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Content Management and Electronic Dissemination Strategies for Multiple Types of Traveler Information

Washington State Department of Transportation Electronic Information and Supporting Systems: Challenges to Effective Practice and Policy

by

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16. ABSTRACT

This project will develop and initiate a content management strategy for design and electronic delivery of multiple types of public traveler information. The results of this research will enable the Washington State Department of Transportation (WSDOT) to integrate coherently a wide range of available transportation-related information and effectively disseminate that information to the public. A content management strategy will be developed based on four factors: (1) the nature of the available information, (2) the information needs and behaviors of the traveling public, (3) the informational goals of WSDOT and (4) the evolving capabilities of emerging communications technologies. This strategy will provide the framework for improving the current WSDOT traveler information website. The process for developing a content management strategy for WSDOT will also serve as a model for other state and local transportation departments as they grapple with the challenge of communicating multiple types of traveler information that is developed by multiple sources, often repurposed for public use, and delivered through a single portal. The project will also outline strategies for continued adaptation of this content management strategy so that WSDOT can continue to update its information strategy and activities as the four key factors inevitably evolve.

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1. Introduction

Like all modern organizations, state departments of transportation (DOTs) are continually engaged in an effort to effectively apply information and communication technology (ICT) to the accomplishment of organizational mission and objectives. This effort is extremely challenging for many reasons, not the least of which is that the state-of-the-art of ICT management, whether in private industry or government, is still in flux and is often insufficient to handle the many complexities it must address. In fact a decade of research sponsored by the National Science Foundation has yet to demonstrate a clear correlation between information technology investment and increased productivity.

For the Washington State Department of Transportation (WSDOT), the task of effectively leveraging its ICT investment is particularly challenging. Numerous factors complicate the situation for WSDOT, not the least of which is the extensive research and development investment it has made over the past decade and a half in the area known as intelligent transportation systems (ITS). Given the nature of ITS funding, this investment has generally occurred on a project-by-project basis, rather than as part of a centrally coordinated strategy. For this reason (and others), different parts of the WSDOT organization have developed differing perspectives on ITS and the information these systems generate. For example, from the perspective of traffic engineers, traveler information systems are operational tools, used to develop and deliver information to travelers so that they can make more efficient use of existing transportation facilities. But from an administrative perspective, communication with the traveling public is seen as part of the ongoing effort to improve public relations and increase legislative support. Since real-time traffic information is the most popular information provided by WSDOT to the public, it is seen as a potentially potent administrative tool, particularly when public votes are being used to determine levels of state DOT funding. Technology systems viewed as operational (engineering) projects are developed, used, and managed far differently than technology systems viewed as infrastructure for administrative public relations projects.

This report examines WSDOT's ability to derive benefits from its extensive ICT investment. We emphasize the importance of information and its use (over technology issues such as compatibility and bandwidth) by focusing on an area we call electronic information and supporting systems (EISS). This report (1) explores general issues of EISS practice and policy, and (2) develops strategies for EISS practice and policy that will help both WSDOT and DOTs in general evolve from organizations driven by localized, project-based acquisition and implementation of information technology to organizations guided by the coordinated use of EISS to accomplish strategic, enterprise-wide missions.

The research and analysis presented in this report is not intended to address specific technology systems at WSDOT. Rather, it is our hope that this report will provide WSDOT with the groundwork and direction to better handle the complexity and interrelatedness of these and other, non-technological, EISS systems.

2. General EISS Issues

Nearly every modern organization relies to some degree on information in electronic form, and with this reliance comes a set of organizational issues that often are difficult to address. At the highest level, these issues relate to managing the full range of EISS assets within the context of organizational environments and objectives. For organizations like WSDOT that use electronic information both internally to drive operational activities and externally to impact audiences outside the organization, strategic management of EISS is significantly complicated.

Some EISS issues are general—they pertain to the general nature of EISS and apply to nearly any organization relying on electronic information. Other EISS issues are specific to a given organization's situation and mission. Both types of issues must be considered as an organization works to meet the various challenges to effective EISS practice and policy. In this section we discuss general EISS issues.

2.1. Characteristics of EISS

When a large modern organization attempts to use EISS to accomplish its mission, it is actually attempting to manage an extremely complex system. The more an organization relies on electronic information, the more complex and critical this management task becomes. In simple terms, a complex system is one in which the whole is greater than the sum of its parts. Traditional management strategies often assume that the systems being managed can be broken down into discrete components and clear, causal relationships among those parts. However, this assumption is no longer valid for systems that have reached a sufficient complexity. "Compared to the analytical procedure of classical science with resolution into component elements and one-way or linear causality as basic category, the investigation of organized wholes of many variables requires new categories of interaction, transaction, organization, teleology, etc…"(Bertalanffy 1998)

To give a better sense of this complexity, following is some discussion of a few of the general characteristics of EISS that must be considered in attempting to manage these complex, open systems.

2.1.1. EISS is pervasive and amorphous

EISS appears to be both everywhere and nowhere. Seemingly every person within an organization both creates and uses electronic information in order to get his or her job done. Generally, individuals want to control the piece of the EISS that they create or rely on, and they often seek to assert ownership of that piece. Conversely, no one person or even organizational entity has responsibility for the entirety of EISS. In fact when things go wrong with EISS, people often reverse their ownership position, seeking not to control the pieces of the system that they rely on but rather looking to others as being responsible for fixing things.(Haselkorn, forthcoming) After all, how can they be responsible for something that is so much larger than the piece they see or touch?

The pervasiveness and amorphousness of EISS can be challenging for those who use or manage electronic information. How can one person or group care for a piece of a larger interdependent system? Who is responsible for electronic information in its various forms and incarnations? And who is responsible for creating and maintaining EISS policy and long-term strategy across the organization? Uncertainty in these areas often leads to multiple lines of guidance and authority.

2.1.2. EISS is multi-purpose

The same electronic information or supporting technology can have a variety of purposes depending on the user of that information. This is true at many levels of EISS. At the content level, for example, designers of electronic information need to be keenly aware of the potential for multiple use. "[A] wide variety of users can access a hypermedia with different purposes; thus, it is important to have different task models for different types of users."(Paterno and Mancini 1998) Since different people can use the same information for different purposes, even dedicated and intelligent people who share the same overall strategic objective can disagree on the basic priorities for design and use of that information.

The honest differences that can exist over what constitutes the best design of electronic information can extend beyond content design and use to management issues at many other levels of EISS. At the supporting infrastructure level, for example, a system set up to provide administrators with greater ability to establish and enforce enterprise-wide standards can at the same time make it more difficult for individual writers to

generate new forms of content. Again, various users of EISS can have honest differences of perspective as to the most desirable features of the system.

2.1.3. EISS is diverse and dynamic

Most organizations generate and rely on many different types of electronic information, and these organizations also often support many types of associated technology. In addition, this information and technology changes often and frequently. There are obvious challenges to managing such a diverse and dynamic activity.

Yet even more challenging is diversity and change in the systems that constitute the environment within which this information and technology lives. EISS consists of diverse and dynamic levels and elements, each with unique attributes and issues. Even a narrow view of EISS would include not only electronic content in its various forms and types (e.g., Web pages, documents, diagrams, slide presentations), but also such diverse supporting elements as computer hardware, communication devices, operating systems, application software, and data and database management systems. A fuller view of EISS (the one we take here) includes even more diverse elements, such as policies and best practices, relevant personnel and job categories, training and continuity plans, consequence management, security and information assurance strategies, funding mechanisms, and the organization's culture of communication.

These various EISS elements differ in many ways and change at varying rates. For example, hardware change is extremely rapid, driven by a dynamic IT industry that lives off rapid innovation and accompanying sales. Once content is created, however, it changes rarely if at all. Meanwhile, such complex interdisciplinary EISS elements as funding mechanisms and an organization's communication culture extend beyond a given organization's control or have a life of their own.

2.1.4. EISS is interdependent

Not only are the various elements of EISS diverse and dynamic, they are also interdependent. This is probably the most complex and confounding aspect of EISS.

Neither EISS nor the organizations within which these systems reside are closed systems; in other words, neither EISS nor the organization itself can be understood or managed independent of their interactions with each other and their environments. "To conceptualize an organization as an open system is to emphasize the importance of its

environment, upon which the maintenance, survival, and growth of an open system depend."(Malhotra 1993)

EISS interdependency issues are manifested at many levels, from the compatibility of hardware and software to the highest levels of intersystem interaction, often called the "system-of-systems" perspective. From this perspective, any given system can be seen as being both composed of other interdependent systems and a part of still others. Interdependency at the system-of-systems level often extends beyond any given organization.

2.1.5. EISS means different things to different people

Because EISS is complex and composed of many diverse elements, it is only natural that people with differing expertise and experience view various individual components as more or less central.

Many traditional IT professionals, for example, see hardware, software and communication devices as the central elements of their systems, with data and information being "fed" into those central elements, "crunched," and "spit out." These IT professionals come from an educational and training background in which the complex subject of computing has been their primary element of concern. They have worked long and hard to gain expertise in this critical and difficult area, and it is not surprising that they might see computers as the central element of EISS, with data and information being there to serve that central element.

On the other hand, people whose central focus is the generation, design, and use of information in the pursuit of organizational missions tend to view EISS differently than the computer-centric perspective of traditional IT professionals. According to Alter, EISS can be understood in terms of "content" and "plumbing." (Alter 1999) The content is the information being shared and used within the system, while the plumbing is the technical layer that enables the use of content.

> [Users] have no interest in the plumbing layer and want to avoid learning about its intricacies. Just as in a building, they want the plumbing to work well and at reasonable expense, but do not care about the technical choices that determine whether the plumbing works well and at what cost… [T]oo much of the effort of work system participants is still devoted to understanding and

> dealing with the plumbing… [Systems will improve when users] can devote their attention to content rather than plumbing. (Alter 1999)

For people focused on content and knowledge, the technology serves the information, not the other way around, and they are often frustrated when changes in the technology that are intended to improve or modernize the system actually distract them from their primary goal of effective use of information.

The tensions that arise from differing EISS perspectives and priorities are a challenge not only to WSDOT but to nearly any organization that relies on information technology.

2.2. Approaches to EISS Management

What has been done to address these challenges stemming from EISS complexity? In the literature and in practice, there has been a movement away from the common view of technology as the central ingredient to a broader, more mission-focused vision of information use and management. Davenport (1997) refers to this information-centered approach as "information ecology," which focuses on the environment within which organizations create, distribute, understand, and use information to achieve objectives, rather than seeing technology as the primary component of information infrastructure.

Modern communication is extremely dependent on technology and has typically been managed with strategies that focus on the acquisition, implementation, standardization, maintenance and modernization of that technology. Unfortunately, this can also lead to confusion between *communication*—a functional-level activity based on human interaction and decision-making—and *communications*—an infrastructure-level activity involving IT that supports the human communication function. This confusion contributes to a common belief that technology can address deficiencies in an organization's information activities. However, "the status quo approach to information management – invest in new technologies, period – just doesn't work." (Davenport 1997) In managing EISS, it is necessary to consider numerous other factors in the larger information environment, including common practice, policy, and even organizational politics.

> Curiously, many observers acknowledge the importance of information technology governance but still ignore information politics…[y]et I believe focusing on the governance of information is equally important, if not more so. Which matters more—who operates the data center, or who decides what information will be gathered and used within the firm... Is the architecture of information less significant than the architecture of technology? The effective use of information, much more than any new technology, can change how an organization runs. (Davenport 1997, p. 68)

Although technology is certainly an important component of EISS, it is there to serve a larger, more diverse effort centered on people, organizations, and goals.

2.2.1. Information, knowledge and content management

Over the past decade, a more complex understanding of how organizations use technology and information has been growing. This has manifested itself in a series of formal organizational approaches to managing the information-carrying components of the system—"information management," "knowledge management," and "content management." But while these strategies represent a positive change in focus, they have generally not lived up to their promise. This has been due in part to the fact that organizations have applied their "status quo" views and practices to these new approaches.

> Knowledge management (KM) today [is]a good idea gone awry. KM has fallen victim to a mixture of bad implementation practices and software vendors eager to turn a complex process into a pure technology play. The result: like many a business concept, KM has evolved from a hot buzzword to a phrase that now evokes more skepticism than enthusiasm. (Berkman 2001)

In other words, efforts such as information or content management have actually become technology, not information, centered. For example during the course of this study, WSDOT initiated a content management effort by purchasing an implementation technology, when actually that should have been one of the last steps in such an effort. This is a common mistake made by many organizations.

Why have information, knowledge, and content management strategies, originally conceived to make fundamental improvements in how organizations manage their intellectual assets, evolved instead into an array of standard technology-based "toolsets." Certainly part of the answer is the influence of a technology industry eager to sell its products.

> [S]ome of the most widely distributed knowledge management periodicals (*KMWorld* and *Knowledge Management* magazine, for example) are sponsored almost exclusively by the advertising dollars of technology companies marketing their products. The funding and influence of information technology departments and technology companies has unfortunately fueled a widespread misconception that knowledge management is almost exclusively a technological issue and that the accompanying technology-centered definition of knowledge is *the* comprehensive definition. (Wick 2000)

In addition, powerful information technology departments with technology-centered perspectives have often become the homes of these efforts within organizations.

But perhaps the most critical reason why information, knowledge, and content management movements have not lived up to their promise is that organizations have underestimated the complexity of the endeavors and the necessity of treating them as cross-enterprise efforts requiring wide participation and open dialogue addressing cross-organizational issues. In its early years (1995-2000), knowledge management suffered from the belief that systems could be developed to organize the world according to rational principles using clever code. The idea was that organizations should capture and organize bits of 'knowledge' in central databases, organized systematically. The people involved in production (such as writers) were seen as relevant only as donors to the common knowledge base, while readers were rather unsophisticatedly imagined to be empty vessels into which knowledge could be poured. Neither role proved particularly comfortable or popular in the workplace, making workers' resistance a common cause for failure of these initiatives. Other contributing factors to worker reticence to adopt these management systems included distrust of central administration, concerns about the relatively short lifespan of the "toolsets" (none of which have yet established themselves to have the permanence of paper), or objections to the taxonomies (or category-systems) employed in a particular database information model.

In recent years, there has been a growing awareness that systems for central management of content (also called single-sourcing) must be far more amenable to people and the ways they view their work.

> A single-sourcing initiative brings with it changes to the way people work. For some people… change brings with it concerns and push back (resistance),

> especially if the change is not well communicated or if the change appears to take away a part of their job that they value. (Rockley 2003)

Real workers are not likely to easily accept changes to their regular behavior, nor are "content creators" (e.g., writers, editors, or Web developers) eager to redefine themselves as "contributors" to a shared pool of "metadata." In addition, universal taxonomies used to organize information will not be useful if they are divorced from the subjective experience of those who use or generate that information in their role as part of a group within an organization. Modern knowledge management systems attempt to address this by modeling existing individual and group behavior patterns, conversation streams, and corporate relationships into a context for the information that human users already create and manipulate. These systems attempt to record and organize workplace interactions, rather than trying to automate them. A number of high-end content management software packages like this are on the market, but not surprisingly implementing these packages requires far more than new software, and the cost of deployment can run to six times the software's purchase price. (Tweney)

In short, contemporary information, knowledge and content management is less and less about traditional "management" in the sense of allocating resources, and more about establishing an organizational environment where intellectual resources are available to those who need them, when they need them, in the form they need them. Thus any successful information or content management activity is also a meeting of different corporate cultures, and this can be extremely challenging. The activity is more strategic than it is automated. As Ann Rockley, content management guru, says, "successful content management initiatives cannot be achieved without a strategic plan." (Rockley 2003)

2.2.2. Integrating technology and strategic perspectives

While a successful EISS management effort hinges on the integration of many organizational perspectives, particularly crucial and challenging is the need to integrate the perspectives and activities of both technology and strategic management. According to Weill and Broadbent, the new information infrastructure is a complex investment "which must be managed like a financial portfolio, balancing risk and return to meet

management goals and strategies for customer and shareholder value."(Weill and Broadbent 1998)

> However, aligning the information technology portfolio and strategy is tough, as they have fundamentally different characteristics. Firms often have multiple strategic goals and strategies that are fluid, constantly adapting to shifts in the business environment. Information technology infrastructures necessarily take time to develop and technical discipline to put in place and integrate. Although the new infrastructure is as important to firms as their traditional physical infrastructure of buildings, plant, and location, it has proved harder to conceptualize and manage. (Weill and Broadbent 1998 p.25)

Typically, there have been significant differences between IT management and the strategic management of an organization. IT management has focused on acquisition and keeping technology working within an imperfect world where failures and fixes are a common occurrence. In this world, correct decisions about hardware and software, based primarily on technical knowledge, result in clearly defined system improvements, such as restored or improved functionality, increased compatibility, and easier maintenance.

On the other hand, strategic organizational and business decisions are seen as being more fluid and pervasive, with longer term impact on a wider range of the enterprise. Strategic decisions are generally the result of a negotiated consensus process within a dynamic context of shifting economic, legal, and political forces. The goal is to achieve an accepted best direction based on appropriate trade-offs and compromises. While the nature of this decision is complex, once it has been made there is little tolerance for error and miscalculation.

To a strategic planner, failure is a career-threatening event; to an IT manager, failure is part of the job. This is just one example of the differences in perspective, focus, and knowledge between technology and strategic managers. These differences can result in a gap between IT and strategic management that both sides contribute to. "Managers have often delegated or abdicated decisions to information technology professionals… [while] poor specification of strategic objectives often leads to the information technology group setting an information technology strategy in isolation from the business."(Weill and Broadbent 1998 p.18)

Organizations such as WSDOT seeking to improve the management of their intellectual assets must address far more than technology-related issues. They must also take on a number of challenges related to the integration of the various roles and perspectives of people and units within the organization.

2.3. Organizational Challenges to Effective EISS

Many of the challenges associated with establishing and maintaining effective EISS stem from the need to integrate the various roles and perspectives of people and units involved in the creation, manipulation, delivery, management, and support of information. It is useful to briefly review these and related challenges before looking more specifically at EISS within WSDOT.

2.3.1. Balancing central management and local execution

Perhaps the most pervasive organizational EISS issue is the intricate and dynamic tension between central management and local units or departments. Neither the central nor local perspective is right or better, and it would be neither feasible nor appropriate to attempt to eliminate the differences between them. In fact, many organizations in both the public and private sectors attempt to balance the advantages of both perspectives by using some version of a strategy commonly referred to as "manage centrally, execute locally." This strategy attempts to simultaneously (1) coordinate action toward a common goal while (2) freeing individual groups to adjust tactics to their specific conditions. Achieving an effective balance between central management and local execution is a critical component of any organizational information strategy.

2.3.2. Assuring that central guidance is at an appropriate level

In order to coordinate central management with local execution, organizations need to gear central EISS guidance to an appropriate level—if too high, there may be a disconnect with local execution; if too low, local executors may be overburdened with specifics and have little room to adjust for individual circumstances. The subtleties involved in gearing central guidance to an appropriate level can be further complicated during unusual times (e.g., mergers, major centrally driven information initiatives, Y2K) by the increased involvement in EISS decision-making of higher-level administrators with little or no EISS

management experience. For example, during the Y2K effort there was considerable tension between high-level managers with low tolerance for risk and technology mangers with a higher (and often more realistic) tolerance. On the one hand, it is critical that top-level managers be involved in crucial information activities; on the other hand, they need to realize that there are many other perspectives involved in these activities, and that those responsible for execution must be free to make local decisions within the context of an agreed upon organizational goal.

2.3.3. Clarifying ownership and responsibility

Another common source of organizational tensions is a lack of clarity in the ownership of and responsibility for EISS systems. It is extremely rare for one person or group to have complete ownership of organizational EISS. As mentioned earlier, when things are going smoothly, individuals and groups tend to assert control over their piece of the system; when there are problems, individuals and groups tend to look outside for those with responsibility for fixing a system over which they have only limited control. In actuality, neither central nor local units alone can be fully responsible for shared EISS systems. Even when central units are solely responsible for development and fielding of organization-wide, off-the-shelf systems (whether government or commercial), these systems invariably require ongoing adjustment for implementation, operation, and maintenance under local conditions and needs. For this reason, comprehensive management of shared EISS requires an appropriate integration of central and local perspectives.

2.3.4. Considering the impact of local diversity and autonomy

Closely related to ownership and responsibility issues are issues that stem from the diversity of local EISS environments and resources. Multiple ownership and guidance can confuse individuals as to who is responsible for the different parts of the complex systems they rely on, but in large, complex organizations, central owners and maintainers of those systems face the equally confusing task of understanding and managing a complex “system of systems” that spans significantly different functional and geographical environments.

Local diversity issues are often further complicated by a high degree of local autonomy. This autonomy can stem in part from the nature of the organization and in part from the nature of EISS itself. At WSDOT, as we will see, local autonomy is fostered by many factors, including history, the nature of the mission, and how EISS is funded or, as is often the case, not funded. When central funding does not accompany central guidance on the nature and use of EISS, local units may be unable or unwilling to follow that guidance. On the other hand, the existence of flexible money can enable local units to do what they want outside of central guidance. This autonomy can impair central management of enterprise-wide issues like security and ease of information exchange, but especially in government organizations, this use of flexible money to support local EISS initiatives can also be seen as a local unit's response to rapidly changing needs within the context of a slowly changing bureaucracy.

2.3.5. Overcoming funding disincentives

As just mentioned, funding is a visible source of EISS tensions, and as is the case for other tensions discussed here, funding tensions generally represent not a choice between a desirable and undesirable outcome, but rather a need to balance competing desirable ends. In this case, accounting practices driven by the central need for fiscal accountability seek to define projects that can be tracked and managed through a clearly identified owner. However, cross-functional EISS initiatives and activities often do not have an easily identifiable owner. Nevertheless, funding is generally used to identify ownership of EISS projects, even though those projects serve a range of local purposes for a wide variety of users and functional units. Unfortunately, identifying complex EISS projects on the basis of narrower funding practices can lead to a piecemeal view of these highly interdependent systems.

2.3.6. Strengthening horizontal relationships

In addition to vertical EISS tensions between central and local needs and perspectives, there are equally critical horizontal tensions across functional organizational lines. These horizontal tensions also work against effective global management and local execution of EISS policy and practice. Given the overall focus on functional groupings in most organizations (including WSDOT), the lack of strong horizontal relationships is an extremely common barrier to effective cross-organizational EISS policy and practice.

Communication paths generally run up and down functional lines, the well-known "stovepipe" problem. This can result in inconsistent assumptions, locally motivated interpretations, misalignment, and confusing practices across functional lines in an organization. Issues like these need to be addressed through formal mechanisms for cross-boundary communication and interaction. Without clear mechanisms for coordination and communication across both horizontal and vertical organizational boundaries, EISS policy cannot be fully developed nor clearly funded.

2.3.7. Considering the evolution of issues over time

Another set of factors that can complicate the effort to manage EISS stem from the different ways that EISS projects evolve over time. Problem-solving activities (e.g., Y2K) tend to evolve up, from local recognition and activity into (if they are not solved) centrally managed responses. On the other hand, centrally managed initiatives (e.g., the institution of a content management system) tend to evolve down, from a centrally conceived plan into locally driven problem-solving activities associated with implementing that plan. Each of these related patterns has the potential to generate tensions across organizational layers. For example, as EISS problems evolve up toward central awareness, local units continue to work on them, meaning that central management can face a difficult task just in keeping up with the current version of these dynamic issues. On the other hand, as central EISS initiatives evolve down toward local execution, local units may be put in the role of testers for the centrally developed projects, often bringing to light unanticipated problems that then filter back up the layers of the organization, perhaps leading central managers to adjust their initial plans. Local units do not generally like to see themselves as a testing ground for central initiatives. These units are focused on their functional missions; missions they expect will be enabled by EISS, not disrupted. Thus, when the central idea does not match the local reality, it can generate strong responses and loss of support at the local level.

2.3.8. Tackling the informational support effort

Another key set of issues related to the rapid pace of EISS change is the need to acquire and maintain necessary information about an organization's systems and information environments. It is difficult to manage, protect, or fix a system when its components and configuration are not clear. Yet in most organizations seemingly basic

information, such as the state of the installed equipment base and how it is used, is not readily available nor being constantly maintained. Unfortunately, in a large, complex, and diverse organization, it is extremely costly and time-consuming to meet comprehensive EISS informational needs—so much so that these activities are often limited to local databases for local purposes. Maintaining the big picture is an extremely difficult task complicated by rapid change (e.g., constant upgrades from the highly dynamic IT industry, often exacerbated by an organizational focus on staying abreast of the latest technology) and distributed ownership. Given ongoing operational demands, little time or energy is left for the large ongoing effort required to address comprehensive EISS informational needs.

2.3.9. Addressing issues of organizational culture

Communication among people and the culture within which that communication occurs can have far more impact than the type of technology, accuracy of data, or even the relevance of information. Information is not neutral. Existing relationships with an information source, for example, can have more to do with the impact of a message than the specific message content. Similarly, existing informal patterns of interaction can mean more than formal plans of operation. This is especially evident during major, cross-organizational changes in EISS such as occur during mergers or strategic realignments. In 1995, when changes in the economics of health care forced Johnson and Johnson to move toward a more integrated delivery system involving doctors, hospitals, patients, and insurance companies, the president of its customer support center found himself in a countercultural effort: “Johnson and Johnson has over 100 years of history authorizing operating companies to manage all business facets to maximize their brands’ [profits and losses]…we are learning how difficult it is to break those paradigms and work together to leverage the strength of the firm with larger retail customers.” (Weill and Broadbent 1998 p. 19) WSDOT has a similar historical culture of regional autonomy.

At the top level, EISS management is about the space between functional areas. It is therefore critical to recognize and address the many organizational subcultures that sustain these various functional homes.

2.4. The Role of the CIO

Finally, before turning to EISS at WSDOT, it is helpful to consider the role of the person who in many organizations has the final responsibility for balancing many of the tensions just discussed—the Chief Information Officer (CIO). Since the mid 1990s (stimulated by the Y2K effort and the Clinger-Cohen Act of 1996), CIOs have increasingly been charged with managing an organization's information and knowledge systems. However, there has been considerable uncertainty as to the exact nature of and appropriate skills for this position. What is enterprise-wide management of an organization's ICT systems? What does an entity devoted to this activity do?

Many people assume that the management of organizational information and communication systems is primarily a technological activity. But at the level of the CIO, the systems being managed are not machines; they are dynamic and "open" systems consisting of people, organizational entities, policies, common practices, and organizational culture. The whole of EISS is far greater than the sum of its parts. As Christopher O'Brien, CIO of the city of Chicago, puts it "The CIO is one of the very few government officials that has an enterprise-wide scope. Specific agency heads are well versed in their own area of expertise. But myself and my staff are working in all of these departments, so we understand how it all fits together." (Towns 2001)

When the CIO's office was first established, most organizations saw it as an extension of already influential acquisitions and development functions. This fostered two related perspectives: (1) technology was the central component of an organization's information and communication activities, and (2) the CIO's primary role was as owner and manager of that technology. Thus, many CIO offices centered their information and knowledge management activities on standardizing and keeping up with new information and communication technology. This focus was not only aligned with existing IT units, but was also economically beneficial to the many technology companies with products in this area.

But as we have begun to see, enterprise-wide management of information, knowledge and content is not primarily about functionally organized technology. If the CIO owns anything, it is the space between these nodes of responsibility, the conversation and interactions that link the functional parts into a strategic whole. As

such, one of the primary activities of the CIO's office must be team building. "It's no longer the case that companies are just forming teams within their own walls. Now they're doing teams across company lines. So you have teams that are cross-organizational, cross-company, cross-culture, cross-hierarchy, cross-technologies, cross-languages, cross-functional—cross-everything" (Lipnack 2001)

Cross-functional team building is a complex activity, one in which organizational CIOs charged with enterprise-wide information management need to play the central leadership role. This impacts the desired skill-set for the CIO position. "Given the high risk for failure of teams, the CIOs who lead [collaborative] groups require business, technology, team-building, project management, and communication skills to be effective." (McCartney 2001)

What else must the CIO do? The CIO needs to distinguish functionally bound IT issues from enterprise-wide EISS ones. Where the issue resides within a functional responsibility, the role of the CIO is greatly minimized or nonexistent. But the CIO needs to be extremely sensitive to the interdependencies of the overall system. When an error is made, it is likely to be the incorrect assumption that a cross-functional issue is bounded within a particular functional responsibility.

When an issue is identified to be enterprise-wide, the CIO must take ownership. This means assuring there is a single "point of contact" providing consistent guidance at the appropriate level, but it does not mean that the CIO's office should be that point of contact or own the problem parts. The CIO owns the space between the parts—the space that makes it a cross-enterprise, strategic issue. In this case, his or her primary role is to identify the relevant organizational perspectives, determine the best available representatives of those units and perspectives, and then link, guide, and empower those people and units to manage the issue. Under the CIO's guidance, a cross-boundary entity defined to represent the relevant organizational perspectives on an issue becomes the point of contact. Only such an entity, acting with the guidance and authority of the CIO's office, can take on the delicate task of balancing the competing organizational goals that surround a cross-boundary EISS issue. The CIO is the fulcrum in this balancing act—team building, facilitating cross-boundary communication and activity, assuring that

EISS activities are aligned with organizational goals and strategies, and institutionalizing desired change.

Certainly there are times when the CIO must go beyond the fulcrum role to one of greater authority and stronger leadership. Specifically, during times of critical activity such as security threats, the CIO may be required to assure speed and flexibility in the face of traditional methods for doing things. In addition, the CIO's office should serve as a single point of contact for EISS coordination outside the organization. During "normal" times, however, the CIO's role is more that of communicator and facilitator than owner. As Weill and Broadbent point out, the CIO's role is to help others in the organization understand what is possible and what sorts of opportunities are available. (Weill and Broadbent 1998, p. 18)

Finally, the CIO must foster the use of EISS systems themselves as part of the solution to the challenges they generate. Information systems are increasingly the primary medium for the cross-boundary conversation and activity the CIO must establish and guide. Through these systems and the appropriate application of central authority, the CIO seeks to assure a single point of responsibility for the overall EISS as well as to foster cross-boundary cohesion across the organization.

At the level of the CIO, the toughest problems occur not within areas under the responsibility of a functional manager, but rather within areas that cut across functional and hierarchical boundaries. These are more holistic problems, not "hard" machine issues but rather involving integration of and communication across the entire system of systems that constitutes how an organization knows what it knows and uses that knowledge to help achieve its mission. The goal of "system integration" goes far beyond assuring that wires are connected, wireless hubs are implemented, and machines can transfer and understand data. Far more challenging to the CIO are issues of system integration that involve balancing the various tensions across organizational boundaries that surround EISS. (For a DOT-specific example of this, see Appendix A—Interview with the CIO of ODOT.)

3. Investigation

For our research, we wanted to examine cross-organizational EISS issues and the unique challenges that WSDOT faces when these affect its use of information and supporting technology. We chose this focus on WSDOT's EISS, rather than the more common focus on "information technology," because EISS is a broader, more organizationally based concept that addresses activities involving the generation, maintenance, and dissemination of electronic information both internally and externally. From the perspective of EISS, technology is a tool in support of more primary issues surrounding the creation and maintenance of information and how people in an organization use that information to achieve their mission and goals. As discussed in the first half of this report, EISS is complex in nature and far-reaching, affecting every aspect of an organization.

The methodology consisted of structured interviews with WSDOT internal EISS stakeholders. The focus of these interviews was to determine people's EISS roles, how their work was affected by EISS, and to obtain their perspectives on EISS at WSDOT.

Interviewees were identified as follows. The research team constructed a list of functional tasks (including management) associated with EISS projects and initiatives at WSDOT. Once we had constructed a list of EISS roles, we consulted with our tactical contact at WSDOT, who provided names of individuals responsible for the functional tasks we described. The technical contact also made additional recommendations about people we should interview. When stakeholders were interviewed, one question they were all asked was who else they thought we should interview. In most cases, stakeholders did not suggest anyone who wasn't on our previously compiled list; but if they did, we added their suggestions to the list.

Our interviews with WSDOT stakeholders were conducted either in person or by telephone. All stakeholders were asked a set of common questions, and at least two research team members took notes during an interview. After an interview was completed, one researcher compiled the notes taken by all researchers and shared them. The vast majority of the time, the data were extremely consistent, and few edits were needed. In cases where there were discrepancies, researchers met to clarify the

inconsistencies. Once the compilations had been completed, the interview notes were posted to a Web-based project management document repository, so that all the researchers could review the interview data.

To encourage candor, it was agreed that individual sources of information would not be identified in this report, but their statements would be used to inform our understanding and presentation of the situation. Citations from these interviews are presented in the text in 10-point type, single-spaced and indented, but the speaker is not identified. For example, following is a statement from an interview:

> People at WSDOT don't understand marketing or recognize that it works on a continuum. Some of what the local regions put out actually works against them.

And here is another:

> Locally, you have people addressing the needs of their customers in the best way they can with the resources they have. Then you have Olympia wanting to streamline and make it more consistent; or at least making it seem more consistent, in order to conceal the twenty-seven groups and regions involved. Different regions have different scenarios, in terms of how they do business.

As is evident in these example statements, sources of conflict between internal stakeholders were identified. When this occurred, interviewers explored these issues further.

4. Conclusions and Recommendations

Transportation itself is a system of systems. For instance, WSDOT's ability to manage congestion is affected by the number of commuters and where they live and work, which in turn is affected by factors such as the economic condition of the state, land use regulations, and historical regional planning decisions. WSDOT's EISS is also a system of systems; one that is being applied to the management of the complex transportation system of systems. Clearly, this is an extremely difficult perspective for any individual or organization to maintain on a daily, operational basis.

As discussed in this report, a number of challenges face WSDOT in its efforts to effectively employ electronic information and supporting systems. Following are conclusions and recommendations intended to help WSDOT successfully face these challenges, particularly as they pertain to the relatively new and highly challenging environment of intelligent transportation systems.

4.1. Establish More Formal, Permanent Cross-Organizational Communication Mechanisms

Our interviews revealed strong tensions at WSDOT surrounding EISS issues, both (1) across the various organizational entities and (2) between decentralized, local autonomy and centralized, enterprise-wide leadership. In nearly every case, these tensions do not represent a battle between what is right and wrong for WSDOT; rather they represent valid, competing perspectives and goals that, while in conflict, need to be balanced and maintained. For example, the goal of using real-time traffic information to increase the efficiency of transportation facilities is a very good one, and so is the goal of using Web-based communication to market WSDOT services and improve public relations. Yet these two "goods" have generated tensions between the Seattle TMC and the Communications Office. Similarly, the individual initiative stimulated by local autonomy is good, but so is the central assurance that this initiative serves larger organizational missions.

Tensions like these can be healthy or unhealthy, depending to a large extent on the cross-organizational mechanisms that exist to share, integrate, and balance these "goods." Balancing these conflicting "goods" must be an ongoing organizational process that requires cross-organizational interaction, empowered and facilitated by central administration.

Presently, cross-organizational communication at WSDOT on EISS issues tends to be informal and initiated at the local level. A good example is the difficulties that arose over the CARS (Condition Acquisition and Reporting System) database. CARS is a database of construction information that was developed by a consortium of DOTs, including WSDOT, and led by Castlerock Consultants. Unlike other construction databases that are designed to support the local management of work activities (e.g., scheduling work crews), CARS is a cross-regional traveler information tool.

Every WSDOT region has its own ways to manage construction, as well as its own ways to attempt to keep the public informed about construction. Some regions send faxes to newspapers, others use phone calls, while others use Web postings that are also available to the public. Some regions do daily updates, some weekly, and some monthly. During the course of our investigation, meetings were held to encourage the use of CARS to establish a cross-organizational database of construction information. Each region reacted differently. Some regions agreed to replace how they currently inform the public with CARS. Some said they liked what they do now but would use CARS in addition. One said no, they would not use CARS. Later, one of the regional representatives who had agreed to use CARS changed his mind.

It is instructive to look at the nature of these meetings and agreements. WSDOT operates through a disseminated management structure, with each region having strong autonomy to address its unique local conditions. No central authority initiated the CARS meetings; rather it was a series of topic-driven meetings called by someone interested in pursuing the issues.

> I was going region to region trying to sell the idea. It was difficult getting people to switch over [to the new system.]

This person invited people on the basis of their relationship to the topic, but attendance was a voluntary act. So, too, was any agreement reached; when participants

decided the agreement was no longer workable for them, they informed the group they had changed their mind.

There are both strengths and weaknesses to decentralization, and the tensions between central authority and local autonomy are generally about balancing competing "goods," not choosing between right and wrong. As the case of CARS showed, mechanisms for achieving this coordination were lacking. The "committee" that attempted to obtain cross-organizational agreement on the use of CARS was typical. Committee members were invited by a local group with particular interest in the subject; people attended (or didn't attend) as their schedule and interest dictated; the only authority of the group was the individual authority that each member brought from his or her local arena. The nature of EISS activities and technologies establishes a greater demand for cross-organizational coordination.

In the area of EISS, WSDOT needs more formal, centrally supported, cross-organizational communication mechanisms. A good start would be if WSDOT held formal, enterprise-wide discussions of key EISS issues. But central administration must go further than this, to take an active role in bringing representatives of the various key perspectives on an issue to a common table and empowering (and guiding) that group as owners and managers of that issue.

4.2. Make Public Outreach an Integrated Component of Operational Activities

Positive public outreach efforts present special challenges for WSDOT. When things go well, there is generally little of interest to the average citizen. Most citizens only focus their attention on WSDOT when a transportation-related problem arises and the residents and media seek accountability. An example of this occurred during our study when a shutdown of the SR 520 Bridge for repairs created traffic jams that lasted for hours. WSDOT was criticized not so much for the traffic jams or delays but for insufficiently publicizing the work and its impacts. A failure like this to adequately alert the public to time-consuming traffic conditions can cause serious harm to WSDOT.

> The public perception of WSDOT is often that of a large, poorly organized and managed bureaucracy that spends a lot of money and does little for the public.

Historically, WSDOT's decentralized structure has encouraged local units to set their own public outreach methods and priorities. While this has had many positive aspects (e.g., responsiveness to and awareness of unique local needs), this has also worked against the establishment of a more systematic approach to public outreach that could preserve the benefits of local autonomy within a more uniform standard of public communication.

Also historically, traffic operations and public outreach have been seen as being in competition, handled by different groups with different roles and organization (e.g., operational versus administrative) and competing for portions of a finite operating budget. In our interviews we found numerous examples in which operations people saw communication initiatives as working against operational efforts, and in which communications people saw operational initiatives as ineffectively handling public outreach. Here again, a more systematic approach is needed that integrates operational and outreach efforts.

WSDOT needs to make public outreach a fundamental part of any significant operational activity, as much as activities such as budgeting and scheduling. Just as budgeting, for example, is driven by standard organizational practices and goals, so must public outreach become a part of the organizational system for managing transportation projects. This should not be formalized in a manner that eliminates the advantages of local experience but should include a standard approach that determines the likely public impact of a project and establishes an outreach component of the project that is appropriate to that impact.

4.3. Establish Organizational Homes for Policies and Practices That Support the Enterprise-Wide Use of Electronic Information

In the course of our interviews, we asked WSDOT employees working on information and communication issues, "Where is the home of WSDOT information and communication policy and practice? Who is the WSDOT Chief Information Officer (CIO)?" Even among these knowledgeable people there was little agreement. Some employees said this was handled on an ad hoc basis and that there was no official home, nor was there an official WSDOT CIO. Some said it was housed in the Information

Technology Office in Olympia, and that the head of IT was the CIO. Some said it was housed in the Communications Office in Olympia, and that the head of Communications was the CIO. Some even said that while there was no official CIO, for all practical purposes it was an operational activity and that it was the Chief Traffic Engineer in Olympia who guided organizational policy and practice in this area.

WSDOT needs to establish a strong, visible CIO's Office and, more importantly, assure that this office plays an appropriate role in cross-organizational management of EISS. As this report has discussed, enterprise-wide EISS management is not primarily about "owning" technology. At WSDOT, owners of functionally organized technology already exist. What is lacking is the owner of the space between these nodes of responsibility.

WSDOT's CIO should own this "space between"—the formal communication and interactions that link the functional parts into a strategic whole. When an EISS issue is not isolated within a functional or regional unit, the CIO's Office should (1) identify the relevant organizational perspectives on this issue, (2) determine the best available representatives of those perspectives, and then (3) link, guide, and empower those people to establish a cross-organizational team that becomes the manager and organizational point of contact on this issue. Acting with the guidance and authority of the CIO's office, this enterprise-wide team can consider and balance the competing organizational goals that surround a cross-enterprise EISS issue. The CIO is the fulcrum in this balancing act—team building, facilitating cross-boundary communication and activity, assuring that EISS activities are aligned with organizational goals and strategies, and institutionalizing desired change.

Presently within WSDOT, no person or office is charged with handling these and related critical coordinative activities and responsibilities. WSDOT sorely needs a strong, appropriately defined CIO's office.

4.4. Transform WSDOT into a Knowledge-Based Organization

Traditionally, WSDOT has been an organization based on technology, particularly the technology of highway construction and maintenance. Now, without

sacrificing its effectiveness in this area, WSDOT needs to become an organization that is also based on knowledge. Previous recommendations such as establishing formal cross-organizational communication mechanisms; integrating public outreach into operational activities; and establishing a strong, appropriately focused CIO's office are all ways of helping transform WSDOT into such an organization. However, these specific activities need to be informed by an overall conception of WSDOT as an organization that acquires, transforms, maintains, and effectively uses specific types of information to accomplish clear strategic goals, and this conception needs to be translated to employees so that they see themselves (whatever else they do) as knowledge workers in a knowledge-based organization.

There are many useful analyses of the flow of organizational knowledge. Some authors focus on the importance of differentiating among data, information, and knowledge. Hedelin and Allwood, for example, describe a hierarchical relationship among the three and explain how transformation occurs in this hierarchy:

> The transformation of data into information adds meaning, understanding, relevance, and purpose. The change from information to knowledge can occur through mediation of personal application, values, and beliefs. Knowledge is enriched and becomes expertise through experiences, training, and education. (Hedelin and Allwood 2001)

Other authors focus on the transformation from knowledge of individuals in an organization, which they refer to as "tacit," to knowledge that is captured and made available to others within the formal information systems of an organization, which they refer to as "explicit." (see, for example, Stenmark 2001) These authors focus on how individual knowledge becomes group knowledge, and then how that group knowledge gets reconceived and used by individuals to create new knowledge and accomplish organizational goals.

WSDOT should employ these and related analyses in a rigorous self-study designed to better understand how the organization knows what it knows and uses that knowledge to achieve its mission. With this knowledge in hand, WSDOT can then better conceptualize and work to become the kind of knowledge organization it wants to be. For example, in a newly conceptualized WSDOT knowledge environment, a focus on collaborative knowledge activity might replace a focus on ownership of creative EISS

work. Today, individuals at a traffic management center see the real-time traffic system as "theirs," while managers at the WSDOT Communications Office see public information as "theirs." In the future, they all need to see these as part of the shared knowledge environment that all WSDOT employees contribute to and rely on.

Outside this effort, WSDOT has not supported projects focused on the improvement of organizational EISS infrastructure (including people, policy, and practices) under its Advanced Technology Branch (ATB) research and development program. This work has been seen as too "soft" an area to fund. In the future this must change. Organizational self-study and projects to improve how WSDOT develops and manages EISS should be seen not only as acceptable research but should be given high priority. Without them, "hard" research in the development of ITS technology cannot reach its full potential.

4.5. Improve the Alignment between the Organizational Mission and EISS Activities

The misalignments and tensions that negatively affect WSDOT EISS activities generally represent competing perspectives and local "goods." The goal should not be to choose a single "good" among these but, rather, to maintain an ongoing balance of these perspectives and "goods" based on alignment with higher-level organizational missions and objectives.

Many EISS activities at WSDOT are localized or fragmented, even though they have strong cross-organizational impacts and require integration and coordination across WSDOT to reach their potential. In order to achieve the enterprise-wide integration and coordination needed for EISS projects, many tensions, multiple perspectives, and cross-organizational differences must be considered and balanced. For example,

- Balancing central management and local execution
- Assuring that central guidance is at an appropriate level
- Clarifying ownership and responsibility
- Considering the impact of local diversity and autonomy
- Overcoming funding disincentives
- Considering the evolution of issues over time
- Strengthening horizontal relationships
- Addressing issues of organizational culture

The best way to address critical cross-organizational issues like these is to empower permanent cross-organizational entities focused on EISS issues. These entities (guided by central administration) are in the best position to align the various local perspectives with the overall WSDOT mission. Many of the previous recommendations, working together, can help supply supportive mechanisms. For example, the recommendation for permanent, cross-organizational teams to manage EISS issues can help achieve this alignment, but only with the guidance of a strong CIO and a culture of shared knowledge to assure that the work of these cross-organizational teams balances the various local perspectives based on higher-level organizational goals.

4.6. Evolve from a Focus on Technology to a Focus on Information and Knowledge

Part of the evolution to a knowledge-based organization will be a shift in focus from technology as the primary driver to technology as part of the supporting infrastructure for a new driver—information and knowledge.

Traditional IT professionals and the organizations they work for often see hardware and software as the central elements of their systems. Hardware and software are critical, but an organization like WSDOT involved in enterprise-wide EISS initiatives cannot limit its focus to issues involving computers, communication devices, operating environments, and application software. To successfully develop and deploy programs such as ITS or content management systems (CMS), which promise to manage content-like data and then integrate that content with on-line (and other) presentation forms, WSDOT employees are increasingly being called on to address issues involving the generation, capture, manipulation, sharing, and use of data, information, and knowledge in the pursuit of organizational missions.

From the computer-centric perspective of many traditional IT professionals, the operational use of data is separate from the system that is their primary concern. They see themselves as keepers of the technology system that lies at the center of their universe, while data and information belonging to other units is used to “feed” their central system. But EISS efforts such as ITS and CMS remind us that data and information are more than numbers being eaten, crunched, and spit out by hardware and

software. Databases represent the entities of interest to an organization, the relationships among those entities, the questions that an organization wants to be able to answer, and how they go about answering them. In other words, a well-constructed database (especially one consisting of content elements) represents how an organization views the world and how it conducts its business.

Over the course of WSDOT's ITS and CMS efforts, it has become clear that changes made to hardware and software generally do not address the central information and communication issues. These initiatives should foster a perspective in which data and information move to the central position, with hardware and software being adjusted to serve those data and information. This perspective is consistent with the fact that hardware and software change rapidly, while data and information change rarely and only at great cost (as demonstrated by the massive Y2K effort over the latter half of the 1990s).

For many IT professionals this represents a new perspective on their systems, but it is in no way a diminishment of their importance or worth. It is, however, a modification and expansion of what they do, who they work with, and how they work with them. As Weill and Broadbent point out, a company's information technology infrastructure includes not only hardware and software but also the people who rely on and maintain the hardware and software to get things done. (Weill and Broadbent 1998, p.6) Similarly, Davenport states that the "status quo approach to information management, invest in new technologies period, just doesn't work." He argues that since information and knowledge are created by humans, "we will never be good at managing them unless we give people a primary role." (Davenport 1997, pp.3-4)

WSDOT initiatives such as ITS and CMS should encourage the organization to reverse the commonly held perspective of computer-centric IT management by emphasizing the central nature of information and knowledge as they are used in the accomplishment of organizational missions. Data and information are used to generate the core knowledge of an organization, and any rational organization, given the choice between saving its processing systems and saving its data and information, will always choose the data and information.

4.7. Evolve toward a Systems Rather Than Localized or Centralized Approach

EISS is a complex, open system that functions differently than closed systems or machines. This is because "real systems are open to, and interact with, their environments, and… they can acquire qualitatively new properties through emergence, resulting in continual evolution." (Bertalanffy 1998) Complex systems like these require different management methods than simpler systems, and the study of managing these systems—*Systems Theory*—has been a hot topic of research for nearly a century. "Rather than reducing an entity to the properties of its parts of elements, systems theory focuses on the arrangement of and relations between the parts which connect them into a whole." (Bertalanffy 1998)

As WSDOT shifts from an organization that focuses on building and maintaining pavement to an organization that also generates and uses information, it needs to understand and adopt new methods of managing the complex information and communication systems it is increasingly relying on. Here is another example of where WSDOT needs to expand its notion of "acceptable research."

4.8. Improve and Clarify the Use of the WSDOT Intranet

In addition to the recommended use of cross-organization, cross-functional teams focused on EISS issues, there is another important internal mechanism that WSDOT needs to better exploit in support of cross-organizational coordination of EISS—the WSDOT intranet. In the past, WSDOT has focused more on the external use of computer-based communication (the Internet), but as WSDOT shifts more to being a knowledge-based organization, an effective intranet is a prerequisite.

An effective intranet is an important tool in establishing an effective internal EISS community, one that works across geographical and functional lines to foster cross-organizational interaction. In other words, an effective WSDOT intranet will not only foster the exchange of data and information, it will also affect organizational process and culture. "[The intranet] has been considered almost entirely as just another means of distributing information rather than a tool to streamline and redesign the process." (Goodwin and Vidgen 2002)

In undertaking an intranet initiative, it is important to recognize that, like a CMS

effort, an intranet initiative is not primarily about technology, nor is it primarily about the IT elements of WSDOT. In order to be successful, WSDOT will need to focus on its use of information and knowledge to achieve organization goals, and it will need to establish its intranet under the direction of a strategic-level manager who empowers all the relevant organizational parties to participate in a cross-enterprise effort.

In addition to fostering information exchange and building an internal working community, an effective intranet will need to be coordinated with WSDOT's use of the Internet to communicate with external audiences. The origin and evolution of WSDOT's use of the Internet has been similar to that of many other organizations: it has been the direct result of technology professionals taking the initiative to start, develop, and maintain website projects. (Goodwin and Vidgen 2002)[i] The next generations of WSDOT Internet and intranet sites need to be part of a strategically integrated whole. In other words, internal and external communications must be supportive of each other.

5. Future Work and Research

Following are six inter-related future projects that would constitute an excellent first wave of research to help WSDOT achieve the goals discussed in Section 4.

1. Hold a goal-oriented, cross-organizational workshop for WSDOT EISS experts and stakeholders as soon as possible.

2. Initiate a project to define the nature, role, and implementation of a revitalized WSDOT CIO office, with an eye toward establishing that office as soon as possible.

3. Initiate research to better understand WSDOT as a knowledge organization as well as the roles of WSDOT employees as knowledge workers.

4. Initiate a project to redefine and implement a revised WSDOT intranet, distinct from yet strategically integrated with the WSDOT Internet sites.

5. Develop a revised strategic plan for WSDOT ITS in the light of projects 1-4.

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Appendix A— Interview with the CIO of ODOT

In support of the overall perspective on the CIO position presented in this report, we present the following interview with the CIO of Oregon's Department of Transportation (ODOT).

(1) When was the position of Chief Information Officer created? How was the position created (e.g. by the governor, secretary, legislature, etc)?

The ODOT CIO position was created in 1991 by the Director of ODOT. It was approved by the Transportation Commission and the Oregon Legislature.

(2) Why was the CIO position created?

The department had several separated IT units, all doing their own thing and not very well. The CIO position was created to pull those units together and to develop a professional IT organization within ODOT.

(3) What do you see as your most important job functions or duties as CIO?

Ensuring that IT is aligned with ODOT's various businesses and their missions. Ensuring that IT resources such as money and people are available to meet the agency's IT needs. Developing external partnerships to accomplish the two above jobs. Developing personal working relationships with ODOT's executive management team.

(4) When you took the position as CIO, what were the main challenges your organization faced? What roles have you and your office played in addressing these challenges?

When I took this position in the Fall of 1995, the department was facing a major failure of its multi-million dollar DMV project. The agency lacked IT direction, standards and suffered from ailing infrastructure. IT was not aligned with the business. There was little support of the IT organization and no trust that it could deliver.

My office helped kill the DMV project and over a period of months, upgrade the infrastructure to restore good service to Oregon citizens at DMV offices. Technology standards were developed and implemented. An Executive IT Steering Committee was created by business executives to set IT strategy, policy and make funding decisions. I personally met with and developed personal relationships with senior management across ODOT to start the healing process, mend fences and start to regain trust for the IT organization.

(5) What role does your office play in cross-functional or cross-organizational projects involving electronic information and supporting systems? In functionally-bound projects within a single organizational unit?

My office plays little role in projects unless they are of a major magnitude, such as Y2K or ERP. In those cases, I am directly involved in the governance of those projects, along with other ODOT executives. For all projects over $500K, I review the QA reports. I receive a monthly status report on all projects over $50K and review problem areas with my managers.

(6) Do you create organization-wide policy? If so, what types of policy? How is this policy disseminated and sustained?

My office is responsible for developing IT policy. Examples are Appropriate Use of Email and Internet, Quality Assurance for IT Projects, Use of Development Methodology, Security, etc. My office formulates policy and the IT Executive Steering Committee approves them for implementation within the agency.

(7) Can you give us an example of something you're particularly proud of that would not have been possible if the CIO office did not exist?

I think everything I mentioned in Answer # 4 could not have been accomplished without a CIO office. But the one thing I am most proud of is that the ODOT IT organization is viewed as the number one IT organization in Oregon State government. We couldn't say that in 1995. This has occurred because we have come together from five separate groups into one that has a common vision. We have built a leadership team that can attract outstanding people to this organization so that we can continue to build upon the successes of the past. A CIO office was needed for that or at least someone functioning in that capacity.