Vita

Master Sergeant James R. Orlovsky enlisted in the United States Marine Corps and attended recruit training at Marine Corps Recruit Depot, San Diego, California in August 1979. He entered undergraduate studies at Saint Leo University's satellite school in Little Creek, Virginia where he graduated with a Bachelor of Arts degree specializing in Accounting in September 1995. He passed the CPA examination in November 1999.

His primary military occupational specialty has focused on communications, ranging from tactical to garrison communications support architectures. He has served with all aspects of the Fleet Marine Force to include the Marine Division, Marine Aircraft Wing, and Force Service Support Group. He has also served in numerous instructor billets at the Marine Corps Communications and Electronic School, Twentynine Palms, California; the Naval Gunfire School, Little Creek, Virginia; and with the Expeditionary Warfare Training Group, Little Creek, Virginia. Additionally, he has served tours of duty as a Drill Instructor and internal auditor.

In August 2002, Master Sergeant Orlovsky entered the Graduate School of Engineering and Management at the Air Force Institute of Technology. He was one of the initial enlisted Marine pioneers to attend post-graduate education there. Upon graduation, he will be assigned as an Information Assurance Manager for Headquarters, I Marine Expeditionary Force, Camp Pendleton, California. He is married and they have one son who is currently a junior at the United State Air Force Academy.

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<b>14. ABSTRACT</b> Change is a constant within our contemporary IRM environment. The rapid development of information and communication technologies has been the most predominant among the many agents of change that are forcing a reevaluation of the role of the IRM professional. Few studies to date have compared public and private sector CIO perceptions concerning the IRM challenges and critical technologies faced by their organization. An earlier study concluded that the sector's CIOs do perceive to be faced with many of the same challenges and also view many of the same technologies as critical to the organization's operations. A limiting factor identified in that study was the temporal separation of sector sampling. Any conclusions comparing the public and private sectors were based on survey responses separated by almost one year. The goal of this research is to validate if public and private sector senior IRM managers perceive they are still being faced with the same challenges and view the same technologies as being critical to an organization's information resource management needs. Performing an analysis on datasets obtained from both sectors during the same time period provided a more accurate comparison between those sectors. The results of a 2002 annual survey of public sector CIOs and senior IRM managers are compared with data collected from 2002 private sector CIOs. Findings from this study provide sufficient evidence that both sectors have developed a closer correlation than was previously concluded.					
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