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# An Update on Analyzing Differences Between Public and Private Sector Information Resource Management: Strategic Information Challenges and Critical Technologies

James R. Orlovsky


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

THESIS

James R. Orlovsky, Master Sergeant, USMC

AFIT/GIR/ENV/04M-17

**DEPARTMENT OF THE AIR FORCE**
**AIR UNIVERSITY**

***AIR FORCE INSTITUTE OF TECHNOLOGY***

**Wright-Patterson Air Force Base, Ohio**

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James R. Orlovsky, BA
Master Sergeant, USMC

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James R. Orlovsky, BA
Master Sergeant, USMC

Approved:

| | |
|---|---|
| Alan R. Heminger, PhD (Chairman) | date |
| Kevin L. Elder, PhD (Member) | date |
| Capt David D. Bouvin, PhD (Member) | date |

## 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 (Hernon, 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 if 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 if 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 privates 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 marker 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).

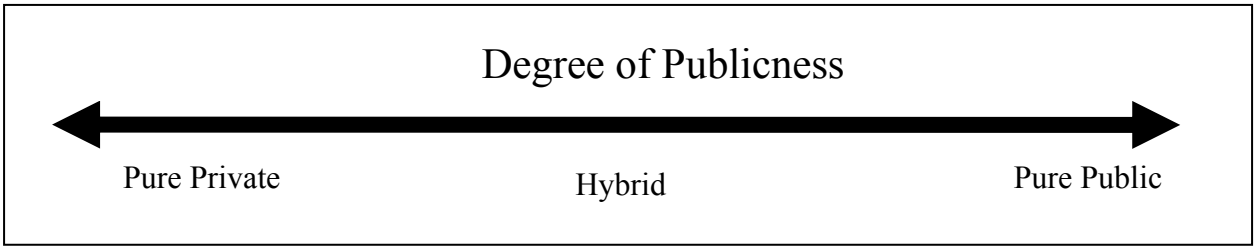



**Figure 1. Scale of the Range of Publicness Level for an Organization (Mitchell, 2002:15)**

Few empirical studies exits 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 lead 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 mangers 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 is 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$^{th}$ 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 there 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 if IT as a competitive asset varies by industry, in many cases, it has become a central element, as a resent 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.

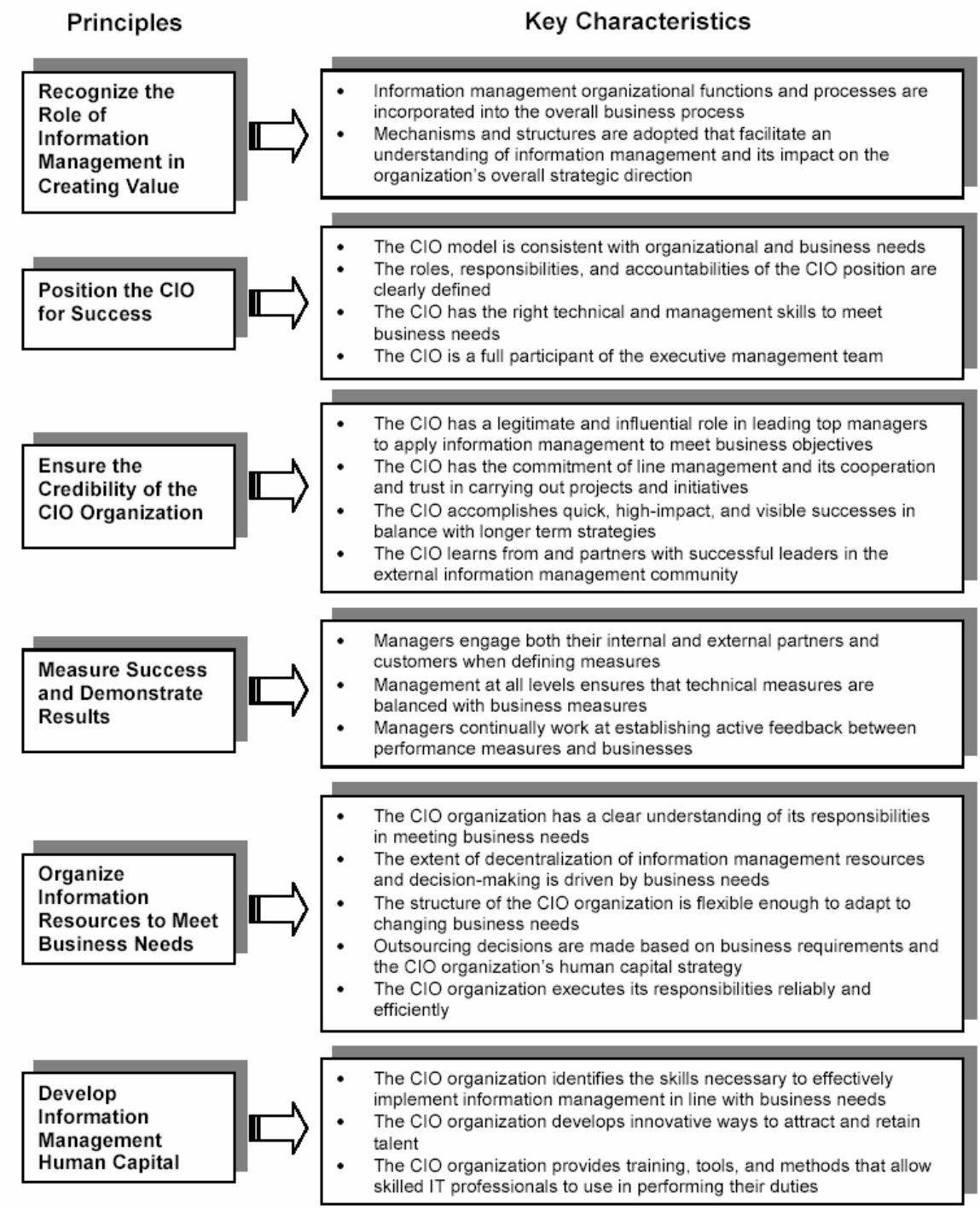



**Figure 2. Six Principles and Key Charateristics of CIO Managment in Leading Organizations (GAO-01-376G)**

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 public 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 exits differences between the sectors' MIS systems. However, there has been a convergence is 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 in 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 exits 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 in 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)**

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

| Description | Modification |
|---|---|
| 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**

| Description | Modification |
|---|---|
| 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 of 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:

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

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 mangers 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)**

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

**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 1st 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 where 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)**

| Challenges | 2002 Private Sector Score (N=150) | 2001 Public Sector Score (N=80) | 2002 Private Sector Rank | 2001 Public Sector Rank |
|---|---|---|---|---|
| Using IT to improve service to customers/stakeholders | 71 | 29 | 2 | 1 |
| Making the business/cultural changes for e-Business | 31 | 28 | 10 | 2 |
| Hiring and retaining skilled professionals | 16 | 27 | 17 | 3 |
| Obtaining adequate funding for IT programs and projects | 47 | 26 | 5 | 4 |
| Preventing unauthorized system intrusions | 40 | 25 | 6 | 5 |
| Formulating/implementing organization IT architecture | 40 | 24 | 7 | 6 |
| Building effective relationships w/ senior executives | 67 | 23 | 3 | 7 |
| Capturing/organizing/accessibility org. knowledge | 27 | 19 | 15 | 8 |
| Simplify business processes to maximize benefits of technology | 73 | 18 | 1 | 9 |
| Unifying "islands of automation" w/in lines of business | 30 | 17 | 12 | 10 |
| Aligning IT and organizational mission goals | 55 | 16 | 4 | 11 |
| Implementing e-business solutions | 12 | 15 | 19 | 12.5 |
| Providing effective IT infrastructure and related services | 30 | 15 | 13 | 12.5 |
| Implement IT capital planning/investment mgmt across org. | 38 | 14 | 8 | 14 |
| Assessing/developing org. IT competence (training/edu) | 16 | 12 | 18 | 15 |
| Measuring and reporting past performance | 10 | 10 | 21 | 16 |
| Ensuring public access to info vs. need for sys. security | 8 | 9 | 22 | 17.5 |
| Controlling IT budgets | 23 | 9 | 16 | 17.5 |
| Managing or replacing legacy systems | 31 | 8 | 11 | 19.5 |
| Developing organization-wide IT accountability | 37 | 8 | 9 | 19.5 |
| Identifying/reporting CIO/IRM measures/outcomes. | 11 | 3 | 20 | 22 |
| Implementing COTS solutions (ERP, CRM, etc.) | 29 | 3 | 14 | 22 |
| Planning/implementing IT disability access solutions | 0 | 3 | 24 | 22 |
| Responding to outsourcing requirements | 3 | 3 | 23 | 22 |

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

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

| Challenges | 2002 Private Sector Score (N=150) | 2002 Public Sector Score (N=101) | 2002 Private Sector Rank | 2002 Public Sector Rank |
|---|---|---|---|---|
| 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:

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

**$H1_a$**: 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® 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**

| Variable | by Variable | Spearman Rho | p-value |
|---|---|---|---|
| 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)**

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

With a level of statistical significance (α) 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 where 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 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® 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 where 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 1st 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 where 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 mangers 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:

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

**$H2_a$**: 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® 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® 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 where 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 where analyzed from the same timeframes. Therefore, both $H1_o$ and $H2_o$ 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 that 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**

| IRM Views | Test Statistic (TS) | Non Adjusted Mitchell | Adjusted Mitchell | Difference | This Study (TS/p-value) | Difference |
|---|---|---|---|---|---|---|
| ***Challenges*** | Rho | 0.6318 | 0.5988 | - | 0.6058/0.0022 | + |
| | Tau | 0.4687 | 0.4308 | - | 0.4582/0.0024 | + |
| | | | | | | |
| ***Critical*** | Rho | 0.6595 | 0.6037 | - | 0.6878/<0.0001 | + |
| ***Technologies*** | 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 mangers 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 where 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$^{th}$; 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 there 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$^{th}$ in the private sector and fell from its 8$^{th}$ ranking in the earlier study (2001) to a ranking on 12$^{th}$ 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 6th ranking in the 2001 study to a ranking of 15th 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 13th. 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 where 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 |

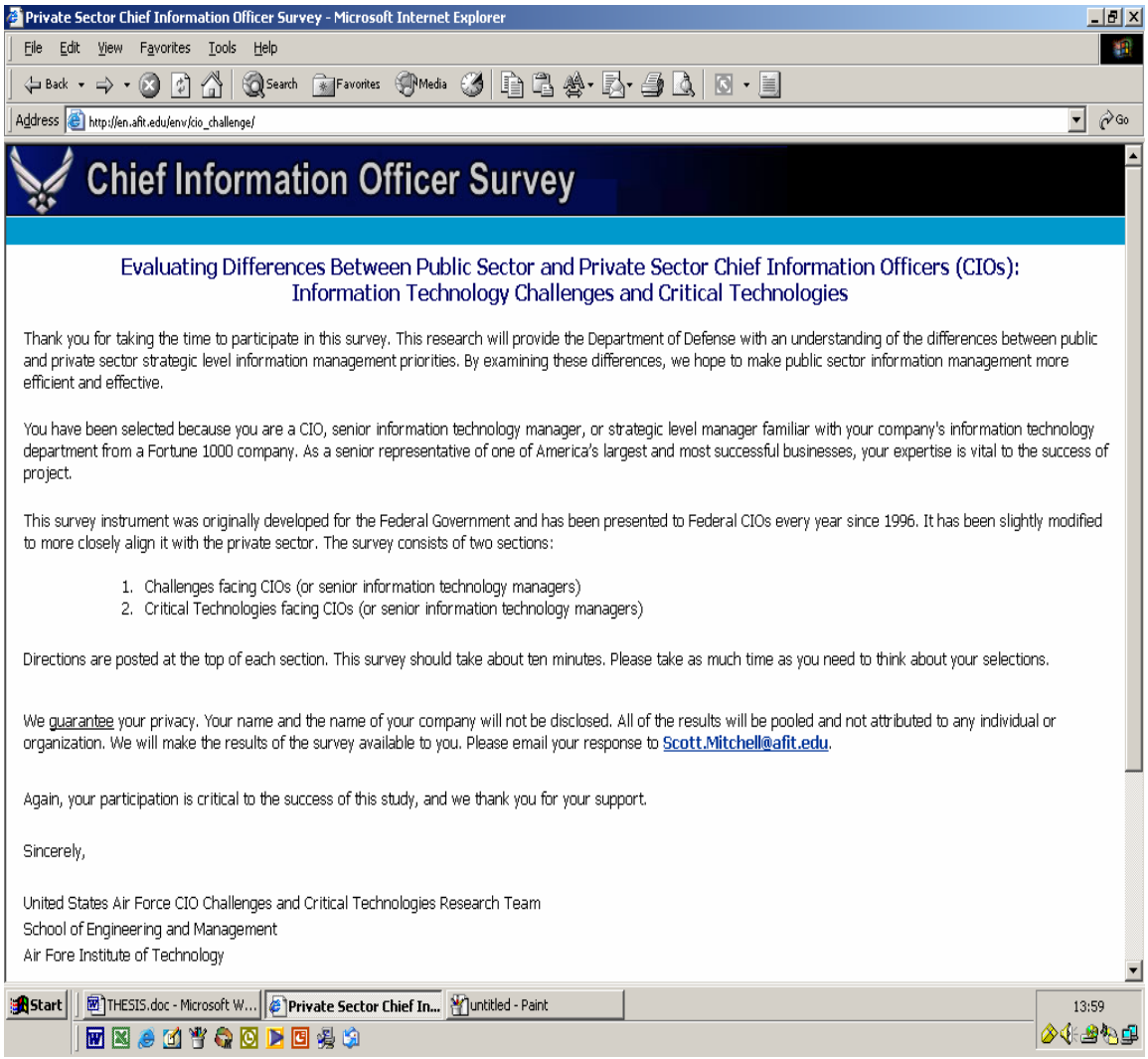
CIO Technologies:

| | |
|---|---|
| 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




## ***Background Information***

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

Company Name:

Position/Title in Company:

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

# Chief Information Officer Survey (Part 1)

## *CIO Challenges*

**Directions:**

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

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

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

- [ ] Capturing, organizing and making accessible organizational knowledge and expertise (knowledge management)

- [ ] Simplifying business processes to maximize the benefits of technology

- [ ] Unifying “islands of automation” within lines of business

- [ ] Aligning IT and organizational mission goals

- [ ] Implementing e-business solutions

- [ ] Providing effective IT infrastructure and related services (not including the desktop)

- [ ] Implementing IT capital planning and investment management across the organization

- [ ] Assessing and developing organization IT competence (training and education)

- [ ] Measuring and reporting past performance

- [ ] Ensuring public access to information vs. the need for system security

- [ ] Controlling IT budgets

- [ ] Managing or replacing legacy systems

- [ ] Developing organization-wide IT accountability

- [ ] Identifying and reporting specific CIO/Information Resource Management measures/outcomes.

- [ ] Implementing Commercial Off The Shelf solutions  (ERP, CRM, etc.)

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

- Responding to outsourcing requirements

# Chief Information Officer Survey (Part 2)

## ***CIO Critical Technologies***

**Directions:**

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

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

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

☐ Application Service Provider (ASP)

☐ Imaging

☐ LINUX

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

| | | | |
|---|---|---|---|
| 133 | PUBLIX SUPER MARKETS INC | 633 | WHOLE FOODS MARKET |
| 134 | THE HARTFORD FINANCIAL SERVICES GROUP INC | 634 | PEOPLES ENERGY |
| 135 | EXELON | 635 | MAIL WELL |
| 136 | NATIONWIDE | 636 | REPUBLIC SERVICES |
| 137 | XCEL ENERGY INC | 637 | LA Z BOY |
| 138 | VALERO ENERGY CORPORATION | 638 | RYERSON TULL |
| 139 | MCDONALD S CORPORATION | 639 | CHIQUITA BRANDS INTERNATIONAL |
| 140 | WEYERHAEUSER COMPANY | 640 | CONSOLIDATED FREIGHTWAYS |
| 141 | KIMBERLY CLARK CORPORATION | 641 | HERMAN MILLER |
| 142 | LIBERTY MUTUAL INSURANCE COMPANIES | 642 | BUDGET GROUP |
| 143 | THE MAY DEPARTMENT STORES COMPANY | 643 | BJ SERVICES |
| 144 | THE GOODYEAR TIRE & RUBBER COMPANY | 644 | TOLL BROTHERS |
| 145 | WYETH | 645 | POLO RALPH LAUREN |
| 146 | OCCIDENTAL PETROLEUM CORPORATION | 646 | NABORS INDUSTRIES |
| 147 | HOUSEHOLD INTERNATIONAL INC | 647 | MDU RESOURCES GROUP |
| 148 | DELTA AIR LINES INC | 648 | PILGRIM S PRIDE |
| 149 | THE GAP INC | 649 | LABORATORY CORP OF AMERICA |
| 150 | LEAR CORPORATION | 650 | TELLABS |
| 151 | NORTHROP GRUMMAN CORPORATION | 651 | WESTERN RESOURCES |
| 152 | AMERADA HESS CORPORATION | 652 | PEP BOYS MANNY MOE & JACK |
| 153 | HALLIBURTON COMPANY | 653 | EQUITY RESIDENTIAL PROPERTIES |
| 154 | DEERE & COMPANY | 654 | LANDAMERICA FINANCIAL GROUP |
| 155 | EASTMAN KODAK COMPANY | 655 | VECTREN |
| 156 | CMS ENERGY CORPORATION | 656 | CINTAS |
| 157 | CIRCUIT CITY GROUP | 657 | OMNICARE |
| 158 | CINERGY CORP | 658 | MAXXAM |
| 159 | ANHEUSER BUSCH COMPANIES INC | 659 | ALASKA AIR GROUP |
| 160 | WINN DIXIE STORES INC | 660 | AMERICAN NATIONAL INSURANCE |
| 161 | AVNET INC | 661 | ALLEGHENY TECHNOLOGIES |
| 162 | WELLPOINT HEALTH NETWORKS INC | 662 | OUTBACK STEAKHOUSE |
| 163 | SUNOCO INC | 663 | MDC HOLDINGS |
| 164 | TEXTRON INC | 664 | SUN HEALTHCARE GROUP |
| 165 | EDISON INTERNATIONAL | 665 | CENTURYTEL |
| 166 | GENERAL DYNAMICS CORPORATION | 666 | NATIONAL SEMICONDUCTOR |
| 167 | TENET HEALTHCARE | 667 | SWIFT TRANSPORTATION |
| 168 | UNION PACIFIC CORPORATION | 668 | CUNA MUTUAL GROUP |
| 169 | PACIFICARE HEALTH SYSTEMS INC | 669 | HARSCO |
| 170 | FARMLAND INDUSTRIES INC | 670 | HILLENBRAND INDUSTRIES |
| 171 | ELI LILLY AND COMPANY | 671 | WYNDHAM INTERNATIONAL |
| 172 | WASTE MANAGEMENT INC | 672 | KLA TENCOR |
| 173 | OFFICE DEPOT INC | 673 | MONY GROUP |
| 174 | THE WILLIAMS COMPANIES INC | 674 | NATIONAL FUEL GAS |
| 175 | TOYS R US INC | 675 | J B HUNT TRANSPORT SERVICES |
| 176 | ORACLE CORPORATION | 676 | WILLIAMS SONOMA |
| 177 | TYSON FOODS INC | 677 | SNAP ON |
| 178 | STAPLES INC | 678 | MARINER POST ACUTE NETWORK |
| 179 | THE TJX COMPANIES INC | 679 | INSIGHT ENTERPRISES |

| | | | |
|---|---|---|---|
| 180 | DOMINION RESOURCES INC | 680 | NORTEK |
| 181 | COMPUTER SCIENCES CORPORATION | 681 | PEOPLESOFT |
| 182 | MANPOWER INC | 682 | SYNOVUS FINANCIAL CORP |
| 183 | DANA CORPORATION | 683 | ZALE CORPORATION |
| 184 | ANTHEM INC | 684 | AMERICA WEST HOLDINGS |
| 185 | ALLEGHENY ENERGY INC | 685 | AFFILIATED COMPUTER SERVICES |
| 186 | WHIRLPOOL CORPORATION | 686 | E TRADE GROUP |
| 187 | HUMANA INC | 687 | SIMON PROPERTY GROUP |
| 188 | SOUTHERN COMPANY | 688 | NEW JERSEY RESOURCES |
| 189 | MARRIOTT INTERNATIONAL INC | 689 | SIEBEL SYSTEMS |
| 190 | MBNA CORPORATION | 690 | STORAGE TECHNOLOGY |
| 191 | ARROW ELECTRONICS INC | 691 | QUANTA SERVICES |
| 192 | HEALTH NET INC | 692 | ZIONS BANCORP |
| 193 | MARSH & MCLENNAN COMPANIES INC | 693 | COMPUWARE |
| 194 | NORTHWEST AIRLINES CORPORATION | 694 | RPM INC |
| 195 | PUBLIC SERVICE ENTERPRISE GROUP INCORPORATED | 695 | BELL MICROPRODUCTS |
| 196 | SCHERING PLOUGH CORPORATION | 696 | GENERAL CABLE CORPORATION |
| 197 | ILLINOIS TOOL WORKS INC | 697 | VOLT INFORMATION SCIENCES |
| 198 | COMCAST CORPORATION | 698 | METALDYNE |
| 199 | CONSOLIDATED EDISON INC | 699 | CHARMING SHOPPES |
| 200 | ENTERGY CORPORATION | 700 | WEIS MARKETS |
| 201 | THE AES CORPORATION | 701 | DOLLAR TREE STORES |
| 202 | AFLAC INCORPORATED | 702 | BECKMAN COULTER |
| 203 | NISOURCE INC | 703 | PROTECTIVE LIFE |
| 204 | NIKE | 704 | CBRL GROUP |
| 205 | UNUMPROVIDENT | 705 | SCHOLASTIC |
| 206 | H J HEINZ COMPANY | 706 | HARRIS CORPORATION |
| 207 | COLGATE PALMOLIVE COMPANY | 707 | WESTERN DIGITAL |
| 208 | THE LIMITED INC | 708 | INGLES MARKETS |
| 209 | JOHN HANCOCK FINANCIAL SERVICES INC | 709 | ABM INDUSTRIES |
| 210 | EXPRESS SCRIPTS INC | 710 | W R BERKLEY |
| 211 | BURLINGTON NORTHERN SANTA FE CORPORATION | 711 | SILGAN HOLDINGS |
| 212 | AGILENT TECHNOLOGIES INC | 712 | WGL HOLDINGS |
| 213 | NATIONAL CITY CORPORATION | 713 | TRAVELCENTERS OF AMERICA |
| 214 | FLUOR | 714 | SOUTHERN UNION |
| 215 | UNITED SERVICES AUTOMOBILE ASSN | 715 | SUNGARD DATA SYSTEMS |
| 216 | CONTINENTAL AIRLINES INC | 716 | CASEY S GENERAL STORES |
| 217 | CENDANT CORPORATION | 717 | SAFEGUARD SCIENTIFICS |
| 218 | THE ST PAUL COMPANIES INC | 718 | BROWN FORMAN |
| 219 | GUARDIAN LIFE INSURANCE COMPANY OF AMERICA | 719 | CH2M HILL |
| 220 | KELLOGG COMPANY | 720 | WALTER INDUSTRIES |
| 221 | PRINICPAL FINANCIAL | 721 | VALSPAR |
| 222 | SCI SYSTEMS | 722 | FLOWSERVE |
| 223 | THE BEAR STEARNS COMPANIES INC | 723 | TELEFLEX |
| 224 | R J REYNOLDS TOBACCO | 724 | TRINITY INDUSTRIES |
| 225 | ASHLAND INC | 725 | OHIO CASUALTY |

| | | | |
|---|---|---|---|
| 226 | FPL GROUP INC | 726 | COMPASS BANCSHARES |
| 227 | PROGRESS ENERGY INC | 727 | FURNITURE BRANDS INTERNATIONAL |
| 228 | THE PEPSI BOTTLING GROUP INC | 728 | FISERV INC |
| 229 | SUNTRUST BANKS INC | 729 | SENTRY INSURANCE GROUP |
| 230 | DILLARD S INC | 730 | DYNCORP |
| 231 | SMURFIT STONE CONTAINER CORPORATION | 731 | FRONTIER OIL |
| 232 | ANADARKO PETROLEUM CORPORATION | 732 | ALPINE GROUP |
| 233 | MASCO CORPORATION | 733 | CORN PRODUCTS INTERNATIONAL |
| 234 | US AIRWAYS GROUP INC | 734 | HEALTH MANAGEMENT ASSOCIATES |
| 235 | GENUINE PARTS COMPANY | 735 | MARSH SUPERMARKETS |
| 236 | TEXAS INSTRUMENTS INCORPORATED | 736 | LITHIA MOTORS |
| 237 | PPG INDUSTRIES INC | 737 | MAGELLAN HEALTH SERVICES |
| 238 | CSX CORPORATION | 738 | SILICON GRAPHICS |
| 239 | CONSECO INC | 739 | METRIS |
| 240 | GILETTE | 740 | CARLISLE COMPANIES INCORPORATED |
| 241 | SEMPRA ENERGY | 741 | LUBRIZOL |
| 242 | FIRSTENERGY CORP | 742 | INTL FLAVORS & FRAGRANCES |
| 243 | CLEAR CHANNEL COMMUNICATIONS INC | 743 | FREEPORT MCMORAN COPPER & GOLD |
| 244 | CENEX HARVEST STATES COOPERATIVES | 744 | JACK IN THE BOX |
| 245 | DTE ENERGY COMPANY | 745 | WORTHINGTON INDUSTRIES |
| 246 | ARAMARK CORPORATION | 746 | BRIGHTPOINT |
| 247 | AON CORPORATION | 747 | LINENS N THINGS |
| 248 | BAXTER INTERNATIONAL INC | 748 | COLLINS & AIKMAN |
| 249 | THE CHUBB CORPORATION | 749 | PSS WORLD MEDICAL |
| 250 | ALLTEL CORPORATION | 750 | AMERCO |
| 251 | CALPINE CORPORATION | 751 | TEREX |
| 252 | NEXTEL COMMUNICATIONS INC | 752 | MCLEODUSA |
| 253 | KOHL S CORPORATION | 753 | GOLD KIST INC |
| 254 | THE PROGRESSIVE CORPORATION | 754 | RENT A CENTER |
| 255 | AMERICAN STANDARD COMPANIES INC | 755 | KENNAMETAL |
| 256 | BOISE CASCADE CORPORATION | 756 | MID ATLANTIC MEDICAL SERVICES |
| 257 | KEYCORP | 757 | BEAZER HOMES USA |
| 258 | APPLIED MATERIALS INC | 758 | SEABOARD |
| 259 | EATON CORPORATION | 759 | MINNESOTA LIFE INSURANCE |
| 260 | CAPITAL ONE FINANCIAL CORPORATION | 760 | HON INDUSTRIES |
| 261 | THE BANK OF NEW YORK COMPANY INC | 761 | PACKAGING CORP OF AMERICA |
| 262 | CROWN CORK & SEAL COMPANY INC | 762 | LSI LOGIC |
| 263 | EMC CORPORATION | 763 | DOW JONES |
| 264 | GENERAL MILLS INC | 764 | WESTPOINT STEVENS INC |
| 265 | ADVANCEPCS INC | 765 | EQUITABLE RESOURCES |
| 266 | AUTOMATIC DATA PROCESSING INC | 766 | DIEBOLD |
| 267 | SAFECO | 767 | W R GRACE |
| 268 | TRICON GLOBAL RESTURAUNTS | 768 | BROWN SHOE |
| 269 | PNC FINANCIAL SERVICES GROUP | 769 | SEQUA |
| 270 | NEWELL RUBBERMAID INC | 770 | POTLATCH |
| 271 | KEYSPAN CORPORATION | 771 | SCOTTS COMPANY |
| 272 | OMNICOM GROUP INC | 772 | NATIONAL OILWELL |

| | | | |
|---|---|---|---|
| 273 | NORTHEAST UTILITIES | 773 | PRIMEDIA |
| 274 | PLAINS ALL AMERICAN PIPELINE | 774 | HOVNANIAN ENTERPRISES |
| 275 | ARVINMERITOR INC | 775 | SOUTHERN STATES COOP |
| 276 | ONEOK INC | 776 | PAYCHEX |
| 277 | AVAYA INC | 777 | HAWAIIAN ELECTRIC INDUSTRIES |
| 278 | UNOCAL CORPORATION | 778 | GREENPOINT FINANCIAL |
| 279 | THE INTERPUBLIC GROUP OF COMPANIES INC | 779 | HARMAN INTL INDUSTRIES |
| 280 | NAVISTAR INTERNATIONAL CORPORATION | 780 | BAUSCH & LOMB |
| 281 | CENTEX CORPORATION | 781 | CONCORD EFS INC |
| 282 | CAMPBELL SOUP COMPANY | 782 | CABOT |
| 283 | FIFTH THIRD BANCORP | 783 | THE DIAL CORPORATION |
| 284 | FIRST DATA CORPORATION | 784 | ENERGIZER HOLDINGS |
| 285 | PREMCOR INC | 785 | COMMUNITY HEALTH SYSTEMS |
| 286 | LINCOLN NATIONAL CORPORATION | 786 | INTEGRATED ELECTRICAL SERVICES |
| 287 | GANNETT CO INC | 787 | WALLACE COMPUTER SERVICES |
| 288 | SONIC AUTOMOTIVE INC | 788 | ALLERGAN |
| 289 | CORNING INCORPORATED | 789 | METALS USA |
| 290 | DEAN FOODS COMPANY | 790 | EGL INC |
| 291 | BB&T CORPORATION | 791 | ALLETE |
| 292 | UNITED AUTO GROUP INC | 792 | RELIANCE STEEL & ALUMINUM |
| 293 | NORFOLK SOUTHERN CORPORATION | 793 | DST SYSTEMS |
| 294 | SCIENCE APPLICATIONS INTERNATIONAL CORPORATION | 794 | VIAD |
| 295 | PACCAR | 795 | XILINX |
| 296 | GATEWAY INC | 796 | RAYMOND JAMES FINANCIAL |
| 297 | SAKS | 797 | NEWMONT MINING |
| 298 | LENNAR CORPORATION | 798 | VISHAY INTERTECHNOLOGY |
| 299 | AVISTA CORPORATION | 799 | EOG RESOURCES |
| 300 | UNISYS CORPORATION | 800 | EXPEDITORS INTL OF WASHINGTON |
| 301 | OWENS ILLINOIS INC | 801 | DAVITA |
| 302 | AVON PRODUCTS INC | 802 | D&K HEALTHCARE RESOURCES |
| 303 | PARKER HANNIFIN CORPORATION | 803 | APPLERA |
| 304 | NCR CORPORATION | 804 | UST INC |
| 305 | SMITHFIELD FOODS INC | 805 | FLOWERS FOODS |
| 306 | ROHM AND HAAS COMPANY | 806 | AIRGAS |
| 307 | CONECTIV | 807 | APPLIED INDUSTRIAL TECHNOLOGIES |
| 308 | THE SERVICEMASTER COMPANY | 808 | QUINTILES TRANSNATIONAL |
| 309 | PPL CORPORATION | 809 | TIFFANY & CO |
| 310 | AIR PRODUCTS AND CHEMICALS INC | 810 | CIENA |
| 311 | CUMMINS INC | 811 | PERKINELMER |
| 312 | IDACORP INC | 812 | GREAT LAKES CHEMICAL |
| 313 | STATE STREET CORPORATION | 813 | MILLENNIUM CHEMICALS |
| 314 | NORDSTROM INC | 814 | CRANE |
| 315 | CAREMARK RX INC | 815 | STANCORP FINANCIAL |
| 316 | ALLIED WASTE INDUSTRIES INC | 816 | MAXIM INTEGRATED PRODUCTS |
| 317 | SOUTHWEST AIRLINES CO | 817 | AGWAY |
| 318 | MEDTRONIC INC | 818 | NOBLE AFFILIATES |
| 319 | PROVIDIAN FINANCIAL CORPORATION | 819 | JO ANN STORES |

| | | | |
|---|---|---|---|
| 320 | VF CORPORATION | 820 | LANDS END |
| 321 | FEDERAL MOGUL CORPORATION | 821 | COOPER CAMERON |
| 322 | EASTMAN CHEMICAL COMPANY | 822 | BLACK HILLS |
| 323 | BAKER HUGHES INCORPORATED | 823 | STILWELL FINANCIAL |
| 324 | PULTE HOMES INC | 824 | PERINI |
| 325 | APPLE COMPUTER INC | 825 | THOMAS & BETTS |
| 326 | DOLLAR GENERAL CORPORATION | 826 | IMPERIAL SUGAR |
| 327 | FORTUNE BRANDS INC | 827 | MPS GROUP |
| 328 | R R DONNELLY & SONS | 828 | CHAMPION ENTERPRISES |
| 329 | USA NETWORKS INC | 829 | GRANITE |
| 330 | THE CHARLES SCHWAB CORPORATION | 830 | NATIONAL COMMERCE FINANCIAL |
| 331 | BJ S WHOLESALE CLUB INC | 831 | SYSTEMAX |
| 332 | IKON OFFICE SOLUTIONS | 832 | COMFORT SYSTEMS USA |
| 333 | TRIBUNE COMPANY | 833 | GREIF BROS |
| 334 | TRANSMONTAIGNE | 834 | ASTORIA FINANCIAL |
| 335 | TESORO PETROLEUM CORPORATION | 835 | SHAW GROUP |
| 336 | PRAXAIR INC | 836 | DI GIORGIO |
| 337 | AMERICAN FAMILY INSURANCE GROUP | 837 | EQUIFAX |
| 338 | ENGELHARD CORPORATION | 838 | LEGG MASON |
| 339 | THE SHERWIN WILLIAMS COMPANY | 839 | ACT MANUFACTURING |
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| 341 | RYDER SYSTEM INC | 841 | RGS ENERGY GROUP |
| 342 | CNF | 842 | UNIVERSAL FOREST PRODUCTS |
| 343 | BARNES & NOBLE INC | 843 | WORLD FUEL SERVICES |
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| 366 | AMEREN CORPORATION | 866 | GREAT PLAINS ENERGY |

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| 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 |
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| 375 | FOOT LOCKER INC | 875 | TERADYNE |
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| 377 | THE BLACK & DECKER CORPORATION | 877 | AMERICAN WATER WORKS |
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| 381 | GOLDEN STATE BANCORP INC | 881 | PHILLIPS VAN HEUSEN |
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| 383 | LEVI STRAUSS & CO | 883 | SPORTS AUTHORITY |
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| 385 | NORTHWESTERN CORPORATION | 885 | FAIRCHILD SEMICONDUCTOR INTL |
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| 387 | COMPUTER ASSOCIATES INTERNATIONAL INC | 887 | BURLINGTON INDUSTRIES |
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| 389 | TEMPLE INLAND INC | 889 | DIMON |
| 390 | LEXMARK INTERNATIONAL INC | 890 | STEWART & STEVENSON SERVICES |
| 391 | NUCOR CORPORATION | 891 | TECUMSEH PRODUCTS |
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| 479 | AIRBORNE INC | 979 | SOFTWARE SPECTRUM |
| 480 | COMDISCO INC | 980 | VIASYSTEMS GROUP |
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| 493 | LENNOX INTERNATIONAL INC | 993 | HANDLEMAN |
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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.

# REPORT DOCUMENTATION PAGE

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**14. 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 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.

**15. SUBJECT TERMS**

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