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A Systems View of IS Governance and IT Governance: A Case Study of the Virginia Department of Transportation

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A dissertation submitted in partial fulfillment of the requirements for the degree of Doctor of Philosophy at Virginia Commonwealth University.

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GLOSSARY AND DEFINITIONS

Acronym / Term	*Definition*
APA	Virginia Auditor of Public Accounts; a constitutionally mandated office within the Virginia legislative branch that audits all state bodies and officers that handle state funds.
BTO	VDOT's Business Transformation Office
CIO	Chief Information Officer
CMMi	Capability Maturity Model Integration
CobiT	Control Objectives for Information and Related Technology Framework
CRM	Customer Relationship Management
DGS	Virginia Department of General Services; an executive branch agency that provides support services to other agencies, local governments, and citizens. The services include engineering, fleet management, laboratory, purchasing, and real estate.
DP	Data Processing
GEIT	Governance of Enterprise IT
I&IM	Instructional and Informational Memoranda – a VDOT governance document that describes approved policies and processes.
IaaS	Infrastructure-as-a-Service
ICT	Information and Communications Technology
Information	For a thing (symbol or a collection of symbols) to be considered information it is necessary and sufficient for such a thing to have a socially created interpretation that is believed to be a true representation of knowledge
Information System	For a system to be considered an information system, it is necessary and sufficient that at least one of its parts be an IT and that at least one of its products satisfices the information needs of at least one other constituent part of the system in which the information system is also a part.
Information Technology	Information technology is a system that consists of an underlying tangible digital electronic-based device (hardware) and intangible sequences of instructions for that hardware (software) that enable any of the storage, transmission, or manipulation of data
IP	Intellectual Property
IS	Information Systems / Information System
IT	Information Technology
IT governance	"Specifying the decision rights and [the] accountability framework to encourage desirable behavior in using IT" (Weill and Ross 2004, 2)
ITD	VDOT's Information Technology Division

Acronym / Term	*Definition*
ITGI	IT Governance Institute
ITIL	Information Technology Infrastructure Library
JLARC	Joint Legislative Audit and Review Commission; a commission of the legislative branch of the Virginia state government that performs audits and oversight of government operations
MIS	Management of Information Systems
OTSP	VDOT's Office of Technology Strategic Planning
PaaS	Platform-as-a-Service
SaaS	Software-as-a-Service
SIM	Society for Information Management
SSM	Soft Systems Methodology
STIB	Strategic Technology Investment Board
System	To be considered a system it is necessary and sufficient for a thing to be teleological, to transform inputs into desired outputs, and to have differentiated, interdependent, and controlled elements that constitute the whole thing.
Technology	Activities and resultant products that arise from the practical application of scientific epistemology
VDOT	Virginia Department of Transportation; a department within the Transportation Secretariat of the executive branch of the Virginia state government
VITA	Virginia Information Technologies Agency; a Department within the Technology Secretariat of the executive branch of the Virginia state government

ABSTRACT

A SYSTEMS VIEW OF IS GOVERNANCE AND IT GOVERNANCE: A CASE STUDY OF THE VIRGINIA DEPARTMENT OF TRANSPORTATION

By Bernard W. Farkas, Ph.D.

A dissertation submitted in partial fulfillment of the requirements for the degree of Doctor of Philosophy at Virginia Commonwealth University

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A review of the research related to Information Technology (IT) governance reveals that researchers have yet to use systems theory directly as a basis for understanding IT governance; however, analysis of these researchers' various definitions of IT governance shows a concurrence between these definitions and the characteristics of a system. This case study research adopts a systems imagination to observe IS and IT governance in the Virginia Department of Transportation (VDOT), which has a budget of over $5 billion and over 7,500 employees and has recently conducted a strategic assessment of its IT organization - including IS and IT governance.

The case study posits that VDOT is an indivisible, purposeful, goal seeking (teleological) system where (1) there are three peer elements (governance, management, and operations);

(2) there is a governance feedback mechanism (auditing and monitoring); (3) there are peer areas within the governance element that are specialized for a VDOT asset (e.g., capital asset governance, financial governance, human resource governance, etc.) and IS governance is the peer area that is specialized for IT assets; and (4) there are sub-peer areas within IS governance that are specialized for an IT, and this specialized form of IS governance is named IT governance.

Chapter 1 – INTRODUCTION

Whenever an institution malfunctions as consistently as boards of directors have in nearly every major fiasco of the last forty or fifty years, it is futile to blame men. It is the institution that malfunctions.
— Peter F. Drucker (1976)

IT governance is no longer some stand-alone function but is an integral part of any organization's overall corporate governance. If an organization cannot survive as a competitive player without IT, then the Board cannot apply acceptable corporate governance without overt IT governance.
— Deloitte & Touche (2003)

1.1 RESEARCH BACKGROUND

Fraud and deceit abound in these days more than in former times!
— Sir Edward Cole (1602)

Let the people think they govern and they will be governed.
— William Penn (1691)

To govern is to choose. To appear to be unable to choose is to appear to be unable to govern.
— Nigel Lawson (1992)

As demonstrated by the ideas above, the concept of governance has a long provenance and a broad application. Governance's etymology traces to the late fourteenth-century old French *gouvernance* (government, rule, administration), which is derived from the Greek word κυβερνάω (to steer or pilot a ship) (Online Etymology Dictionary). Presently, the word governance is taken to mean "the action or manner of governing" or "controlling, directing, or regulating influence." It does not follow that IT governance is the control or direction of an organization's IT function. Since the 1990's, researchers have proposed meanings for IT governance that somewhat vary (Balocco, Ciappini, and Rangone 2013; Brown and Grant 2005). In their influential study, Weill and Ross define IT governance as "specifying the decision

rights and accountability framework to encourage desirable behavior in using IT" (Weill and Ross 2004, 2). Joining with many subsequent studies (e.g., De Haes and Van Grembergen 2009; Huang, Zmud, and Price 2010; Bradley, et al. 2012), this research adopts the Weill and Ross definition of IT governance.

Prior research into IT governance has observed this organizational phenomenon through the lens of technology use and outcome; for example, the Weill and Ross definition (fully stated above) concludes that IT governance "… encourage[s] desirable behavior in using IT." However, Weill and Ross's perspective is not a systems perspective. Weill and Ross view IT governance as an influencer of an organization's use of IT but stop short of a full investigation of systemic effects. A systems perspective, applying insights from systems philosophy (thinking) and systems theory that have long been available but also ignored within the IS research domain, could dramatically expand and enrich Weill and Ross's view.

1.1.1 Systems Philosophy and Systems Theory

Information systems research examines a phenomenon seeking to identify those items that influence it. In other words, a specialist in IS research, using the domain's accepted research methods, seeks to explain how identified things affect a phenomenon, i.e. a unidirectional relationship is derived between the phenomenon and the identified variables (things). Adopting a systems philosophy, an IS researcher would examine the phenomena as a collection of distinct, interacting things and seek to explain this collection of things as a whole under different influences (Laszlo 1996, 4), i.e., a multi-directional relationship is derived among a collection of things (Angyal 1981, 35).

This systems philosophy worldview is familiar to experiences in everyday life. For instance, the behavior of an automobile to transport people and things are commonly viewed as the whole collection of parts that comprise the car, as is the speed in which a car's elements and contents proceed. By observing a car as a whole or as a related group of wholes, the researcher's investigation into a phenomenon is simplified. Cars contain tens of thousands of parts (per Toyota, a car has about 30,000 parts) and millions of relationships among these parts, some of which are not known. Investigating a phenomenon that contains such a magnitude of things and relationships is very complex and, by necessity, would be limited in the number of relationships considered. Alternatively, considering a collection of parts and relationships as a whole (or partitioning them into a small number of wholes) dramatically simplifies the investigation and reduces (approaching elimination) the need for relationships a priori.

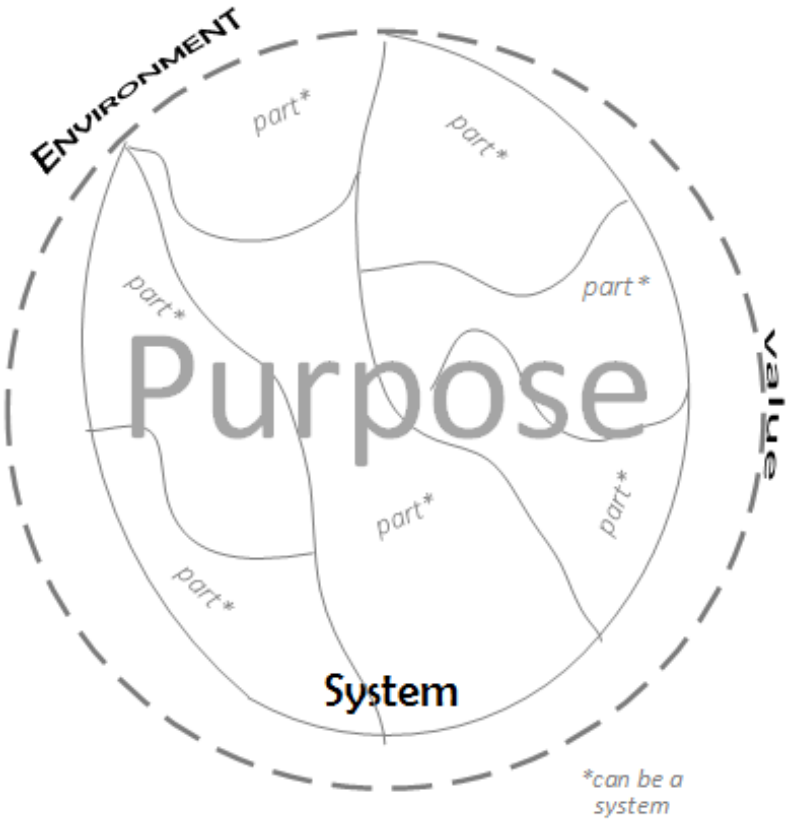


Figure 1-1. Open Systems Model

Systems theory posits that for a collection of things to be a system, they will collectively have certain characteristics: differentiation, teleology, hierarchy, holism, interrelationship, regulation, and transformation.

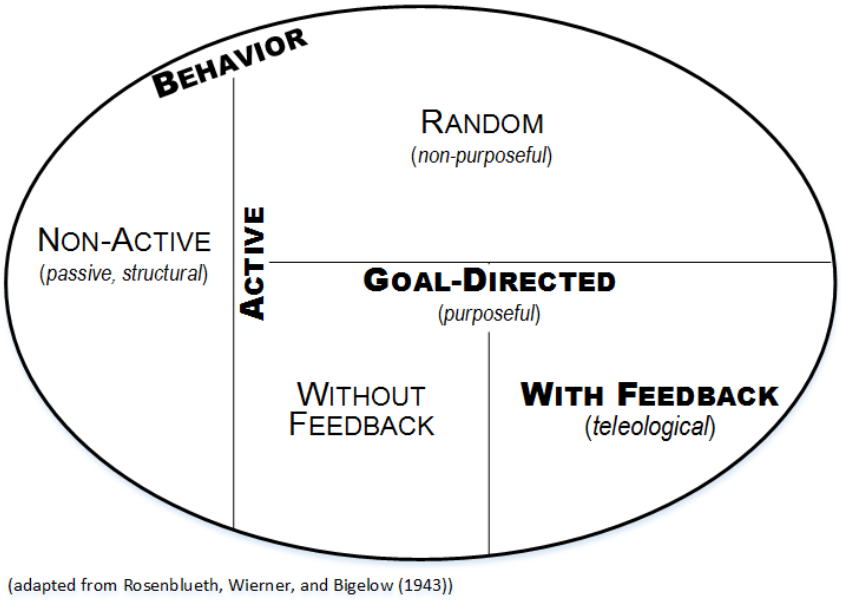
1.1.1.1 Differentiation

The system consists of specialized elements that perform a specialized function(s), i.e., specialization, division of labor. For example, among the elements of a car are power generation, cooling, navigation control, and emissions.

1.1.1.2 Teleology

A system has a purpose - it seeks to obtain a desired goal, final state, or equilibrium. The idea of purpose is seemingly overarching and vague; nevertheless, it expresses an important

characteristic. The concept of purpose refers to a behavior, which can be subdivided or categorized (see Figure 1-2). One such category is active behavior, which are those behaviors that involve a change (Rosenblueth, Wiener, and Bigelow 1943, 18). Active behavior can be goal directed (purposeful) or random (purposeless).



(adapted from Rosenblueth, Wierner, and Bigelow (1943))

Figure 1-2. Taxonomy of Behavior

Rosenblueth outright rejects the notion that "all machines [collections of elements] are purposeful." While a machine is created for a purpose, the behavior of the machine does not have to achieve a goal. An example of such a machine is a clock whose purpose is to measure the interval since an initial setting and to display this measurement in units of time, e.g. seconds, minutes, day, month, year. Regardless of the clock's complexity or precision, it is not purposeful; a clock does not seek a final state or goal (Rosenblueth, Wiener, and Bigelow 1943, 19). In contrast, Rosenblueth says that a servomechanism such as a target-seeking torpedo is an example of a machine (system) with an intrinsically purposeful behavior.

The means to obtain the goal is not fixed. The system can have equally valid means to obtain a goal, which is referred to as equifinality. Also, the system can obtain different desired goals, which is referred to as multifinality. An example of equifinality is the element of a car that maintains the car's velocity, which can be obtained by using the accelerator or by using the cruise control. An example of multifinality is the element of a car that maintains the operating temperature of the engine (radiator), the passenger compartment (heater), and the visibility of the windshield (defroster).

1.1.1.3 Hierarchy

A system is a whole that can be contained within another system, and that may contain systems, i.e. systems are nested. In considering the example of an automobile, it contains systems, e.g. engine, transmission, coolant, etc. These systems also contain systems. Also, the automobile is a part of a system, e.g. a family, the family's supply chain system, the local transportation system, an employer's human resource system, etc.

In his seminal article, *General Systems Theory – The Skeleton of Science*, Boulding (1956) proposed a hierarchy of systems. The hierarchy consists of nine levels and the complexity of the systems increases in subsequent levels. Each of these levels has emergent properties. Also, a system in a higher level contains all the systems in the lower levels (see Figure 1-3).

Level	Characteristics	Examples (concrete or abstract)	Relevant Disciplines
1. Structures, Frameworks	Static, spatial pattern	Crystal structures, bridges, atoms	Description, verbal or pictorial, in any discipline
2. Clock-works	Predetermined motion (may exhibit equilibrium)	Clocks, machines, the solar system	Physics, Astronomy, Engineering, classical natural science

Level	Characteristics	Examples (concrete or abstract)	Relevant Disciplines
3. Control mechanisms	Closed-loop control	Thermostats, homeostasis, mechanisms in organisms	Control theory, Cybernetics
4. Open systems	Structurally self-maintaining	Flames, biological cells	Theory of metabolism (information theory)
5. Lower organisms	Organized whole with functional parts, 'blueprinted' growth, reproduction	Plants	Botany
6. Animals	A brain to guide total behavior, ability to learn	Birds and beasts	Zoology
7. Man	Self-consciousness, knowledge of knowledge, symbolic language	Human beings	Biology, Psychology
8. Socio-cultural systems	Roles, communication, transmission of values	Families, the Boy Scouts, drinking clubs, nations	History, Sociology, Anthropology, Behavioral Science
9. Transcendental systems	'Inescapable unknowables'	The idea of God	?

Source: Contents adapted from Checkland (1999); Wilby (2006)

Figure 1-3. System Hierarchy and Complexity

1.1.1.4 Holism

A means to distinguish a system from a collection of related elements is that a system as a whole has one or more characteristics not associated with any of the elements, i.e. each element is an individual that has its characteristic(s), and the system is a distinct individual with its characteristic(s). Further, a system can perform only as a whole; therefore, an observer can only obtain an understanding of the system as a whole. This is represented in Figure 1-1 by the inner circle that contains a collection of puzzle parts, which fit together to realize the function

of the system. In other words, deconstructing a system into its constituent elements loses the capability of this independent collection of elements to perform the original holistic function, e.g. a deconstructed airplane cannot fly, a deconstructed thermostat cannot control temperature, a deconstructed cell phone cannot make or receive a phone call, etc. Further, analyzing each system element independently reveals individual structures and functions without a holistic understanding of the overall system function (Ackoff 1994).

1.1.1.5 Interrelationship

A system consists of related and dependent elements. Through the interactions of these elements, something is accomplished that is more than the elements can accomplish individually, i.e. the whole is greater than the sum of its parts (Bertalanffy 1969, 55). This collective behavior depends on the behavior of each constituent element (Churchman 1979, 11; Gharajedaghi and Ackoff 1984, 293). This collective behavior is reflected in the system's *collective efficiency*, the overall efficiency of the interactions among the constituent elements.

Counterintuitively, improving the overall efficiency of the system, *collective efficiency*, is achieved by enhancing the performance of the interaction between elements rather than focusing on the performance of individual elements (Gharajedaghi and Ackoff 1984). As shown in Figure 1-1, rather than improving the area within each part, improvements should be made in the boundaries of each part (i.e. in the interactions represented by the lines). As an illustration, consider an effort to improve the efficiency of a sports car by selecting the highest performance elements, e.g. Porsche engine, Lamborghini transmission, Mercedes exhaust system, Corvette brakes, Ferrari steering, etc. When placed together the overall performance of the sports car will at most be average because the interaction between the elements is not

efficient, e.g., each high-performance element does not align correctly – for example, the size and shape of the exhaust manifold of the engine are different from the exhaust system.

1.1.1.6 Regulation

To obtain its goals, the system's elements must be regulated by some means, e.g. feedback, deviation detection. Feedback refers to a behavior making use of its results, i.e. the resultant output is also an input. The case in which the behavior is moderated by variance from a goal is referred to as negative feedback, i.e. the feedback is used to adjust subsequent behavior. Therefore, when a behavior includes negative feedback, the behavior intentionally achieves its results. This subset of purposeful behaviors is referred to as teleology (see Figure 1-2). This derivation of the meaning of teleology is restricted to purposefulness; the concepts of causality and determinism are not explicitly included. The concept of causality refers to a one-way, irreversible functional relationship that occurs over time. Teleology is a behavior that is controlled by negative feedback over time. However, teleology can be deterministic when a deterministic behavior is involved (Rosenblueth, Wiener, and Bigelow 1943, 24).

1.1.1.7 Transformation

A system exists within an environment, which is the set of conditions that are not controlled by the system (Churchman 1979, 64). A system that consumes inputs from its environments is called an *open system*, whereas a system that contains its inputs is called a *closed system (Skyttner 2005, 62-63)*. To achieve its desired goal, a system transforms inputs into outputs.

1.1.2 *Re-visualizing IT Governance with Systems Thinking*

De Haes and Van Grembergen's highly cited exploratory case study (De Haes and Van Grembergen 2009) of IT governance is an exemplar of IS researchers' disregard of systems theory. In this study, De Haes and Van Grembergen investigated the implementation of IT governance in the Belgian financial sector; the major finding was that "business/IT alignment maturity is higher when organizations are applying a mix of mature IT governance practices."

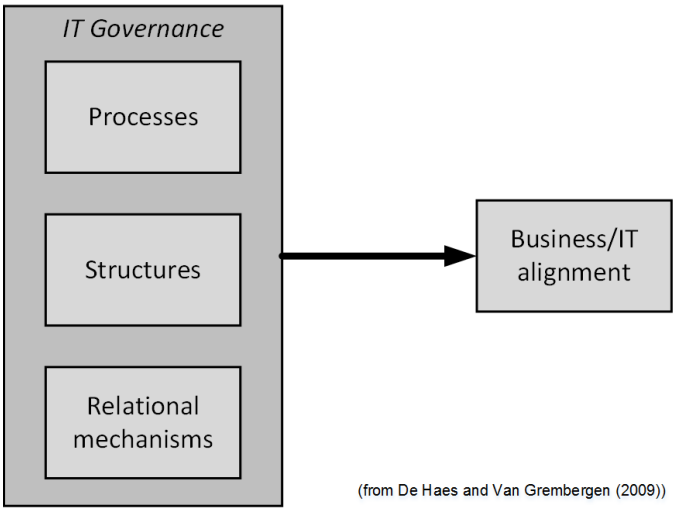


Figure 1-4. IT Governance Framework

The researchers explain that an organization implementing IT governance uses some combination of processes, structures, and relational mechanisms (see Figure 1-4). Processes are the procedures by which an organization monitors IT or makes strategic IT decisions. Structures are the enablers and formal conduits between the organization's business and IT management. Finally, and crucially, the relational mechanisms are the active collaborative and participative relations among the organization's leadership, e.g. executives, business managers, IT managers.

It does not take a vivid imagination to realize the complexity that can exist in the set of possible two-dimensional boxes and arrows that connect each IT governance process, structure, and relational mechanism within an organization; this complexity is compounded when the third dimension of organization hierarchy is included. Coincident with this complexity is the uncertainty of the completeness and necessity of each member of such a set of boxes and arrows. This uncertainty imposes constraints on the traditional IS discipline's approach to investigating IT governance.

An example of such a constraint is the explanation provided by De Haes and Van Grembergen that the scope of the research was reduced, "… we will discard the operational oriented level…" (De Haes and Van Grembergen 2009, 125). The researchers have two justifications for this research design choice: 1) IT governance is hierarchical; and 2) the operational level as defined by Peterson (2004b) is IT management instead of IT governance. According to the researchers, the difference between IT management and IT governance is that the goal of IT management is to effectively and efficiently provide IT services and products while the goal of IT governance is to ensure that IT meets the present and future needs of the business and its customers (De Haes and Van Grembergen 2009, 125). In eliminating the operational level from the study, the researchers have reduced the complexity of the phenomenon that was observed by the selected instruments. This research design implies that the selected instruments are not sufficient to detect or measure the entirety of IT governance, i.e. the instruments constrain the research design by necessitating a maximum level of complexity within a phenomenon.

While the precision of the instruments does not call into question the validity of the observations, it can limit the research's contribution to the body of knowledge. For instance, astronomers have observed the universe using increasingly precise earth-bound telescopes (i.e. instruments that constrained astronomical research because of the limits that the earth's atmosphere imposed). For example, at the beginning of the twentieth century, Edwin Hubble used the then largest telescope, the Mount Wilson Observatory's Hooker Telescope, to determine that nebulae were distinct galaxies instead of a part of the Milky Way Galaxy, which fundamentally altered the scientific understanding of the universe (Peebles 1980). Beginning in 1993, the Hubble space telescope changed astronomical research design and brought new precision to astronomical findings. For instance, the age of the universe was revised from an estimated 10 to 20 billion years to 13.82 billion years plus or minus five percent; and the age of observable galaxies was reduced from two billion years after the origin of the universe to 600-million years after the origin (Redd 2015). For astronomy, the improvement in the available research instrument altered the researchers' imagination. According to astrophysicist Robert Kirshner of the Harvard-Smithsonian Center for Astrophysics, "We didn't have enough imagination at the beginning [observations with the Hubble telescope] to think of all the things that nature does" (Crockett 2015, 20).

Systems theory provides researchers with an instrument that can observe the breadth, the depth, or both IT governance phenomenon. This comes from the worldview that a phenomenon (system) is a cooperative of elements with an objective of the whole (Churchman 1979, 11). This worldview contrasts with the classical natural science worldview (see Figure 1-5), e.g. all things are distinct and measurable versus things are a configuration of energies that

flow and interact, things are separate from their environment versus things are connected and communicate with their environment, etc. In changing the worldview, researchers observe phenomena with a different imagination. As illustrated by the previous astronomy example, the finding of a previously unknown imagination can result in a dramatic alteration to a field's epistemology.

	Natural Science Worldview	Systems Worldview
Conceptualization of Nature	Giant machine composed of intricate but replaceable machine-like parts	An organism endowed with irreplaceable elements and an innate but non-deterministic purpose for choice
Relationship to the Environment	Atomistic and Individualistic – objects are separate from their environment; people are separate from each other and their surroundings	Connections and Communications – emphasizes community and integrity in both the natural and the human world
Nature of Matter	Materialistic - all things are distinct and measurable entities	A configuration of energies that flow and interact; probabilistic processes that allow self-creativity and unpredictability
Application to Everyday Affairs	Accumulation of material goods; promoted a power hungry, compete to win ethos	Importance of information (education), communication, and human services over accumulation of material goods and acquisition of raw power
Measurement of Socioeconomic Progress	Growth in the material sphere – greater and greater use of energies, raw materials, other resources	Sustainable development through flexibility and accommodation among cooperative and interactive parts
Culture	Eurocentric – Western industrialized societies are the paradigm of progress and development	Diversity of human cultures and societies (all equal); ranking based on sustainability and member satisfaction
Human Participation	Anthropocentric – humans master and control nature for their own ends	Organic parts within a self-maintaining and self-evolving whole

	Natural Science Worldview	Systems Worldview
Social Science	Dominant notions are struggle for survival, profit of the individual	Cooperation, tolerance of diversity and experimentation that foster human-made and human-nature adaptation and harmony
Medical Science	A machine frequently in need of repair by factual and impersonal interventions and treatments	The body is a system of interacting parts; attention to psychic and interpersonal as well as physical and physiological factors

Source: Contents adapted from Laszlo (1996, 10-12)

Figure 1-5. Comparison of Natural Science and Systems Worldviews

Another aspect of systems theory is that the connection between elements is in relation to the whole, and the relationship structure is derived from the organization of the whole (Sachs 1981, 403). This system's structure confers a hierarchy that enables a researcher to observe at the desired depth and then the breadth of the phenomenon. For instance, viewing IT governance as a system (and an element of a system) permits observation at the extra-organization-level, organization-level, information systems-level, or information technology-level (see Figure 1-6).

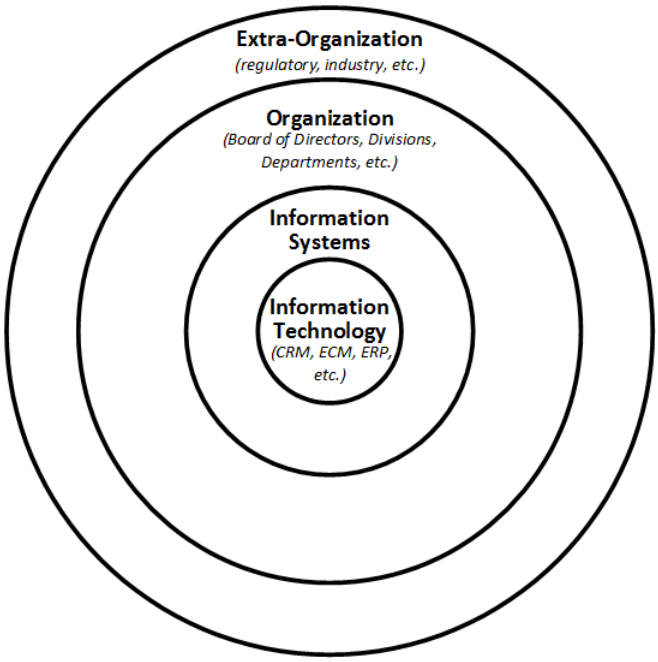


Figure 1-6. Example, IT Governance Hierarchy

Using the systems worldview, De Haes and Van Grembergen's research design would consider the banking organization elements that comprise the IT governance system, i.e. the collection of banking organization elements whose overall goal is to ensure that IT meets the present and future needs of the business and its customers (IT business alignment). Rather than eliminating IT management because it is part of a system with a goal of effectively and efficiently providing IT services and products, IT management would be an element of the IT governance system that has a specific relationship with other elements of the system. Also, processes would be viewed as being performed by an element and only needs to be investigated to the extent of the elements relationships. The structure would be viewed as the relational organization between elements. Finally, Relational mechanisms would be explicitly viewed as the interaction between the elements.

1.1.3 System view of IT Governance

From a Systems Theory perspective, IT governance is viewed as a system rather than an organizational process. Such an interpretation of governance implies that the organization in which the governance system exists is itself a system, i.e. an organization is a system that is comprised of sub-systems, and one of these sub-systems is IT governance (see Figure 1-7). Using this Systems Theory perspective, the Weill and Ross definition of IT governance could be reformulated as *that portion of the organization's framework for decision rights and accountability, whose goal is the enactment of desirable behavior, that produces value from the organization's IT assets*.

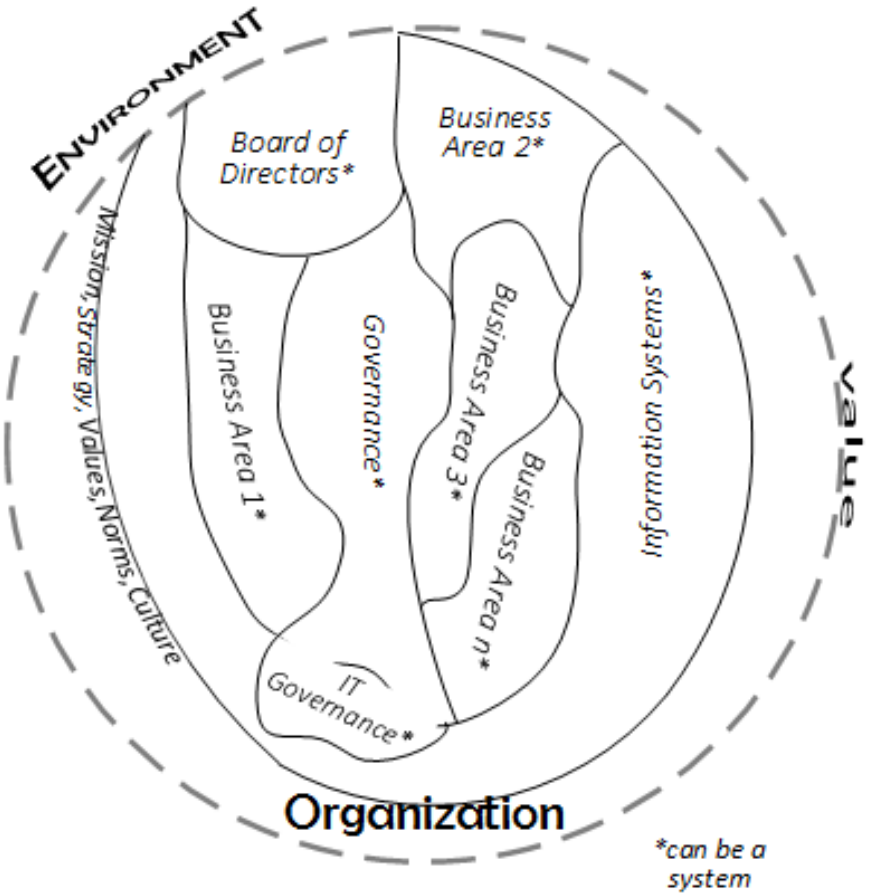


Figure 1-7. System View of an Organization

Even though all organizations have some form of governance, effective governance is purposefully instituted so that informal and formal decision-making authority is coordinated across the organization so that the resultant value is consistent with the organization's mission, strategy, values, norms, and culture (Peterson 2004a; Weill and Ross 2004). Even though IT governance is the responsibility of an organization's management team, it is not an act of management (Peterson 2004a; Weill and Ross 2004). The domain of management is the minutiae of IT decisions, which are informed by the organization's governance framework. The domain of governance is the coordination of decision-making authority across the organization; Figure 1-8 show this relationship between governance and management. The organization's mission, strategy, values, norms, and culture affect the structures within the governance framework. Thus shaped, the governance framework forms the organization's governance, which is used by and affects the capabilities used by management to produce value.

Figure 1-8. Governance Model

1.2 Research Motivation and Significance

... IT governance is the most important factor in generating business value from IT.
... Value comes from integrating the enterprise's key assets.
— Weill and Ross (2004, vii)

1.2.1 Information Systems Taxonomy

Since the founding of the Information Systems discipline over fifty years ago, the discipline's constituent concepts and phenomena have been investigated, and these observations have been published in peer-reviewed journals. One means to determine the IS discipline's taxonomy (i.e., the pertinent concepts) is by having a Delphi panel of esteemed Information Systems researchers assess this published IS corpus. Such a taxonomy (see Figure 1-9) was the outcome of the effort of Willcocks and Lee who were the editors of a six-volume

book series, *Major Currents in Information Systems* (*Major Currents in Information Systems* 2008), which is a compendium of published research selected by noted academics to represent the breadth of the Information Systems discipline[1]. The highest level of the taxonomy consists of Infrastructure, IS development, Design Science, Management, Social and Organizational, and Globalization. IT governance is in the second level under IS Management. The editors' inclusion of IT governance as a discrete sub-category of IS management implies that it is a significant concept within the IS discipline; however, the editors did not imply the significance of IT governance relative to the other sub-categories within the taxonomy.

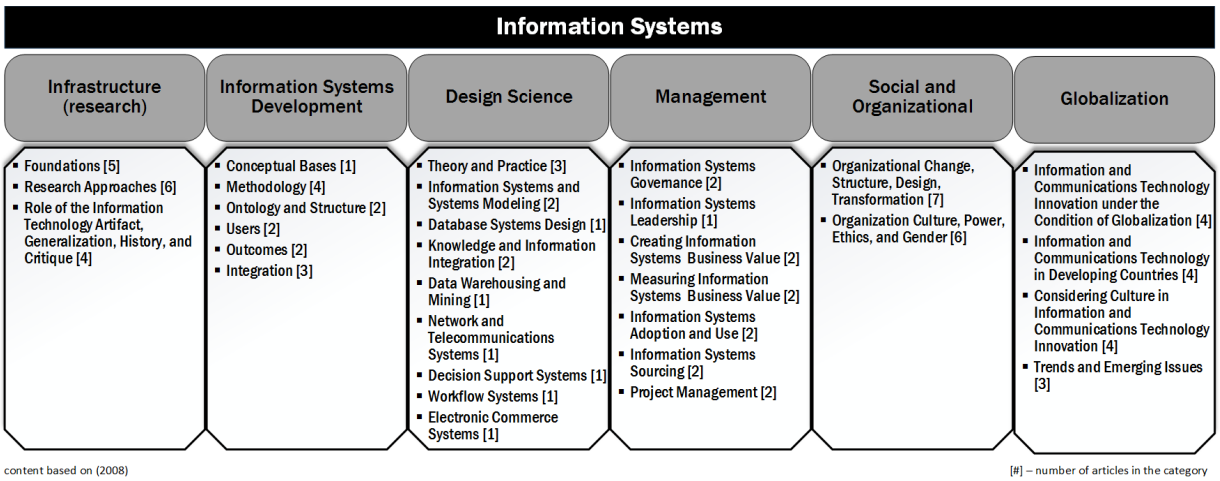


Figure 1-9. Information Systems Discipline Taxonomy

1.2.2 Information Systems Historiography

In a review of the shared history of the Information Systems discipline, Hirschheim and Klein divide the historiography into four overlapping eras: mid-1960s to the mid-1970s, mid-1970s to mid-1980s, mid-1980s to mid/late-1990s, and late-1990s to today (Hirschheim and Klein 2012). Each era is characterized by its management/governance, technology, research

[1] The six-volume series contains 83 articles, and four (4.8%) are related to IT governance: two articles are in Volume IV – Management of Information Systems, IT governance; and two articles are in Volume VI – Information Systems, Globalization and Developing Countries, ICT in Developing Countries.

themes, research methodologies, education, and discipline infrastructure (e.g., organizations, journals, conferences, etc.). While none of the eras had IT governance identified as a research theme, themes closely aligned with IT governance were identified. For example, beginning in the first era, the theme of IT providing business value is identified. During the second era, emergent themes identified include aligning IT with business strategy and IT providing a competitive advantage. Working within these research themes, Weill and Ross concluded that of the collection of factors that contribute to the resultant business value from an organization's investment in IT, IT governance is the most significant (Weill and Ross 2004).

1.2.3 Significance of IT Governance – Practitioner Perspective

Beginning in 1980, the Society for Information Management (SIM) has worked with leading researchers to conduct an annual survey of IT executives representing many industries (e.g., construction, education, healthcare, manufacturing, media, professional services, public sector, wholesale, etc.) to identify key issues. While IT governance has not been an issue directly identified by the survey, the closely aligned concept of IT and business alignment has been a top-three issue in the survey since 2003 and a top concern nearly since the first survey; IT strategic planning has been a consistent top-ten issue since 1980 (Luftman and Derksen 2012).

Like the annual SIM survey, in 2012 the IT Governance Institute (ITGI) commissioned Pricewaterhouse Coopers Belgium to conduct its fourth biennium survey on the Governance of Enterprise IT (GEIT). This web and telephone based survey consisted of over 800 respondents from 21 countries and representing many industries (e.g., education, energy, financial services, healthcare, manufacturing, retail, transportation, etc.). The survey found that the top four

drivers for governance activities were aligning IT with business, managing costs, and increasing agility to support future business changes (2012, 22). Also, the survey reported that the top outcomes of governance are improved management of IT-related risk, improved communication and relationships between business and IT, lower costs, improved IT delivery of business objectives, and improved transparency of IT (2012, 32).

Both the 2011 ITGI and 2012 SIM surveys support Weill and Ross's focus on IT providing business value. Identifying issues closely related to IT providing business value, the SIM survey identified business productivity and cost reduction, IT and business alignment, business agility and speed to market, and revenue-generating IT innovations as the top-four IT issues; these four issues have been in the top-ten since 2009. The ITGI survey concurred in the importance of the first three SIM issues. Finally, echoing Weill and Ross, a significant finding of the ITGI survey is that "the main driver for GEIT activities is ensuring that current IT functionality is aligned with current business needs" (*Global Status Report on the Governance of Enterprise IT (GEIT) — 2011* 2011, 11).

Another indication of the relative significance of governance is a number of resources dedicated to it. One such resource is the time an organization's Chief Information Officer (CIO) has available, which is both a precious and fixed resource. One aspect of the annual SIM survey is examining the amount of time a CIO spends on activities. In its 2012 survey, SIM reported three-quarters of a CIO's time is spent on non-technical matters. CIOs reported that they spent ten-percent of their time on governance, which has been a consistent finding since 2007 (Luftman and Derksen 2012, 215).

1.2.4 IT Governance Definition

Figure 1-10 contains representative definitions of IT governance offered by researchers over the past fifteen years. While there is variance among these definitions, a hermeneutic-like interpretation reveals that IT governance is described in the language of process (the semiotic clues are bolded in each definition). While none of the researchers refer to systems theory in their published findings, analysis of their definitions of IT governance shows a strong concurrence with the characteristics of a system (refer to Chapter 2.1 for a full description of a system). It is this observation and the researcher's extensive practical experience with IT governance within a variety of organizations that motivates the present investigation.

Researchers	IT governance Definition	System Characteristics						
		Differentiation	Teleology	Hierarchy	Holism	Interrelationship	Regulation	Transformation
Sambamurthy and Zmud (1999)	The **direction, control, and coordination** of the activities in the spheres of IT infrastructure management, IT use management, and project management.	✓	✓			✓	✓	
Schwarz and Hirschheim (2003)	"IT related structures or architectures (and associated authority pattern) implemented to successfully accomplish (**IT imperative**) activities in response to an enterprise's **environmental and strategic imperatives**."		✓	✓		✓		
Weill and Ross (2004)	"...specifying the decision rights and accountability **framework** to encourage desirable behavior in using IT. ... reflects broader corporate governance principles while focusing on the management and use of IT to achieve corporate performance goals."		✓	✓		✓	✓	✓

Researchers	IT governance Definition	System Characteristics						
		Differentiation	Teleology	Hierarchy	Holism	Interrelationship	Regulation	Transformation
Simonsson and Johnson (2006a)	"... **preparation** for, **making of and implementation of** IT-related decisions regarding goals, processes, people, and technology on a tactical or strategic level."		✓	✓	✓			✓
Van Grembergen and De Haes (2009)	"Enterprise governance of IT is an integral part of enterprise governance and addresses the definition and implementation of **processes**, structures and **relational mechanisms** in the organization that enable both business and IT people to execute their responsibilities in support of business/IT alignment and the creation of business value."	✓	✓	✓	✓	✓	✓	✓
Huang, Zmud, and Price (2010)	"...**direct and oversee** an organization's IT-related decisions and actions such that desired behaviors and outcomes are realized. [This includes] determining which IT-related decisions are to be addressed ... which individuals are allocated decision rights ... determining how associated decision processes are to be orchestrated."	✓	✓		✓	✓	✓	✓
Bradley, et al. (2012)	"The capacity of top management to control the formulation and implementation of the IT strategy via organizational s**tructures and processes** that produce desirable behaviors, which will ensure that IT initiatives sustain and extend the organization's strategy and objectives."	✓	✓			✓	✓	✓
Zyngier and Burstein (2012)	"...the implementation of authority through a **model** that ensures delivery of anticipated or predicted benefits of a service or process in an authorized and regulated manner."		✓		✓		✓	✓
Jewer and McKay (2012)	"IT governance is the responsibility of the board of directors and executive	✓	✓	✓	✓	✓	✓	✓

Researchers	IT governance Definition	System Characteristics						
		Differentiation	Teleology	Hierarchy	Holism	Interrelationship	Regulation	Transformation
	management. It is an integral part of enterprise governance and consists of the leadership and organizational **structures and processes** that ensure that the organization's IT sustains and extends the organization's strategies and objectives."							
Wilkin, Campbell, and Moore (2013)	"...**evaluating and directing** the use of IT to support the organization and monitoring this use to achieve plans."	✓	✓		✓		✓	✓
Grant and Tan (2013)	"...a dynamic, goal-directed, performance-driven, adaptive, and relational **process** that seeks to bring congruence between organizational and IT strategies, structures, systems, processes, and practices in pursuit of valuable, risk-reduced, and measurable returns on IT investments."		✓		✓	✓	✓	✓

Figure 1-10. System Characteristics within IT Governance Definitions

1.3 Research Objectives and Questions

The time will come when diligent research over long periods will bring to light things which now lie hidden. A single lifetime, even though entirely devoted to the sky, would not be enough for the investigation of so vast a subject... And so this knowledge will be unfolded only through long successive ages. There will come a time when our descendants will be amazed that we did not know things that are so plain to them... Many discoveries are reserved for ages still to come, when memory of us will have been effaced.
— Seneca the Younger (4BCE – 65CE)

Research is exploration and discovery. It's investigating (something that) no one knows or understands. Research is creating new knowledge.
— Neil Armstrong (2005)

The motivation of this research has its genesis in the researcher's professional experience in IT program and project management. During this time, IT governance has been observed in organizations with varying characteristics, e.g., Fortune 100, small business, consumer electronics manufacturer, banking, health care, apparel manufacturer, nuclear power, state regulatory agency, state court, etc. These observations have also occurred during many IS methodology and IT eras, e.g., Waterfall, Iterative, Agile, Mini-computer, Client-server, Cloud, etc. These observations have shown the importance of IT governance to the successful use of an organization's IT assets. Further, it has been observed that the successful governance frameworks have discrete interrelated processes and procedures that are authorized by the organization's leadership and adapted to the organization's other processes and procedures. In other words, regardless of the IS methodology or IT, the researcher has been observing IT governance as a system that is an element of another system - the organization.

Using this practitioner-gained conceptualization of IT governance as a system, this dissertation's investigation seeks first to understand the extent to which the academic understanding of IT governance includes the concept of system, and second to observe the IT governance in an organization from which a model of IT governance that is embedded in the General Systems Theory epistemology can be posited for subsequent research. To realize these research objectives, the investigation is shaped and focused by the research questions contained in Figure 1-11.

	Research Question	Research Objective
R1	Which, if any, IS studies on IT governance have made use of systems thinking? a. Within the IS studies that have been identified, which essential General Systems Theory features have been used (explicitly or implicitly)? b. Within the IS studies on IT governance, what essential IT governance features have been identified or what IT governance features have IS researchers identified as essential, and what are the relationships among these features? c. What is the significance of the correlation, if any, between the essential General Systems Theory features identified in R1.a and the essential IT governance features and relationships identified in R1.b?	Identify the extent of inclusion of the General Systems Theory in IT governance studies
R2	In observing an exemplar organization: a. What General Systems Theory features are observed (explicitly or implicitly)? b. What essential IT governance features can be identified?	Positing a systems model of IT governance for subsequent research
R3	Using the IT governance and General Systems Theory features identified in R2, what is a model of IS and IT governance that explains the IS and IT governance observed at the case site?	

Figure 1-11. Research Questions

1.4 Key Concepts

However expressive, symbols can never be the things they stand for.
— Aldous Huxley (1954)

1.4.1 Organization

The etymology of the word organization is directly from the Latin word *organizationem*, which means system or establishment (Online Etymology Dictionary 2014b). The Oxford English Dictionary provides several commonly used definitions for organization; among these are:

> *The development or coordination of parts (of the body, a body system, cell, etc.) in order to carry out vital functions; the condition of being or process of becoming organized*

The action or process of organizing, ordering, or putting into systematic form; the arrangement and coordination of parts into a systematic whole

An organized body of people with a particular purpose, as a business, government department, charity, etc.

(Oxford English Dictionary 2014)

These definitions include the concepts of systems theory, e.g. carry out vital functions, coordination of parts into a systematic whole, with a particular purpose. The last definition explicitly casts an organization as a social entity, i.e. a body of people. The examples in this definition imply that an organization is not an ad hoc momentary collection of people with a particular purpose. For instance, suppose an individual is hiking along a mountain ridge and falls into a ravine and is trapped. Then over time, hikers arrive and form an ad hoc body of people to aid the unfortunate hiker. While this body of people will organize their activities and have a shared purpose (rescuing and assisting the trapped hiker), they will disperse once the purpose is achieved. As such, they are not an organization, but an organized body of people. This contrasts with a hiker rescue organization that pre-exists the need for the unfortunate hiker and when contacted, implements its rescue purpose of rendering aid to the entrapped hiker. In this case, the body of people exists, have established policies and procedures (norms), and respond regardless of the people on duty during the time of an emergency incident.

As the hiking rescue example illustrates, an organization is more than an organized body of people with a shared purpose. Berger and Luckmann (1966) define the additional part of an organization as a socially constructed reality. This complex idea recognizes that there are constructs of an organization that are antecedents of the people that are presently engaged in the organization; that these constructs exist regardless of the specific individual or the absence

of individuals. These constructs consist of the organization's norms, symbols, and understandings. In a seeming paradox, these constructs are socially created, i.e. the people presently in the organization create the constructs, and the constructs are evolutionary.

1.4.2 Information Technology versus Information Systems

The provenance of information technology begins with the adaptation of electronic computing technology (things) to organizations such as large businesses and national governments. The things were initially referred to as a computer (an adaptation of the common term for an organization's employees who recorded business transactions in ledgers). Later, as the use of these things evolved and were providing more than the encoding and manipulation of transactions, it was recognized that the collection of things was storing and communicating information. In an early, and possibly first, use of information technology, Leavitt and Whisler (1958) described the then unnamed thing.

> *The new technology does not yet have a single established name. We shall call it information technology. It is composed of several related parts. One includes techniques for processing large amounts of information rapidly, and it is epitomized by the high-speed computer. A second part centers around the application of statistical and mathematical methods to decision making problems; it is represented by techniques like mathematical programming, and by methodologies like operations research. A third part is in the offing, though its applications have not yet emerged very clearly; it consists of the simulations of higher-order thinking through computer programs. (Leavitt and Whisler 1958, 41)*

Since then these things have been referred to as *data processing*, *management of information systems* (MIS), and presently, as either *information technology* or *information systems;* academics and practitioners often use these later terms synonymously. Such imprecision makes it difficult to confer meaning and reduces the usefulness of both terms.

The information systems literature contains many definitions for information technology and information systems (for a survey of the variation in definitions see Carvalho 2000; Alter 2008). While using the same term, these definitions are not comparable as they represent a variety of contexts. Several researchers view information systems as an academic discipline (e.g., Alter 2015; Lee, Thomas, and Baskerville 2015; Akhlaghpour, et al. 2013; Orlikowski and Iacono 2001). Somers (2010) views information systems as a profession. Orlikowski and Iacono (2001) surveyed research published in *Information Systems Research* in the 1990s to discover researchers' orientation or context of use and found four groupings within this research corpus: information systems as a tool, as a proxy, as an ensemble, and computational (see Figure 1-12). In other words, the context for researching information technology is the use of technology, technology itself, organizational interactions with technology, and the design of the technology. While understanding the context in which information technology/information systems are used, it does not provide a distinct meaning or an understanding of how information technology is different from information systems. Rather, this contextual understanding contributes to a taxonomical understanding (relationships of the contexts of the concept) of information technology/information systems.

View	Conceptualization	Description
Tool		Research focus on the commonplace conception of technology: an engineered artifact whose purpose is established by its designer
	Labor Substitution	The assumption that technologies are a substitution for and replacement of human labor
	Productivity	Rather than a substitution for labor, technology extends labor's reach and performance benefits, i.e., older, less efficient means of work are replaced with newer, beneficial technological means of work
	Information Processing	The best use of technology is to alter and enhance the processing of information
	Social Relations	Coincidental to substituting for labor, extending labor, or processing information, technology is a catalyst for the transformation of social relationships
Proxy		A research focus that represents technology as an essential aspect, property, or value
	Perception	Technology is represented by measures of user's perceptions of technology, e.g., ease of use, usefulness, intention to use, etc.
	Diffusion	Technology is represented by measures of diffusion and penetration of a particular IT artifact within some organizational context
	Capital	Technology is represented by measures of money (e.g. dollars).
Ensemble		Research focus on the dynamic interactions between people and technology
	Development Project	A focus on the social processes of designing, developing, and implementing technology within an organizational context
	Production Network	A focus on the alliances that develop new technologies and maintain their competitiveness, e.g. the interactions among inventors, research and development organizations, corporations, governments, etc.
	Embedded System	A focus on the dynamic social context that contains technology, i.e. understanding how technology came to be used and is being used within a user community
	Structure	A focus on the social structures (i.e. sets of rules and resources as described in structuration theory) adopted by users by the use of technology where such structures are contained within the technology
Computational		Research focus on the computational power of technology; the capability to represent, manipulate, store, retrieve, and transmit information
	Algorithm	Technology is represented by an algorithm that supports some human activity; once the algorithm is perfected, it is assumed that the technology is effective and useful
	Model	Technology represents social, economic, and information phenomena to facilitate investigations by researchers

Source: Contents adapted from Orlikowski and Iacono (2001)

Figure 1-12. Researchers' Orientation or Context for Information Technology

Defining the meaning of terms is important from a variety of perspectives. First, it enables authors and readers to exchange information clearly. Second, it enables researchers a consistent foundation to make observations, i.e. it defines the variables in positivist investigations and concepts in interpretive investigations. Third, over time a community will

shape and adopt the meaning, and thereby contribute to the community's norms and shared understanding. Lastly, to some degree, the concepts that are captured in a community's language influence the community's thinking[2]. For these reasons, this subchapter provides a means to use the terms information technology and information systems uniquely. The sub-chapter proceeds by defining the concept information (see Chapters 1.1.2 and 2.2 for a discussion of systems). Then, the subchapter provides a distinct definition for information technology and information systems.

1.4.2.1 Information

Perplexingly, both academia and professionals have adopted a name (information technology/information systems) that includes a fundamental concept, information, for which there is no generally accepted meaning (see McKinney Jr and Yoos II 2010 for a detailed discussion; Newman 2001; Tuomi 1999). Similar to the previous observation that a taxonomy of information technology is useful, McKinney Jr and Yoos II (2010) present a taxonomy of the uses of information. McKinney and Yoos assert that the taxonomy is more useful than a definition; they conclude, "We expect that IS research will improve as the term information is used more precisely" (McKinney Jr and Yoos II 2010, 330).

While a discussion of the historiography and nuances of the epistemology of knowledge, which includes information, is beyond the scope of this dissertation, a brief description of the theory of knowledge provides an understanding of the relationship between the concepts of data, information, and knowledge - Figure 1-13 shows this traditional

[2] Linguistic anthropologists have been debating the linguistic relativity hypothesis, which posits that aspects of individual's thinking differ across linguistic communities according to the language they speak (Gumperz and Levinson 1996). Recently, there has been empirical evidence that supports this hypothesis (Everett 2013).

relationship. From this traditional perspective, data represents simple facts; with experience, these facts are placed within context (information); and with further experience, the information is placed in or alters the accepted knowledge (Tuomi 1999, 105-107). Traditional epistemology considers knowledge to be a belief that is justifiably true[3]; it can be argued that experience applied to data and then to information provides the justification for such a belief.

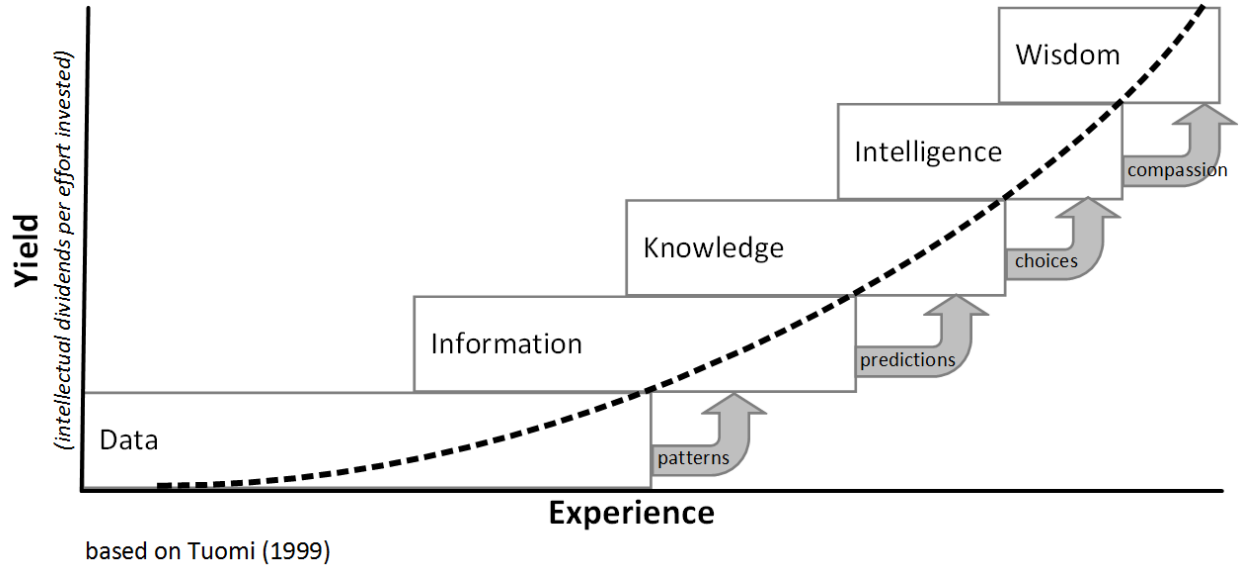


Figure 1-13. Traditional Data, Information, Knowledge Hierarchy

Using a semiotic perspective, information is conceived as a symbol and is considered to be "deliberately built in order to enable communication and the formation of knowledge" (Carvalho 2000, 5). Stamper (1973) explains that symbols have three means by which they are understood: pragmatics, semantics, and syntax. Pragmatics refers to the relationship between the symbol and peoples' behavior, e.g. the way the symbol is used, the sensitivity to the symbol, etc. Semantics are the rules by which a symbol is interpreted while syntax is the

[3] Plato explained that for something to be knowledge it must have three characteristics: justified, true, and believed.

structural relationship among the symbols being used. Thus using pragmatics, semantics, and syntax, a community reaches an accepted interpretation of a symbol, which enables the symbol to convey its meaning (Berger and Luckmann 1966).

For purposes of this research, for a thing (symbol or a collection of symbols) to be considered information it is necessary and sufficient for such a thing to have a socially created interpretation that is believed to be a true representation of knowledge. Figure 1-14 illustrates the difference between data, information, and knowledge.

Concept	as Data	as Information	as Knowledge
Language	one or more words	a related group of words and punctuation	a book an encyclopedia
Retail Sale	a sales receipt	a sales journal	sales forecast
Temperature	one or more thermometer readings	daily temperature graph	historical temperature trends
Text Message	a single message	a message thread	a social-media blog

Figure 1-14. Examples of Data, Information, and Knowledge

1.4.2.2 Information Technology

For purposes of this research, Information technology is a system that contains an underlying tangible digital electronic-based device (hardware) and intangible sequences of instructions for that hardware (software) that enable any of the storage, transmission, or manipulation of data. This definition differentiates the hardware and software constituents of information technology from other conceptions of hardware and software. For instance, examples of hardware in the apparel industry include a loom and a sewing machine, and examples of software are cloth and clothing. The video industry considers analog and digital recording and playback devices to be hardware while software is the recorded analog or digital media, e.g. a VHS tape, a CD disc, or a DVD movie.

In addition to the variety of applications of the concepts of hardware and software, the application of the term information technology has changed over time. For example, in antiquity, a means of communicating data was accomplished with the invention of writing and alphabets (symbols and socially agreed meanings). Later inventions included paper, pencils, and books – all of which provided a means to store, transmit, and manipulate data. The eighteenth and nineteenth centuries saw the invention of various information technology devices including the difference engine and the analytical engine, which mechanically enabled the storage and milling of information. Also, the jacquard loom introduced binary logic and the punch card. The later eighteenth and nineteenth centuries brought the invention of Morse code, the telephone, and radio. Also, the Hollerith census machine was invented, which used electro-mechanical mechanisms to create, read, and tabulate information on encoded punch cards. Each of these devices is a form of information technology, some of these devices are like our modern conception of a computer. However, none of these devices are modern digital electronic devices, i.e. none of the devices make use of an electronic microprocessor and supporting electronic circuitry. Therefore, this definition specifically eliminates these early information technologies.

1.4.2.3 Information Systems

As demonstrated by the research into IT governance (see Chapter 2.3), the phenomenon being observed by this research occurs within an organization, which is a socially constructed system of norms, values, and understandings. While information technology is used in many contexts, e.g. personal, societal, organizational, etc., it is appropriate for the purposes of this research to consider such technology from an organizational perspective. As

such, throughout this research for a system to be considered an information system, it is necessary and sufficient that at least one of its parts be an IT and that at least one of its products satisfices the information needs of at least one other constituent part of the system in which the information system is also a part.

The conception of an information system as a system that satisfices the information needs of another system embraces the concept that as a system it has constituent parts; however, the definition does not explicitly require any specific thing to be a constituent, e.g. technology, information technology, information, people, etc. (see Alter 2008; Lee, Thomas, and Baskerville 2015, for examples of information system constiutents). Importantly, the product of such a system must meet the minimum information requirements of another constituent within the system that contains the information system; it is not important that the information system itself recognize its product as information only that the recipient of the product recognize it as information. For example, a library constitutes an information system within a university. When an English-speaking student receives an original German edition of Bertalanffy' s *General System Theory: Foundations, Development, Applications* from the library, the product is not received as information (the student is unable to interpret the symbols contained in the product, i.e. the student cannot read German). In this instance, the library does not meet the minimum requirement (a book written in English) for the receiving constituent (a student) of the overall system (the University). However, when the library provides the same book to a German-speaking university professor, the library meets the minimum information requirement (a book written in English or German) for the receiving constituent (a professor) of the overall system (the University). In this example, the library is an

information system because within the whole of the university of which the library is a part, one of the library's products, the loan of a German-language book, can be received by a member of the University and interpreted as information. Similarly, when mini-computer-based information systems began replacing mainframe-based information systems there was an incompatibility in the encoding of the alphabet and other textual characters: mainframes used EBCIDIC while mini-computers used ASCII; when exchanging text files between these systems it was necessary to translate the encoded characters so that the resultant information could be recognized by the respective system.

Example	Category	Explanation
Alarm Clock, app	Information Technology	In isolation, an app is a specific collection of instructions (software) that operates within a digital electronic device (hardware)
Alarm Clock, mechanical	Technology	A mechanical alarm clock does not contain any digital electronic elements; however, it is a human-made machine
Car	Technology	While a modern car contains information technology elements (e.g., infotainment system, diagnostic system, GPS, etc.), the whole is a collection of mechanical and other elements
Car, Self-driving	Technology	A self-driving car is a transportation system that has had the traditional navigation element (a person) replaced with information technology; however, the whole retains its dominance of mechanical and other elements
Digital Camera	Information Technology	A digital camera is a specific collection of instructions (software) and digital electronic elements (hardware) with other elements (optics, case, buttons, etc.)
Human Resource Department	Information System	The human resource department of an organization constitutes a work system (see Chapter 2.2.5) and provides various products that are used by other constituents of the organization. For instance, one product of the department is the organization's employee policies, which are received as information by each employee (constituent).

Example	Category	Explanation
SAP, organization implementation	Information System	Once SAP is integrated within an organization, it provides data that is used by other constituents of the organization. In most such uses of SAP, various departments recognize a product of the system as information, e.g. analyze data to obtain sales trends, purchase forecasts, etc.
SAP, product offering	Information Technology	The SAP boxed product consists of a variety of information technology elements; however, since the product is not a constituent of a system, it is not able to provide information for another constituent element

Figure 1-15. Examples of Technology, Information Technology, and Information Systems

1.5 DISSERTATION ORGANIZATION

The remainder of this dissertation is organized into six chapters. First, Chapter 2 contains the literature review, which describes the foundational theories to this research: systems theory and governance. The system theories described include General Systems Theory, Soft Systems Theory, and Work System Theory. With the theoretical foundation described, Chapter 3 describes the methodology that is used for the case study. Chapter 4 presents the research data, and Chapter 5, uses this data to describe a systems model for IS and IT governance. Finally, Chapter 6 summarizes the research's findings and implications for future research.

Chapter 2 - LITERATURE REVIEW

We are like dwarfs sitting on the shoulders of giants. We see more, and things that are more distant, than they did, not because our sight is superior or because we are taller than they, but because they raise us up, and by their great stature add to ours.
— John of Salisbury (1159 BC)

I readily absorb ideas from every source, frequently starting where the last person left off.
— Thomas A. Edison (1847 ~ 1931)

The scientific man does not aim at an immediate result. He does not expect that his advanced ideas will be readily taken up. His work is like that of the planter - for the future. His duty is to lay the foundation for those who are to come, and point the way.
— Nikola Tesla (1934)

You learn from a conglomeration of the incredible past - whatever experience gotten in any way whatsoever.
— Bob Dylan (1970)

This chapter reviews the published literature related to systems thinking (Chapter 2.2) and governance (Chapter 2.3). First, Chapters 2.2.1 through 2.2.3 discuss general systems theory. Then the system theories that will be used to analyze the case study are discussed: Soft Systems (Chapter 2.2.4) and Work Systems (Chapter 2.2.5). The exploration of the governance literature begins by examining the initial period of research on IT governance (Chapter 2.3.1). This is followed by a review of the contemporary research, which is delimitated by the research of Weill and Ross (2004) (Chapter 2.3.2). Next, the literature is categorized based on the IT Governance Institute's governance taxonomy, which ITGI calls Focus Areas (Chapter 2.3.3). Finally, the longitudinal characteristics of the governance research corpus are examined (Chapter 2.3.4).

The review of the governance literature makes use of significant published literature reviews and focuses on the research concepts and trends identified in these reviews. This provides a foundation for Chapter 4, in which a granular investigation of the governance literature is performed to address Research Question 1 (Has the corpus of IS research on IT governance succeeded or failed in taking any systems approach?).

2.1 General Systems Theory

I believe that our very survival depends upon us becoming better systems thinkers.
— Margaret J Wheatley (1941 ~)

Human beings, viewed as behaving systems, are quite simple. The apparent complexity of our behavior over time is largely a reflection of the complexity of the environment in which we find ourselves.
— Herbert Simon (1969)

2.1.1 *Replacement of the Theory of Categories*

While the concept of systems can be traced back to ancient Greece, the contemporary scientific investigation of systems was begun in the early twentieth century with independent inquiries by Ludwig von Bertalanffy and Paul Weiss (Drack and Apfalter 2007). Weiss was working in experimental biology and found that his findings did not support the prevalent mechanistic worldview. At nearly the same time, von Bertalanffy was working to resolve the biology conundrum of vitalism versus mechanism, i.e. the worldview that the actions of a living organism are soul-like factors that exist within a cell or the organism versus the worldview that a living organism is an organization of parts and processes (an organized collection of cells and behaviors). In other words, working independently within the discipline of biology, these researchers used the tools of natural science and philosophy respectively to propose General Systems Theory.

von Bertalanffy did not publish this early work. He explains,

> *… I presented it [General Systems Theory] first in 1937… However, at that time theory was in bad repute in biology, and I was afraid of what Gauss, the mathematician, called the "clamor of the Boeotians." So I left my drafts in the drawer…*
>
> *Then, however, something interesting and surprising happened. It turned out that a change in intellectual climate had taken place, making model building and abstract generalizations fashionable. Even more: quite a number of scientists had followed similar lines of thought. So General Systems Theory, after all, was not isolated, not a personal idiosyncrasy as I had believed, but corresponded to a trend in modern thinking (Bertalanffy 1969, 90).*

On recognizing this scientific inflection point, von Bertalanffy published his seminal paper *An Outline of General System Theory* (1950). In this paper, von Bertalanffy argued that the Theory of Categories was "vague, muddled, and metaphysical" and that its replacement, General Systems Theory, was an "exact system of logico-mathematical laws" (Bertalanffy 1950, 142-143). In addition to interpreting General Systems Theory as an example of Popper's concept of theory refutation (Popper 1959), it can also be viewed as the catalyst for a Kuhnsian revolution (Kuhn 1996, 92-98; Bertalanffy 1969, 18). Rather than proposing an alternative theory within the field of biology, von Bertalanffy argued that General Systems Theory applies across scientific fields that investigate problems of *wholeness*, e.g. organization or organized wholes. This assertion was based on the observation that the scientific epistemology contains *isomorphic laws*, i.e. laws that are identical in different fields, which are developed in isolation within a field without knowledge of the work performed in another field(s).

There are three suppositions that form the basis of the existence of isomorphic laws: a limited universe of discernable equations or schemes to explain natural phenomena, the applicability of such constructs to the observable world, and the general applicability of certain

constructs (systems) that can contain specific entities depending on the applied domain (Bertalanffy 1950, 137-138). These suppositions are derived from the activities of empirical science researchers who are investigating the *real world* or the *world of our experience* (Popper 1959, 39).

The artifacts of scientific investigations are representations of natural phenomena. These artifacts are created using the symbols of mathematics or language. In either symbology, an artifact is created from the set of all possible human conceptualizations, e.g. formulas, models, schemas, etc. The limit of the human imagination to envision and manipulate complex artifacts necessitates that these artifacts be simple[4]. As such, scientific artifacts are derived from a smaller codomain of the universe of human conceptualizations[5], i.e. there is a limited universe of discernable equations or schemes to explain natural phenomena.

As an instance of a socially constructed reality, a community of researchers (i.e. a scientific discipline) fabricate its norms (Berger and Luckmann 1966). One of these norms is the set of simple human conceptualizations that are the basis of the community's artifacts. As discussed previously, these candidate conceptualizations are a small subset of the universe of all possible human conceptualizations. Nevertheless, each community of researchers

[4] The meaning of *simple* is relative to a community of scientists and is not materially altered by the community's use of sophisticated tools such as computers. However, the simpler the artifact, the easier its diffusion, which is the goal in empirical science because an artifact's value increases over time with a scientific community's repeated attempts to probe its validity (i.e., corroboration and falsification) and expansion in its explanatory applicability (Popper 1959).

[5] Assume that there is a set X whose members are all human conceptualizations and that there is a function f that when applied to X produces a set Y of simple concepts, i.e. $f: X \rightarrow Y$. Than $\forall x \epsilon X, f(x) = y$. There is no property of f that ensures that a distinct y results from each x. This has two implications. First, two or more members of X can be related to the same member of Y. Second, set Y has fewer members than has set X.

independently selects its candidate conceptualizations from this smaller set, which means that it is probable that multiple communities will select some of the same simple conceptualizations. Once so selected, these common multi-community conceptualizations will be applied to specific natural phenomenon using domain specific constructs, i.e. there are certain human conceptualizations that consist of general constructs that contain specific entities that depend on the applied domain. For instance, the simple conceptualization of balance (i.e. $a = b + c$) is found in the disciplines of chemistry (the law of conservation of mass), physics (the law of thermodynamics), and accounting (the balance sheet equation).

A research community also uses complex conceptualizations. As described previously, a simple conceptualization can be related to more than one complex conceptualization. Therefore, it is probable that a complex conceptualization used by a research community could be related to a conceptualization used by other communities. Further, some of these conceptualizations are generalized within the natural phenomena observed by the research community – these conceptualizations describe more than one phenomena. In other words, the scientific imperative of generalization is a simplification function of the community's artifacts. Therefore, it is possible that one community's generalized conceptualizations are related to the generalized conceptualizations of other research communities. This is not surprising because, "the more general a concept, the more widespread the invariance which it grasps. It tells us less about the individual peculiarities of a thing and more about what it shares with other things" (Laszlo 1996, 20).

2.1.2 *The Characteristics of a System*

In the initial presentation of general systems theory, von Bertalanffy defined a system as "a complex of interacting elements" (Bertalanffy 1950, 143). He explained that the characteristics of a system are that the elements are related to one another (i.e., interaction), the elements behave as a whole, yet the elements are independent and competitive, and that the system seeks an equilibrium (i.e., teleological) (Bertalanffy 1950, 146-155). Consistent with von Bertalanffy's view that a system is a whole with parts, Ackoff defines a system as:

> *A system is a whole consisting of two or more parts (1) each of which can affect the performance or properties of the whole, (2) none of which can have an independent effect on the whole, and (3) no subgroup of which can have an independent effect on the whole. In brief, then, a system is a whole that cannot be divided into independent parts or subgroups of parts. (Ackoff 1994, 175)*

In their definitions of system, von Bertalanffy's meaning of independence differs from Ackoff's. In stating that a part is independent, von Bertalanffy means that a part performs its function independently within the system. Whereas, Ackoff's means that a part cannot perform its function disunited from the system.

Churchman explains that nine conditions are necessary for an entity to be considered a system. These conditions are as follows:

1. A system is *teleological*.
2. A system has a *measure of performance*.
3. There exists a *client* whose interests (values) are served by a system in such a manner that the higher the measure of performance, the better the interests are served, and more generally, the client is the standard of the measure of performance.

4. A system has *teleological components* that coproduce the measure of performance of the system.
5. A system *has an environment* (defined either teleologically or ateleologically), which also co-produces the measure of performance of the system.
6. There exists a *decision maker* who – via his resources – can produce changes in the measures of performance of the system's components and hence changes in the measure of performance of the system.
7. There exists *a designer*, who conceptualizes the nature of the system in such a manner that the designer's concepts potentially produce actions in the decision maker, and thereby changes in the measures of performance of the system's components, and hence changes in the measure of performance of the system.
8. The designer's intention is to change the system so as to *maximize the system's value to the client*.
9. A system is "*stable*" with respect to the designer, in the sense that there is a built-in guarantee that the designer's intention is ultimately realizable (Churchman 1971).

Presently, there is a consensus that a system has ten characteristics (Skyttner 2005, 53). These characteristics are described in Figure 2-1.

Characteristic	Description
Differentiation	A characteristic of complex systems in which specialized elements perform specialized functions, i.e., specialization, division of labor.
Entropy	The level of disorder or randomness within the system. *Non-living systems:* tend toward disorder, ultimately losing all motion, and degenerate into an inert mass. Without some event, the system reaches maximum entropy. *Living systems:* by importing energy from its environment, maximum entropy is avoided, which is known as *negentropy* and is present in all living systems.
Equifinality / Multifinality	*Convergence:* equally valid means to obtain a goal beginning from different initial conditions. *Divergence:* obtaining different, mutually exclusive goals beginning from the same initial condition.
Goal seeking	The interaction of the elements must result in obtaining the desired goal, final state, or equilibrium.
Hierarchy	A characteristic of complex systems in which the whole is composed of systems nested within systems.
Holism	The system has distinct properties that may not be detected by analyzing the individual elements.
Inputs and outputs	*Closed System:* the inputs are defined *Open System:* the inputs are admitted from the environment
Interrelated and interdependent elements	A system consists of related and dependent elements.
Regulation	To obtain its goals, the system's elements must be regulated by some means, e.g. feedback, deviation detection.
Transformation process	To achieve its desired goal, inputs must be transformed into outputs.

Source: Contents adapted from Skyttner (2005)

Figure 2-1. System Characteristics

2.1.3 Classifying Systems Thinking Approaches

Since Bertalanffy introduced Systems Theory, a variety of system approaches has been proposed. While these approaches are nominally ontologically related within the Systems epistemology, Jackson (1991) proposes a framework (see Figure 2-2) that relates these approaches to their applicability to problem-solving. The constraining idea that system

approaches should be related within a problem context is consistent with the characteristics of a system described previously, e.g. teleology, regulation, transformation, etc. In other words, a system is purposeful; it transforms inputs into desired outputs, which is an action of problem-solving.

The constituents of a problem context can be defined to include the actors who will solve the problem, the system(s) in which the problem exists, and the relevant stakeholders (Jackson 1991, 27). One means of characterizing systems is by complexity, i.e., simple to complex. As shown in Figure 2-3, Flood and Jackson (1991) differentiate the characteristics of a simple system from a complex system by the characteristics of the system's elements, behavior, evolution, subsystem goals, and its relationship with the environment. Rather than labeling the extremes of the Systems axis of the framework, Jackson adopted the terminology from Ackoff (1974) for the complexity of systems: *Mechanical* for simple systems and *Systemic* for complex systems. Ackoff explains that there were eras of research that were primarily concerned with simple systems, *Mechanical era*, and complex systems, *Systemic era*.

The second dimension of the Jackson framework reflects the synergy of the agreement among the stakeholders who participate in the definition of the problem context. Jackson refers to the situation when the participants genuinely agree among themselves with the problem context as *Unitary*; the situation in which the participants have an accommodation yet possess a divergence among any of values and beliefs, interests, or objectives is called *Pluralist*; and the situation in which there is little or no agreement among the participants about the problem context and that its definition requires an exercise of power and influence is called *coercive (Jackson 1991, 28)*.

Jackson's framework presents a matrix (systems x participants) that indicates which system approach is appropriate for the problem context's system complexity and the stakeholders' degree of agreement. The systems approach being used by this research are Checkland's Soft System Methodology and Alter's Work System Theory. Both system approaches exist within the same area of Jackson's framework (i.e., Pluralist-Systemic), which indicates their theoretical consistency for their application to the posed research questions. The coercive area of Jackson's framework could also be considered for this research. Emancipatory systems thinking combines soft systems thinking with the five areas of critical thinking: critical awareness, social awareness, complementarianism at the methodology level, complementarianism at the theory level, and human emancipation. By continually comparing the planner's conception against the social conceptions of the intended users, the resultant system emancipates the users, i.e. elevates the individual's quality of work.

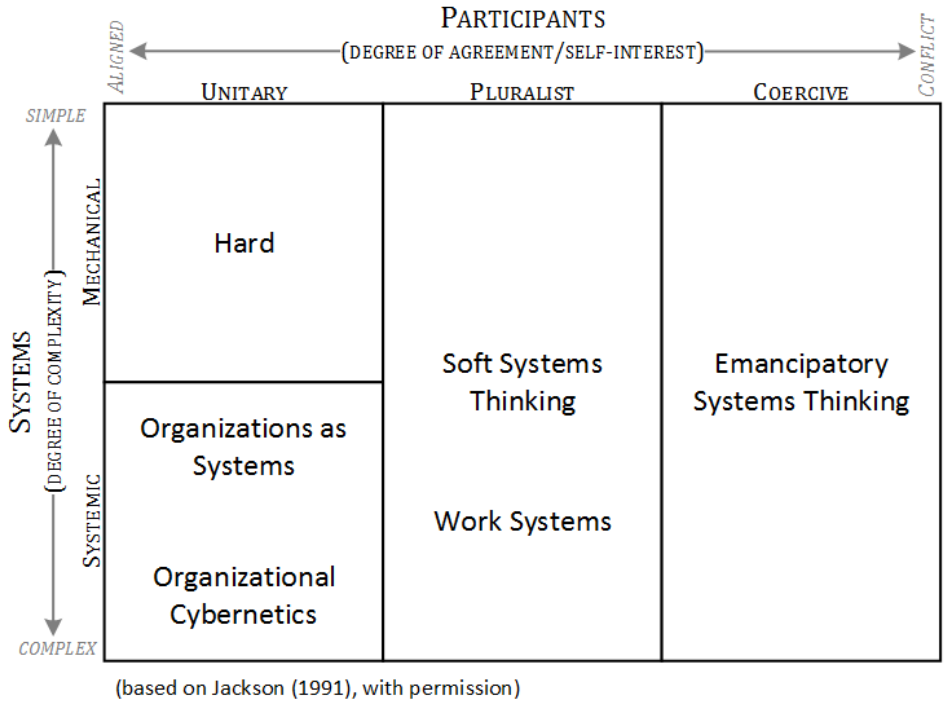


Figure 2-2. Classification of System Approaches

Characteristic		Simple System	Complex System
Elements	*Number*	Small number	Large number
	Interactions	Few interactions between elements	Many interactions between elements
		Highly-organized	Loosely-organized
	Attributes	Predetermined	Not Predetermined
	Behavior	Governed by well-defined laws	Probabilistic
		System is unaffected by behavioral influences	System is subject to behavioral influences
	System Evolution	System does not evolve over time	System evolves over time
	Subsystems Goals	Subsystems do not pursue their own goals	Subsystems are purposeful and generate goals
	Relationship to Environment	Largely closed to the environment	Largely open to the environment

Source: Contents adapted from Skyttner (2005, 105-106)

Figure 2-3. Simple versus Complex Systems

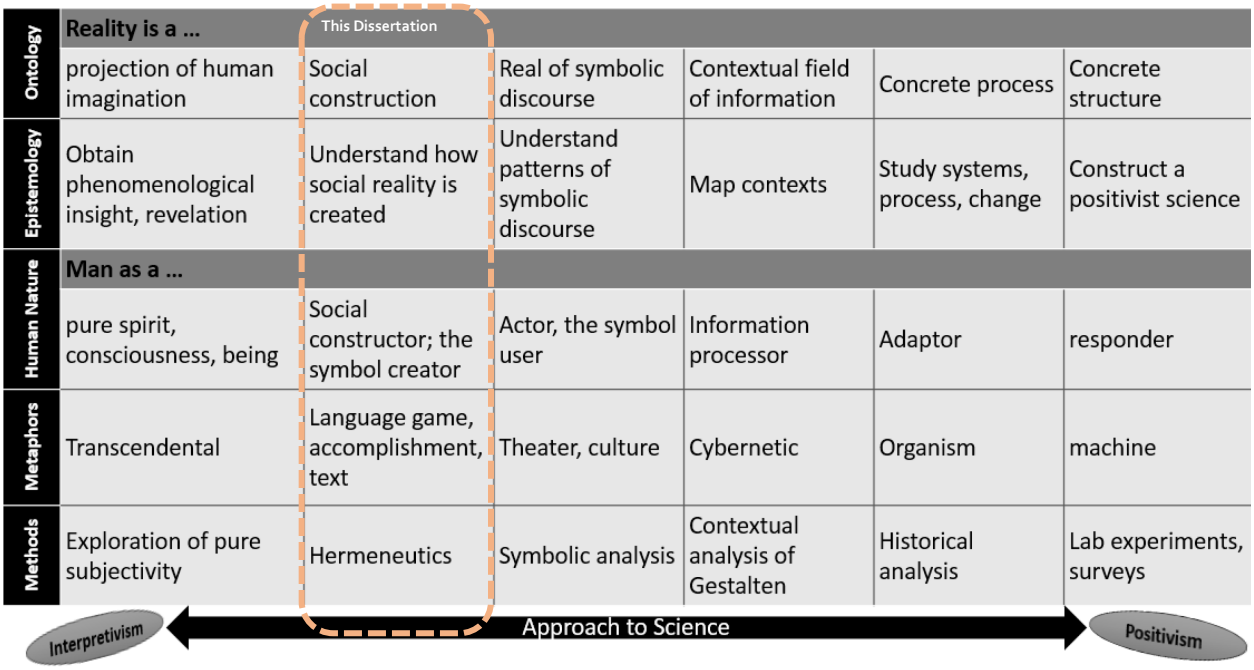
2.2 GOVERNANCE

I am not bound to win, but I am bound to be true. I am not bound to succeed, but I am bound to live by the light that I have. I must stand with anybody that stands right, and stand with him while he is right, and part with him when he goes wrong.
— Abraham Lincoln (1809 ~ 1865)

Good corporate governance is about 'intellectual honesty' and not just sticking to rules and regulations; capital flowed towards companies that practiced this type of good governance.
— Mervyn King (1994)

Governance and leadership are the yin and the yang of successful organizations. If you have leadership without governance you risk tyranny, fraud and personal fiefdoms. If you have governance without leadership you risk atrophy, bureaucracy and indifference.
— Mark Goyder (1953 ~)

2.2.1 *Ontology and Epistemology*



(Source: Contents adapted from Morgan and Smircich 1980)

Figure 3-4. Research Ontology-Epistemology Continuum

The choice of ontology and epistemology for research are highly correlated. As shown in Figure 3-1, there is a continuum of ontology-epistemologies that align with various assumptions (Morgan and Smircich 1980). For this investigation, the ontology and epistemology have been purposefully selected to align with the research questions rather than with the presumptive ontology-epistemology of the Information Systems discipline. As such, this research aligns with the assumptions in Figure 3-1 under *social construction* (outlined in orange in Figure 3-1).

This dissertation's research questions are investigating a phenomenon that is a construction of an organization. Further, these constructions are primarily social, i.e. IT governance is instantiated and performed by people; the technology that is used is secondary

to these social constructions. While an organization creates a myriad of IT governance artifacts, an assumption of this research is that each person within the organization either individually or within organizational groupings (either formal or informal) holds the full meaning of these artifacts.

Markus and Lee (1999) stated that, "From its inception until quite recently, the academic information systems field has often been hostile to non-quantitative and non-positivist research" (Markus and Lee 1999, 37), which means that the community of information systems researchers does not routinely embrace this research's alignment with the social construction ontology-epistemology. Encouragingly, Markus and Lee observed that the acceptance of intensive research "... had already been accomplished well before publication [of the special issue in MIS Quarterly on Intensive Research]... indeed, the acceptance of intensive research has been so total that serious challenges to the legitimacy of such research no longer arise" (Markus and Lee 1999, 37). Interestingly, Markus and Lee choose to use Weick's less known term "intensive research" rather than the well known "qualitative research;" perhaps the acceptance of non-positivist approaches was not as well accepted as the editors claim. More recently, Weber observed that "Historically, the rhetoric of positivism versus interpretivism may have been useful as a way of laying the foundations for change..." (Weber 2004, xii). Weber concluded, "I no longer want to be labeled as a positivist researcher or an interpretive researcher. It is time for us to move beyond labels and to see the underlying unity in what we are trying to achieve via our research methods" (Weber 2004, xii). It is the research imaginations of these eminent information system scholars that validate this

research's selection of social construction as the underlying philosophy and structures in which the research is conducted.

Interpretivism assumes that reality is internal to and a construction of the researcher's consciousness (Burrell and Morgan 1979, 1); it is based on a posteriori knowledge (empirical evidence from one's own observation) rather than a priori knowledge, accepting fact, faith, logic, intuition, or insights (Maslow 1969, 69; Russell 2012). This is important because of the inherent strength of a posteriori knowledge compared to a priori knowledge, which is fallible and defeasible, i.e., the justification of a priori knowledge can be defeated by evidence. However, the adoption of interpretivism does not infer information about the researcher's observation, e.g. truthfulness, accuracy, appropriateness, etc. Rather, the adoption of interpretivism provides information about the researcher's relationship and involvement with an observation, i.e. "knowledge is not a relationship to something outside of consciousness but a relationship within consciousness" (Packer 2011, 174).

2.2.2 Early IT Governance Research

Information System's Historiography can be traced to the 1950s[6]. The lineage of academic interest of information technology governance begins with research in the 1980s about the structure of the information systems division within an organization (e.g., Zmud 1984; Swanson and Beath 1989; Blanton, Watson, and Moody 1992; Clark 1992). The concept of Information Technology Governance emerged in the 1990s (e.g., Loh and Venkatraman

[6] Petter et al. describe the history of information systems as consisting of five eras: 1950 – 1960 is the Data Processing Era; 1960 – 1980 is the Manage Reporting and Decision Support Era; 1980 – 1990 is the Strategic and Personal Computing Era; 1990 – 2000 is the Enterprise System and Networking Era; 2000 and beyond is the Customer-Focused Era (Petter, DeLone, and McLean 2012).

1992; Henderson and Venkatraman 1993; Brown and Magill 1994; Brown 1997). However, a consensus has not formed on a comprehensive meaning of IT governance (Simonsson and Johnson 2006b).

In the past ten years, there have been several reviews of the IT governance research (Brown and Grant 2005; Simonsson and Johnson 2006b; Buckby, Best, and Stewart 2008; Wilkin and Chenhall 2010). Simonsson and Johnson (2006b) observed that there is agreement among most IT governance researchers that IT governance is an upper management concern to ensure strategic alignment and thereby the realization of business value. However, Simonsson and Johnson also observed that researchers do not agree on the core components of IT governance, e.g., structures, processes, relational mechanisms, performance metrics, etc. Nevertheless, Simonsson and Johnson explain that a comprehensive definition of IT governance based on the reviewed research is

> *IT governance is basically about IT decision-making: The preparation for, making of and implementation of decisions regarding goals, processes, people and technology on a tactical and strategic level (Simonsson and Johnson 2006b, 14).*

Concurring with Simonsson and Johnson's observation that decision-making is a fundamental aspect of IT governance, Brown and Grant (2005) bifurcate IT governance into IT Governance Forms and IT Governance Contingency Analysis research streams. The IT Governance Forms stream consists of studies on decision-making structures, i.e. centralization versus decentralization (e.g., Olson and Chervany 1980; Brown and Magill 1994; Brown 1997; Schwarz and Hirschheim 2003). This research also investigates the vertical and horizontal expansion of these structures (e.g., Zmud, Boynton, and Jacobs 1986; King 1983; Boynton and Zmud 1987). Studies in the IT Governance Contingency Analysis research stream seek to

understand the single and multiple factors that organizations consider in adopting different structures (e.g., Olson and Chervany 1980; Ein-Dor and Segev 1982; Tavakolian 1989; Allen and Boynton 1991; Clark 1992; Henderson and Venkatraman 1993; Venkatraman 1997). Brown and Grant observed that these research streams have combined forming contemporary IT governance research.

2.2.3 Contemporary IT Governance Research

The merger of the research streams was delineated when researchers claimed that prior research had fully investigated the contingency analysis of governance structures (Brown and Magill 1994; Sambamurthy and Zmud 1999) and that the assumption that IT governance was a function of organizational design needed to be re-evaluated (Sambamurthy and Zmud 2000). Weill and Ross proposed the first of these contemporary IT governance frameworks in their book and articles (Weill 2004; Weill and Ross 2005; Weill and Ross 2004).

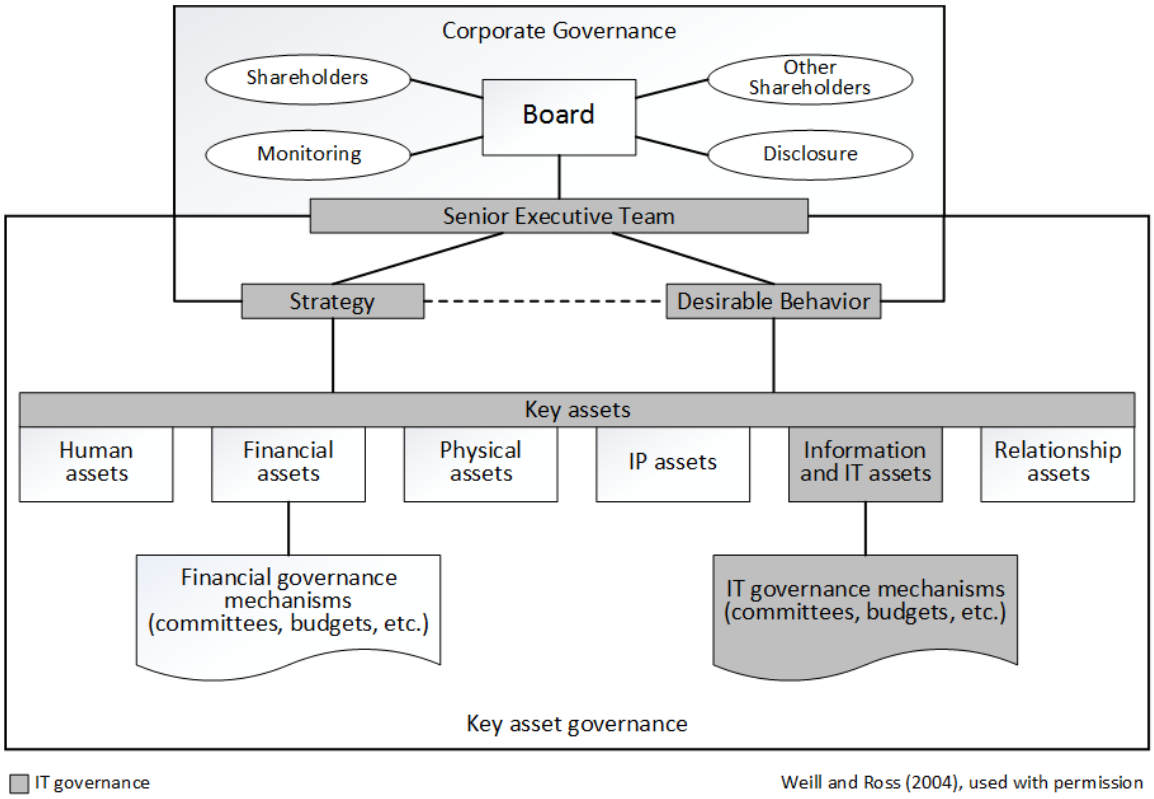


Figure 2-5. Corporate and Key Asset Governance

Key Asset	Examples
Financial	cash, investments, cash flow, receivables, liabilities, etc.
Human	people, skills, training, mentoring, etc.
Information and IT	digital data and information, knowledge, analytics, process performance and metrics, information systems, etc.
Intellectual Property	products, services, processes, patents, copyrights, etc.
Physical	buildings and facilities, equipment, physical security, maintenance, etc.
Relationship	internal relationships, brand, reputation (customer, suppliers, regulators, competitors, etc.), etc.

Source: Contents adapted from Weill and Ross (2004, 6-7)

Figure 2-6. Key Assets Subject to Governance

Weill and Ross proposed a holistic governance framework for an organization (see Figure 2-4).

The top-half of the framework encompasses the organization's Board's relationships; the

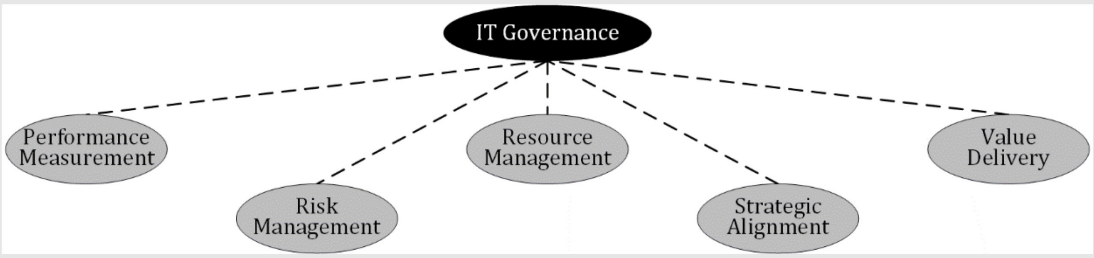
bottom half contains the key assets that the Board governs to realize its strategies and business values (Weill and Ross 2004, 4-6). These key assets are financial, human, information and IT, Intellectual Property, physical, and relationship (see Figure 2-5 for examples of each type of asset). Embracing the consensus of prior IT governance research, Weill and Ross proposed a Governance Arrangement Matrix (see Figure 2-6), which maps the organization structure (archetypes) with the type of decision being made. In this way, the responsibility for necessary governance decision-making is allocated appropriately to the type of governance decision, and such responsibilities can differ for each type of decision. The archetypes are business monarchy, IT monarchy, feudal, federal, IT duopoly, and anarchy (Figure 2-7 for the differentiating decision-maker for each archetype).

Archetype	Decision	IT Principles	IT Architecture	IT Infrastructure Strategies	Business Application Needs	IT Investment
	Decision made by	*Clarifying the business role of IT*	*Defining integration and standardization requirements*	*Determining shared and enabling services*	*Specifying the need for IS solutions (developed, purchased, etc.)*	*Choosing initiatives and level of funding*
Business Monarchy	*Top managers*					
IT Monarchy	*IT specialists*					
Feudal	*Business unit managers, independent of corporate center or other business units*					
Federal	*Combination of the corporate center and the business units with or without IT*					
IT Duopoly	*IT group and one other group, e.g. IT managers with top management or business unit leaders*					
Anarchy	*Isolated individual or small-group*					
Unknown						

based on Weill and Ross (2004, 10-11)

Figure 2-7. Governance Arrangements Matrix

2.2.4 IT Governance Research Taxonomy



	Performance Measurement	Risk Management	Resource Management	Strategic Alignment	Value Delivery
Meaning	Related to ▪ tracking project delivery ▪ monitoring IT services	Related to ensuring the appropriate level of assurance for ▪ Information security ▪ IT assets ▪ Systemic/Operational risks	Related to ensuring the optimal use/allocation of ▪ IT people ▪ IT assets ▪ facilities ▪ data/information	Related to ensuring that IT ▪ aligns with business aims ▪ efficiently used through the entire organization	Related to delivering ▪ appropriate quality ▪ within budget ▪ on schedule
Research Questions	▪ How is value measured, e.g. tangible and intangible factors? ▪ What relevant measurements are used, e.g. Balanced Score Card? ▪ What are alternative measurements? ▪ What are Performance Measurement problems?	▪ What are the types of risk? ▪ What are risk management strategies? ▪ What is the Board's role? ▪ What is senior management's role?	▪ How are IT projects managed, e.g. processes, strategies, accountability? ▪ How is decision-making authority and accountability communicated? ▪ How are appropriate management skills ensured in IT, e.g. strategies, identification? ▪ How are appropriate IT staff recruited and retained, e.g. finances, processes? ▪ How are IT staff trained? ▪ How are IT assets monitored and managed, e.g. licenses, contracts, architecture, applications, etc.?	▪ What is meant by strategy and alignment? ▪ What are the qualities of IT strategy and alignment? ▪ How should IT strategy be devised? ▪ What is the Board's role? ▪ How can the CEO and CIO maximize strategic alignment? ▪ What are the alternatives to strategic alignment?	▪ What value is realized from Value Delivery? ▪ What is the Board's role? ▪ What are Value Delivery problems?

Source: based on ITGI (2003); Buckby, Best, and Stewart (2008); Wilkin, Campbell, and Moore (2013)

Figure 2-8. IT Governance Taxonomy

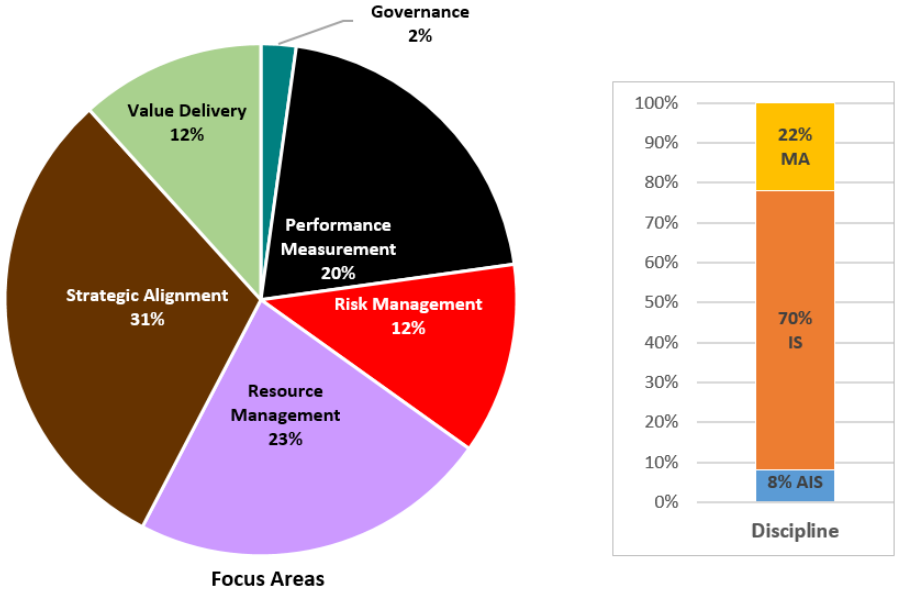
The IT Governance Institute (ITGI) was founded in 1998 with a mission "to advance international thinking and standards in directing and controlling an enterprise's information

technology." Further, ITGI explains that "Effective governance of IT helps ensure that IT supports business goals, optimize business investment in IT, and appropriately manages IT-related risks and opportunities" (ITGI 2015). As shown in Figure 2-7, the ITGI describes IT governance as consisting of five Focus Areas: performance measurement, resource management, risk management, strategic alignment, and value delivery (ITGI 2003, 20-32). ITGI defines performance measurement as those activities that track project delivery and monitor service delivery; resource management as activities related to optimizing knowledge and IT infrastructure; risk management as activities related to safeguarding IT assets and ensuring business continuity, e.g. disaster recovery; strategic alignment as ensuring that IT is aligned with the business and collaborative solutions; and value delivery relates to optimizing expenses and proving IT's value (ITGI 2003, 22).

Using ITGI's Focus Areas, Buckby, Best, and Stewart (2008) and Wilkin and Chenhall (2010) investigated the extant IT governance research: Wilkin and Chenhall concluded that the Focus Areas could be used as an IT governance research taxonomy (see Figure 2-7); and Buckby et al. evaluated the state of IT governance research identifying research gaps and opportunities (see the IT Governance Research sections of the References for the lists of publications each set of researchers used in their analysis).

Wilkin and Chenhall performed a multidisciplinary review of published IT governance research from Accounting Information Systems, Information Systems, Management Accounting, and Management Information Systems. This multidisciplinary approach reflects the worldview that IT governance is an organization-wide phenomenon with multiple facets, and is consistent with the underlying premise of this research, i.e. that IT governance is a

holistic, purposeful sub-system within an organization; it is not exclusively an IT process. Figure 2-8 shows the composition of the 496 journal articles that Wilkin and Chenhall analyzed: the majority (70%) were from Information System journals, the least (8%) were from Accounting Information System journals, and the remainder (22%) were from Management Accounting journals. The majority of the research by all disciplines was focused on Strategic Alignment (e.g., Kearns and Lederer 2000; Hess 2005; Thomas, et al. 2009), Resource Management (e.g., Tuttle and Harrell 2001; Sauer, Gemino, and Reich 2007; Allen, et al. 2008), and Performance Measurement (e.g., van der Zee and de Jong 1999; Lawler and Finegold 2005; Li and Alam 2007).

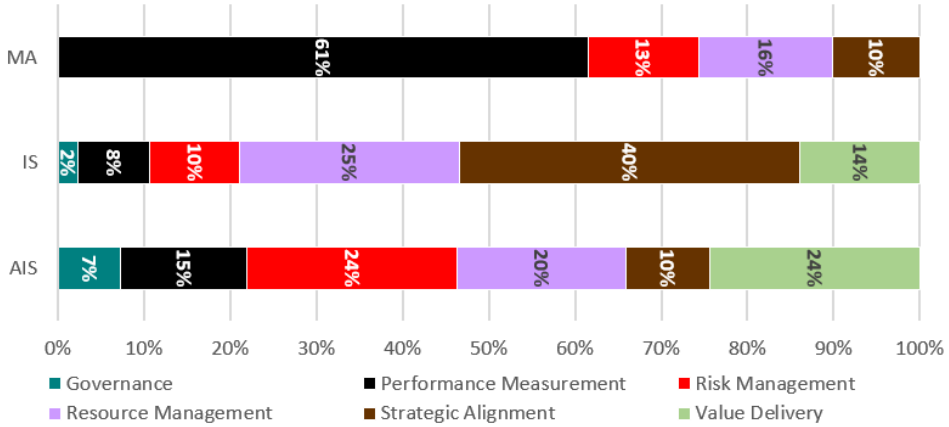


Source: Contents adapted from Wilkin and Chenhall (2010)

Figure 2-9. Multidisciplinary IT Governance Research – Overall

Figure 2-9 shows the composition of the published research within each research discipline. As expected, Management Accounting primarily focused on the Performance Measurement Focus Area (61%). Interestingly, there were no published articles on either

Governance or Value Delivery. Accounting Information Systems and Information Systems researchers investigated all five Focus Areas. Information Systems researchers were most interested in the Strategic Alignment (40%) and Resource Management (25%). Accounting Information Systems researchers showed the most interest in Risk Management (24%), Value Delivery (24%), and Resource Management (20%). The Information System researchers perform the preponderance of the research in all the Focus Areas (Governance 73%, Risk Management 60%, Resource Management 78%, Strategic Alignment 90%, Value Delivery 83%) apart from Performance Measurement, which was predominantly investigated by Management Accounting researchers (66%).



Source: Contents adapted from Wilkin and Chenhall (2010)

Figure 2-10. Multidisciplinary IT Governance Research - Focus Areas by Discipline

In their analysis of IT governance research, Wilkin and Chenhall identified the research questions that were investigated in each Focus Area (see the detailed research questions in Figure 2-7). After their extensive review, Wilkin and Chenhall observed that there is a "lack of literature that deals with ITG [governance] holistically" (Wilkin and Chenhall 2010, 135). They attribute this to the complexity of holistic IT governance and recommend that future research should examine the contribution of the individual Focus Areas to IT governance as a whole,

which can be interpreted as a call for researchers to view and investigate IT governance as a system with the Focus Areas being its constituent elements.

Buckby et al. concur with Wilkin and Chenhall observing that

> the research in these focus areas has been performed in relative isolation, and whilst this research contributes to the overall understanding of the key components of ITG [governance], it has not adopted a holistic viewpoint *(Buckby, Best, and Stewart 2008, 32).*

As shown in Figure 2-10, Buckby et al. assessed the predominant research topic and gaps in each of the IT Governance Focus Areas. There are three overall gaps that they identified within the corpus of IT governance research. First, the researchers consistently recommend that practical applications of research findings be developed that can be applied to an organization's needs by practitioners. This recommendation is closely aligned with the researcher's observation that there is a paucity of research to validate and assess prior findings. Finally, there is a consistent call for researchers to investigate IT governance holistically, i.e., Buckby et al. are implying that IT governance be considered a system, that Systems Theory could be applicable.

Focus Area	Current Research	Research Gap	Future Research Questions
Performance Measurement	Investigations have primarily focused on: ▪ Measurement processes, e.g. maturity models, IT balanced scorecards ▪ ITG measurement models, e.g. CobiT	▪ Identification of practical measurements for practitioners to use for all IT governance focus areas ▪ Improvement of performance measurements to provide a holistic model of IT governance	▪ What practical methods could organizations use to better measure IT governance focus area? ▪ How can maturity models be developed for all IT governance focus areas and how can an overall IT governance maturity be successfully measured?

Focus Area	Current Research	Research Gap	Future Research Questions
Risk Management	Investigations have primarily focused on: ▪ identification of IT risks ▪ development of risk management models and frameworks ▪ development of risk assessment models Leading to understanding: ▪ Outsourcing ▪ IT projects ▪ Security risks	▪ Identification of practical methods for practitioners to improve their IT risk management processes and assess IT risks ▪ Integrating globally accepted enterprise risk management processes into studies	▪ What are practical methods that organizations could use to better manage and assess IT risks? ▪ Does the development of risk management processes within an organization lead to more effective IT governance? ▪ Does the assessment of outsourcing and IT project risks lead to better organizational risk management processes?
Resource Management	Investigations have focused on: ▪ Understanding organization's structures for IT resources ▪ development of IT governance models	▪ Identification of the reasons that an organization should adopt an IT structural model ▪ Development of broader holistic models of IT governance	▪ Does a particular IT resource model lead to improved IT governance? ▪ What are some practical methods organizations could use to better manage their IT resources? ▪ How can an organization assess the maturity of their IT resource management processes?
Strategic Alignment	Development of models and frameworks regarding the relationship between business and IT	Limited research to validate the veracity of models and frameworks vis-à-vis strategic alignment	▪ Do effective strategic alignment processes lead to more effective IT Governance? ▪ Are strategic alignment processes linked to improved organizational performance? ▪ Which of the existing strategic alignment models best explain the relationship between business and IT?
Value Delivery	Development of models and frameworks primarily related to: ▪ distinguishing an IT systems' potential value versus its realizable value ▪ identifying the link between IT systems and organizational performance	▪ Limited research to validate the veracity of models and frameworks vis-à-vis value delivery ▪ Development of practical models that enable practitioners to understand and effectively measure value delivery	▪ Does the establishment of IT governance processes in an organization lead to improved value delivery from IT systems? ▪ Does measurement of value delivery from IT systems (post implementation) lead to improved organizational performance? ▪ What are the most effective methods of measuring value delivery from IT systems?

(Source: Contents adapted from Buckby, Best, and Stewart 2008)

Figure 2-11. IT Governance Current Research and Gaps

2.2.5 *Longitudinal Research Interest*

This literature review was conducted by performing an initial search of the European Journal of Information Systems, Information Systems Journal, Information Systems Research, Journal of Information Technology, Journal of Management Information Systems, Journal of

Strategic Information Systems, Journal of the Association for Information Systems, and MIS Quarterly for the term "IT Governance" using the Web of Science and Academic Search Complete. Then a recursive search was conducted using the references in each identified publication and publications that cited the publication. All publications related to IT governance and ITGI's five Focus Areas were selected. This search identified 275 publications that were published since 1980. Figure 2-11 shows the number of articles or books published each year. There is an initial peak in 2000 with the maximum number of publications occurring in 2007. Importantly, since 2000 there has been nearly consistent interest by the IS research community in IT governance. Also, shown in Figure 2-11 is the regional interest in IT governance. An article or book is associated with a global region based on the location of the publisher. As can be seen, interest in IT governance began in North America, which is consistently where much of research has been performed. Europe has consistently shown interest in IT governance since 1997. There was some research performed in Asia (Japan and Thailand) and Oceania (Australia and New Zealand) in the early 2000s.

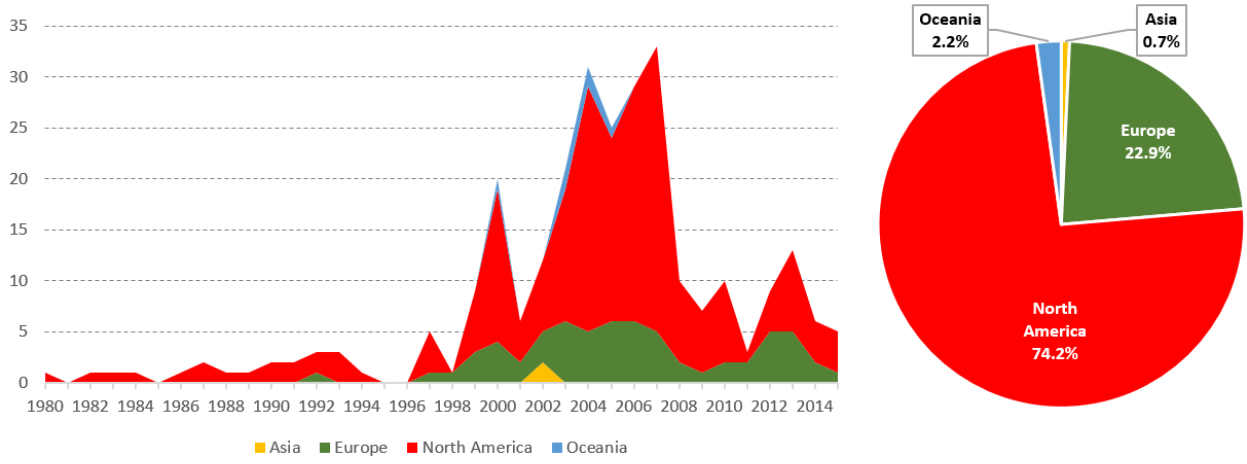


Figure 2-12. IT Governance Publications by Global Region

Contrasting with the literature reviewed previously for Systems Theory, the IT governance literature is in publications whose target audience is not exclusively scholars. Figure 2-12 shows the publications based on the target audience of the publication: academic/practitioner, practitioner, or scholarly. Most the publications were scholarly, i.e. the journal is intended for academic researchers. Nearly one-quarter of the articles were in academic/practitioner journals, i.e. intended for both scholars and practitioners. Importantly, researchers have been publishing in these journals nearly every year since 1990, with a significant publication effort between 2004 and 2008. Equally important, has been researcher's consideration of information reported by practitioners in exclusively practitioner journals, which occurred between 2000 and 2007: the period of maximum research interest in IT governance.

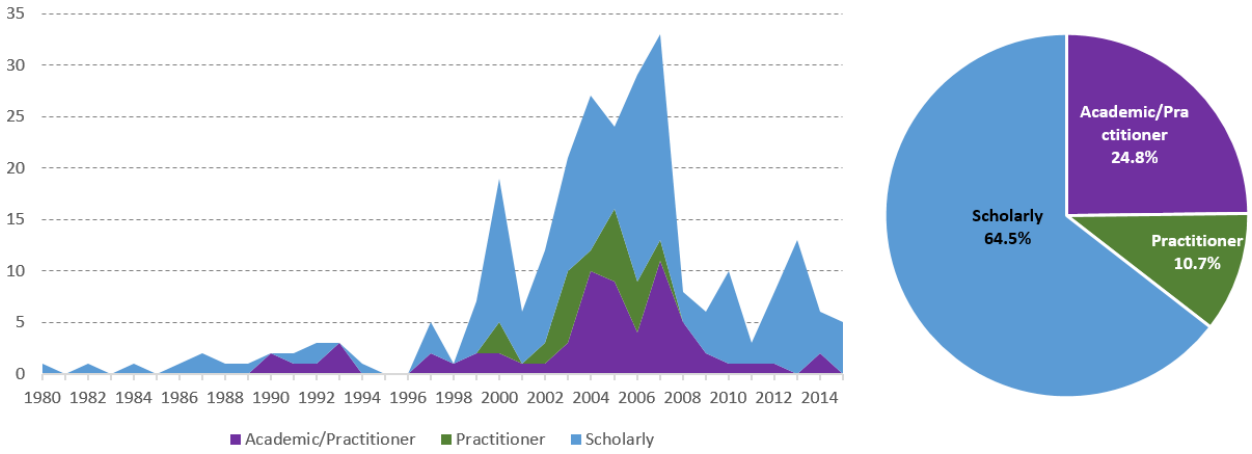


Figure 2-13. IT Governance Publications by Publication Type

Chapter 3 - METHODOLOGY

In questions of science, the authority of a thousand is not worth the humble reasoning of a single individual.
— Galileo Galilei (1564 ~ 1642)

If we knew what it was we were doing, it would not be called research, would it?
— Albert Einstein (1879 ~ 1955)

Research is to see what everybody else has seen, and to think what nobody else has thought.
— Albert Szent-Györgyi (1957)

The selected approach and means by which an investigation is conducted is a function of the investigator's worldview for that investigation. That is, in seeking to understand a phenomenon, a researcher makes certain assumptions, both explicit and implicit, about the world that shapes her investigation (Burrell and Morgan 1979; Eriksson 2008). The highest-level assumptions, ontological, relate to the relationship between people and things within the world, i.e. do the things exist external to or separate from a person (objective reality) or are things internal to or perceptions of a person (subjective reality). The next level of assumptions, epistemological, concern what constitutes knowledge and how knowledge can be obtained, i.e. is knowledge constituted of hard, tangible, observable things (empiricism or positivism), is knowledge constituted of soft, transcendental, socially constructed things (subjectivism or Interpretivist), or is knowledge a mixture of hard things that are interpreted within a context (critical realism). The combination of these ontological and epistemological assumptions informs the researcher's investigation design (methodology).

The remainder of this chapter describes this dissertation's research philosophy (Chapter 3.2), i.e. the selected ontology, epistemology, and methodology. The chapter concludes with a description of the research design (Chapter 3.3).

3.1 Research Philosophy

> *All truth passes through three stages. First, it is ridiculed. Second, it is violently opposed. Third, it is accepted as being self-evident.*
> — *Arthur Schopenhauer (1788 ~ 1860)*

> *Science is simply common sense at its best, that is, rigidly accurate in observation, and merciless to fallacy in logic.*
> — *Thomas Henry Huxley (1825 ~ 1895)*

> *The effort to understand the universe is one of the very few things that lifts human life a* little above the level of farce, and gives it some of the grace of tragedy.
> — *Steven Weinberg* (1933 ~)

3.1.1 Methodology

The social constructive ontology-epistemology encompasses the interpretive research methodology. This methodology is commonly referred to as qualitative research because the data is not objective measurements, i.e. numeric. Similarly to the positivist research methodology producing quantitative data, interpretive research results in qualitative data (Tesch 1990, 55). Qualitative data are human-made creations that are of interest to the researcher, e.g. apparel, ceramics, drawings, journals, paintings, photographs, pictures, publications, recordings, spreadsheets, words, etc. The distinction of interpretive data consisting of non-numeric data is not perfect; it is possible that a qualitative researcher uses numbers. What distinguishes qualitative data is that the researcher uses it to interpret the research subjects' meaning – the data is descriptive.

The character of the research data is not sufficient to describe interpretive or positivist methodology; the researchers' approach to the empirical world is also pertinent. As shown in Figure 3-2, Taylor describes eight characteristics of interpretive research. First, interpretive researchers must suspend their own beliefs and worldviews so that as the observing instrument they capture the research subjects' reality. Second, an interpretive study's findings emerge from the study through an inductive process. Differing from positivist studies, which use the collected data to validate preconceived hypothesis or models, qualitative data is examined for the study's findings. Third, an interpretive researcher observes people and settings together to learn the subjects' day to day reality, i.e. instead of dehumanizing a phenomenon into variables and equations, interpretive researchers seek to humanize their observations. Fourth, interpretive researchers interact with the people and settings in a natural manner trying to remain unobtrusive while obtaining an 'understanding' of the phenomenon. While the interpretive researcher is embedded in the phenomenon, they seek to minimize their interactions so as not to alter the observed phenomenon. Fifth, an interpretive researcher seeks perspectives from throughout an organization; the researcher does not assume that the value of a subject's perspective is directly related to the subject's hierarchical position or power within the organization. Sixth, the value of interpretive research is in its meaningfulness (validity). This differs from positivistic research, which values a study's reliability and reproducibility. However, this difference does not imply that interpretive researchers are less concerned with the reliability of the collected data. Rather, the rigor of interpretive methods ensures the accuracy of qualitative data. Seventh, since the ability to observe things varies with the circumstance, it is important that an interpretive researcher consider everything that

is pertinent to the study's purpose no matter how seemingly unimportant or ordinary. This is amplified by the notion that people and settings are both similar (i.e., in some general sense, people and groups are similar within any setting) and unique (i.e., certain aspects can be best studied in certain settings). Finally, since interpretive methods are neither refined nor standardized, a researcher has a degree of flexibility in the conduct of her study. This means that the successful researcher must use his skills and insights, i.e. a degree of craftsmanship is necessary for interpretive studies.

Characteristic	Description
Concern with the meaning attached to things	▪ A researcher must understand people from their perspective; ▪ A researcher must set aside their own perspectives and worldviews
Inductive	▪ Using a flexible research design that uses emergent analysis, concepts, insights, and understandings are derived from observed patterns in the qualitative data (this differs from positivism in which the researcher uses the collected data to validate a priori models or hypothesis)
Holistic: Settings and people form a whole	▪ A researcher must get to know people within their setting; ▪ A researcher must get to know what people experience in their daily interactions
Concern with how people think and act in their everyday lives	▪ Researchers interact with people in a natural, unobtrusive manner; ▪ In conducting an interview, a researcher speaks with the subject in a normal conversation (this differs from positivist interviewing that uses a structured question-response interaction)
All perspectives are worthy of study	▪ Researchers do not value the perspective of people based on their power or hierarchical position within an organization; ▪ Researchers are interested in all vantage points
Emphasize the meaningfulness of their research	▪ Interpretive methods ensure that the data closely aligns with the peoples' empirical world, i.e. the collected data is unfiltered through operational definitions or rating scales; ▪ Researchers emphasize the study's validity, i.e. meaningfulness (this differs from positivist research's emphasis on reliability and replicability)
Something to learn in all settings and groups	▪ Nothing is too mundane or trivial to be studied; ▪ All settings and people are both similar and unique; ▪ Given the circumstances, some processes can be observed with ease or difficulty
Craft	▪ Research approaches are not refined or standardized; ▪ Researchers are flexible in the means used to perform a study; ▪ Researchers are craftspeople

Source: Contents adapted from Taylor (1998, 7-10)

Figure 3-1. Characteristics of Interpretive Research

There are many research methods available within interpretive research and the selected social construction ontology-epistemology. The choice of research method should align with the high-level objectives of the researcher's investigation. Tesch (1990) proposed a

taxonomy of interpretive research (see Figure 3-3) to aid a researcher in selecting the appropriate research method. The top-most level of the taxonomy consists of the four categories that comprise the continuum of interpretive investigations: characteristics of language, discovery of regularities, discerning meaning, and reflection. These categories differ in the degree of structure and holism in interpreting the qualitative data: characteristics of language are the most structured and reflection is the most holistic.

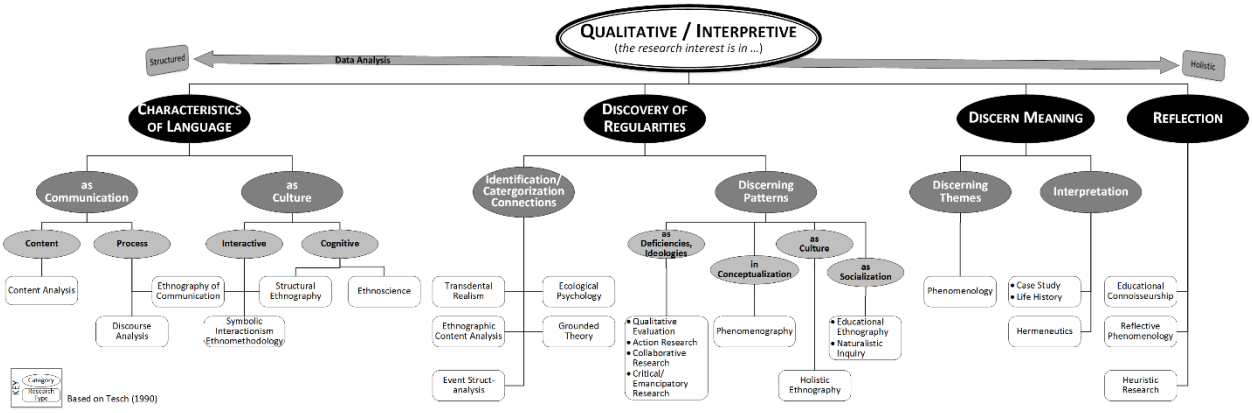


Figure 3-2. Qualitative/Interpretive Research Taxonomy

Continuing the investigations of Weill and Ross (2004), the goal of this research is to seek an understanding of IT governance from an exemplar organization. This goal is consistent with Tesch's discerning meaning interpretive research category in that the research will use the qualitative data from the exemplar organization to find the shared understanding of IT governance by the people of that organization, i.e. the research seeks to understand what IT governance means to a specific organization. Tesch divides the discerning meaning category into *discerning themes* and *interpretation*. While each of these sub-categories intends to interpret the qualitative data, the discerning themes category is concerned with discovering the pattern that connects (Tesch 1990, 67). Of the interpretive methods, *hermeneutics* and *oral*

history seek to gain an understanding over time. A *case study*, however, seeks to gain an in-depth understanding from a single case. Yin (2009) explains that case study research is appropriate to answering how and why questions that focus on contemporary events; he defines a case study as

> *An empirical inquiry that investigates a contemporary phenomenon in depth and within its real-life context, especially when the boundaries between phenomenon and context are not clearly evident. The case study inquiry copes with the technically distinctive situation in which there will be many more variables of interest than data points, and as one result relies on multiple sources of evidence, with data needing to converge in a triangulating fashion, and as another result benefits from the prior development of theoretical propositions to guide data collection and analysis (Yin 2009, 18).*

Therefore, as previously discussed, this investigation makes use of the *case study* method of the *interpretive research* methodology from the *social construction* ontology-epistemology.

3.2 Research Design

> *Just as the largest library, badly arranged, is not so useful as a very moderate one that is well arranged, so the greatest amount of knowledge, if not elaborated by our own thoughts, is worth much less than a far smaller volume that has been abundantly and repeatedly thought over.*
> *— Arthur Schopenhauer (1788 ~ 1860)*

> *The measure of greatness in a scientific idea is the extent to which it stimulates thought and opens up new lines of research.*
> *— Paul Dirac (1937 ~ 1984)*

While the case study method was once confined to exploratory investigations in which relevant concepts, factors, and themes are uncovered and subsequently investigated in-depth, Myers (2009, 71-73) explains that the case study method can also be used for explanatory business investigations, i.e. a case study is an appropriate method for research that seeks to test theory, compare theories, or develop an explanation - a seminal example of such a use of a case study is Markus (1983). The design of this dissertation's research is an explanatory case

study of a single organization in which the qualitative data shall be used to formulate a systems model.

3.2.1 Case Study Tenets

The researcher's adherence to the fundamental tenets of the method used determines the veracity of any research study. Among the tenets for a case study are that the case study shall

1. be interesting;
2. be complete;
3. consider alternative perspectives; and
4. contribute to knowledge (Myers 2009, 83-85)

While a case study should be of interest to the researcher(s), an interesting case study is one that describes something new, i.e. it reveals something new to the research community. As described in Chapter 1, this case study is examining IT governance in an organization to explain this phenomenon as a system. Next, all necessary evidence to support or refute the theoretical idea(s) being investigated needs to be collected. As will be discussed in Chapter 3.3.3, qualitative data is being collected using multiple techniques: a review of existing documentation, interviews, and observation. Equally important to the completeness of the qualitative data is that the data reflects all perspectives within the subject organization, especially those perspectives that conflict with the emergent meaning drawn by the researcher. Finally, in addition to the case study being interesting, it must contribute to the information system discipline's knowledge.

3.2.2 *Subject Organization*

This case study subject is the Virginia Department of Transportation (VDOT) whose annual budget was over $5 billion in the fiscal year 2016 (July 1, 2015 – June 30, 2016). Nearly half of VDOT's budget is used for the operations and maintenance of the infrastructure it provides the state's residents. Approximately twenty percent of the budget is for the addition of infrastructure throughout the state. The remainder of the budget is for debt service and administration, including the agency's IT division. Funding is provided by the federal government, state taxes, and infrastructure usage fees. VDOT is subject to governance oversight from the state legislature and the Virginia Information Technologies Agency (VITA) that is responsible for the state's IT infrastructure and standards. Interestingly, VDOT recently conducted a strategic assessment of its IT organization, including IS and IT governance, and reorganized its IT division and governance processes.

3.2.3 *Data Collection*

There are various sources of qualitative data. The investigation of VDOT will collect data from their governance documentation, e.g. policies, procedures, organization charts, job descriptions, forms, etc. Other documentation will be collected from outside of VDOT, e.g. relevant state law and regulations, state standards and procedures, etc. Another source of data will be collected from observation by the researcher who has been a consultant to VDOT over the past year. A final source of qualitative data will be collected from interviews of VDOT executives, senior managers, and senior IT managers. Finally, each interviewee will be asked to recommend other staff that might be appropriate for follow-on interviews. Regardless, the

collection of interview-based data will be completed after a minimum of three interviews, and there is nothing novel being discovered in the interviews.

3.2.3.1 Triangulation

The collection of qualitative data provides a researcher with insights from individual sources, which is a collection of representations of each source's understanding of each phenomenon. While each such insight is valuable, the objective of interpretive research is to obtain an emergent understanding from all such insights. The principle of triangulation is a means for a researcher to gain such a comprehensive understanding within the setting being observed (Taylor 1998, 80-82). A researcher's use of triangulation is conceptually like the surveyor's method in which measurements are made from several positions to determine characteristics of a single point of interest (e.g. distance, elevation, etc.); a researcher makes use of multiple sources of information to gain a single insight. However, it differs in that the objective is not the attainment of the true or correct "value;" rather, the objective is to obtain a valid insight.

This research will use triangulation in two manners: 1) multiple types of data sources and 2) hermeneutic circle. As previously discussed, qualitative data will be collected from textual sources (i.e. existing documentation), verbal sources (i.e. interviews), and visual sources (i.e. researcher observation). Information from each source will be compared and contrasted to form an insight. Further, the information from the textual and visual sources will be used during interviews as part of the hermeneutic circle, i.e. textual and observational data will be treated like verbal data in each interview. A hermeneutic circle is an iterative process in which the information that has been previously obtained is vetted with the source being interviewed.

Sarker and Lee explain that hermeneutics can be used to discern the meaning of socially constructed phenomena, which are things "whose existence depends on people, but nonetheless have a measure of independence that they outlive and transcend the people who are sustaining them at any point in time" (Sarker and Lee 2006, 133). The hermeneutic method continually validates that the emergent interpretation is consistent with what is known to that time, i.e. the prior emergent meaning can be adjusted with the knowledge obtained in the "text" presently being observed, i.e., an interpretive researcher reaches an emergent meaning whose "validation is temporary and changes as new facts and guesses appear" (Sarker and Lee 2006, 134). This method of iterative validation is significantly different from verification in which the emergent meaning would be determined to be true (or probably true with some degree of confidence).

3.2.3.2 Observation

There are two forms of research observation: formal observation and participant observation. Formal observation involves the researcher observing the setting without being directly involved. Participant observation involves the researcher observing and being involved in the setting (Eriksson 2008, 126; Myers 2009, 138-139). The effectiveness of observation is increased by having multiple researchers (observing instruments) observe the setting, i.e. team observation is a method of triangulation.

As previously described, the author has been a consultant to VDOT for the past year. As a consultant, this researcher has been observing the governance processes of VDOT and has participated in these processes. Further, the author has provided consultation on the IT Division's reorganization.

3.2.3.3 *Interviews*

An interview is a commonplace method to elicit information from an interviewee and is used for a variety of purposes. A research interview is distinctive and differs from other forms of interviews at the level of the relationship between the interviewer (the researcher) and the interviewee (the subject). A research interview is purposeful; it elicits information related to the researcher's interest and desire to contribute to knowledge. The nature of the qualitative interview is a one-way power relationship in which the researcher possesses scientific skills and sets the interview context, i.e. the researcher is a research instrument that obtains qualitative data from the interviewee. In a research interview, the researcher controls the topics, asks questions, decides when to ask follow-on questions, and determines when the interview is complete. In contrast, the interviewee provides answers (Olson 2011, 89-90; Brinkmann and Kvale 2015, 37).

There are three types of research interviews: structured, semi-structured, and unstructured. A structured interview uses pre-formulated questions that are presented in a predefined sequence. The semi-structured interview makes use of pre-selected themes, and provides flexibility to investigate these themes; a semi-structured interview nearly resembles a conversation. The aspects of a semi-structured interview are described in Figure 3-4. An unstructured interview uses few, if any, pre-formulated questions and enables the flexibility in what the interviewee discusses; it is a free-form conversation (Myers 2009, 123-125; Brinkmann and Kvale 2015).

Semi-structured Interview Aspect	Description
Life World	Discuss the interviewee's everyday lived experience; the world as it is encountered and reflective of immediate experience
Meaning	Seek an understanding of the interviewee's lived world by interpreting the meaning of what is said and how it is stated
Qualitative	Seek nuanced accounts of everyday life in normal language (not with numbers)
Descriptive	Seek as precisely as possible a description of experiences and the interviewee's perception of their actions; gathering a diversity of descriptions of a phenomenon
Specificity	Seek descriptions of specific situations, actions, and events rather than unfocused descriptions and generalize opinions
Deliberate Naiveté	Accept the interviewee's introduction of unanticipated or new phenomena
Focus	Maintain focus on pre-selected themes
Ambiguity	Clarify contradictory and ambiguous information; determine if such statements are due to communication issues, inconsistencies in experiences, or contradictions in experiences
Change	Permit the interviewee to reflect on experiences such that over the interview the interviewee can learn and change their meaning
Sensitivity	Ensure that the interviewers possess sufficient foreknowledge and sensitivity to the themes being investigated
Interpersonal Situation	Recognize that and be able to manage the interviewer-interviewee personal dynamics, which moderate the elicited information
Positive Experience	Provide the interviewee an enriching experience in which they can discuss their experiences because the interviewer is clearly interested and sensitive to the interviewee's experiences and views

(Source: Contents adapted from Brinkmann and Kvale 2015, 31-35)

Figure 3-3. Aspects of a Semi-Structured Interpretive Interview

This research will use semi-structured interviews of VDOT staff at all levels of the IT organization. Sample questions for these interviews are shown in Figure 3-5.

Theme	Sample Question
Governance	▪ I am interested in understanding how governance works within this agency; what do you think governance means? ▪ Unlike a corporation where there is a Board of Directors, how do you see the Agency being governed? ▪ What do you think XXX is concerned with? ▪ Do you think that XXX is concerned with IT? How?
IT Governance	▪ How does the agency choose its IT projects? ▪ How does the agency oversee its IT systems? ▪ Do you think the agency makes good use of technology?
Governance Process	▪ What systems do you work with? ▪ How long have you been working with that system? ▪ What controls are in place for system XXX? ▪ Are these the same controls for the other systems? ▪ Explain how control XXX works? ▪ What would you change?

Figure 3-4. Sample Interview Questions

3.2.3.4 Sensitivity

As shown in Figure 3-4, sensitivity is an aspect of a semi-structured interview. The idea of the sensitivity of the research instrument to obtain information from the observed phenomenon is fundamental to the veracity of all research. In positivist research, the concept of sensitivity refers to the capability of a physical instrument such as a telescope or scale to make a measurement. When gathering data through interviews, the concept of sensitivity also refers to the observing aptitude of the research instrument – the researcher (Strauss and Corbin 1990, 41). A researcher's sensitivity is a function of the researcher's experience and knowledge of the phenomenon being investigated. It is reflected in the researcher's ability to discern what is pertinent within the data and then to derive insights and meaning. A researcher's sensitivity can be developed through an understanding of the literature (e.g. theory, prior research, practitioner documents, historiographies, etc.), professional experience,

personal experience. Another means by which sensitivity is developed is through the knowledge gained in conducting the research, e.g. collecting data, analyzing data, etc.

The sensitivity of this researcher is based on two elements: 1) the knowledge of systems theory and IT governance gained through the academic literature as demonstrated in Chapter 2; and 2) through the experience as an IS practitioner over the past 40-years. This practitioner experience includes working within a variety of organizations including Fortune 100 and mid-size companies, small and medium business, government agencies, and as a sole proprietor. Some of these organizations developed and sold software-based products, others provided IT services to clients, and some organizations had their own internal IT division. Within this organization, the researcher performed in many roles. Most relevant to this research are the years of experience in project and program management in which governance process was used and developed.

3.2.3.5 Case Study Database

Another means of improving the reliability of research, regardless of the research approach, is making the data available to other researchers to vet. This is accomplished through a database. A case study database consists of "notes, documents, tabular materials, and narratives" (Yin 2009, 119). While this information is gathered during the research, the privacy of individuals and organizations need to be protected in the case study database. As such, anonymized data is placed in the database, i.e. nothing that can specifically identify an entity is contained in the data; such information is consistently coded before being placed in the database.

Chapter 4 - DATA FROM THE CASE SITE

You may have heard the world is made up of atoms and molecules, but it's really made up of stories. When you sit with an individual that's been here, you can give quantitative data a qualitative overlay.
— Joseph Mallord William Turner, RA (1775-1851)

Most executives, many scientists, and almost all business school graduates believe that if you analyze data, this will give you new ideas. Unfortunately, this belief is totally wrong. The mind can only see what it is prepared to see.
— Edward De Bono (1993)

I am enough of the artist to draw freely upon my imagination. Imagination is more important than knowledge. Knowledge is limited. Imagination encircles the world.
— Albert Einstein (1929)

Data was collected from VDOT to paint a picture of VDOT's organization governance with a specific view of the governance of VDOT's IT assets. However, Weill and Ross (2004) have provided a clear picture of IS and IT governance as an organization process. Therefore, the emergent picture from the collected data seeks an alternative perspective: painting VDOT as a system that contains IS and IT governance as a system within VDOT's governance system. In so doing, the collected data is the foundation on which rests the answers to Research Questions 2 and 3 (see Chapter 1.3):

R2. In observing an exemplar organization:
   a. What essential IT governance features can be identified?
   b. What General Systems Theory features are observed (explicitly or implicitly)

R3. Using the IT governance and General Systems Theory features identified in R2, what is a model of IS and IT governance that explains the IS and IT governance observed at the case site?

Data was collected at VDOT from two essential sources: interviews and existing documentation. The interviews involved VDOT executives and managers who had some level of responsibility for VDOT's information technology assets and were involved in some manner

with VDOT's recent changes in its IT division. The documentation included routine organization information, e.g. organization charts, policies, history, organization descriptions, budget information, etc. Details about each data source are in the following subchapters.

4.1 Sources of the Research Data

Research is formalized curiosity. It is poking and prying with a purpose.
— Zora Neale Hurston (1903-1960)

There's only one interview technique that matters... Do your homework so you can listen to the answers and react to them and ask follow-ups. Do your homework, prepare.
— Jim Lehrer (1934-)

4.1.1 Interview Data Source

On obtaining the University's Institutional Review Board (IRB) approval, the collection of the case site's interview data commenced with the researcher conducting six interviews between June 7, 2016, and August 23, 2016, at VDOT's central office facilities (see Figure 4-1). The first through fifth interview was conducted in the interviewee's office; the last interview was held in a conference room. To ensure the interviewee's anonymity, they are identified as Z0#. The interviews were private conversations between the researcher and interviewee; however, Z02 was present throughout the interview of Z01 (Z02 did not contribute to the interview of Z01).

Interviewee	VDOT Position	Interview		
		Date	Location	Length
Z01	Senior Executive	June 7, 2016	Office **(Z02 was present)**	30 minutes
Z02	Senior Manager	June 15, 2016	Office	60 minutes
Z03	Executive	June 21, 2016	Office	110 minutes
Z04	IT Manager	July 1, 2016	Office	40 minutes
Z05	Senior IT Manager	July 20, 2016	Office	30 minutes

Interviewee	VDOT Position	Interview		
		Date	Location	Length
Z06	VITA Senior Staff Member	August 23, 2016	Conference Room	40 minutes

Figure 4-1. Interviews

As part of the IRB review process, interview guidelines were established (see Appendix A). Per the interview guidelines, the start of the scheduled interview session began with the researcher providing a copy of the Research Subject Information Form (see Appendix B) to the prospective interviewee. Once the prospective interviewee reviewed the form, the researcher asked if the prospective interviewee consented to proceed with the interview; all interviewees provided verbal consent. Next, the interviewee was asked for permission for the researcher to make an audio recording of the interview; verbal consent was provided in all but the first interview. Having completed the pre-interview portion of the session, the researcher initiated an informal conversation that ranged through the interview guideline's interview themes (see Figure 4-2), as appropriate. Beginning in the second interview as a theme was being discussed, the researcher sought the interviewee's reaction to and understanding of emergent concepts from the prior interviews. In this manner, the validity of the emergent concepts as understood at the time of an interview was vetted with the current interviewee, which is part of establishing a hermeneutic circle and a method of triangulation. Examples of such emergent concepts included the meaning of governance, the goals of the IT division reorganization, and the future direction of IT governance.

Organization Governance
- Understanding of governance
- Strengths of governance
- Weaknesses of governance

IT Governance
- What is governed
- Is IT governance part of the organization governance?
- Areas to improve IT governance

Governance Processes
- IT governance mechanisms/processes
- Common governance mechanisms/processes
- Processes needing improvement

Figure 4-2. Interview Themes

After each interview, the audio recording was fully transcribed, and interview notes were written up. In all cases, the resulting transcript and interview notes were anonymized and placed in the research database, which was accessible to only members of the researcher's dissertation committee (the audio recordings were stored in a separate secure location that was accessible only to the researcher and dissertation committee chair). After the interviews had been concluded, the researcher examined the notes and transcripts who extracted and coded data snippets. Rather than working with pre-conceived coding categories, the coding categorization shown in Figure 4-3 emerged from the analysis of the research database. Finally, each snippet was assessed for representing the presence of one or more systems characteristics. Some snippets provided counter-intuitive evidence. For instance, senior IT manager Z05 provided evidence of holism by explaining that there is an industry consensus that the absence of governance is not desirable, i.e., the industry has learned that an organization that does not contain IT governance in toto has significant issues; that IT governance provides essential capabilities that the organization requires to be successful.

Coding Category	Meaning
Commonality	Describes governance that applies to more than one area within VDOT or the Commonwealth of Virginia
Concerns	Describes governance issues, risks, or both
Controls	Describes a governance monitoring method
Definition	Provides a meaning for governance
Demographics	Provides information about the interviewee
Exemplars	Describes a governance incident within VDOT or another organization
External	Describes the effect of an external organization on VDOT's governance
Infrastructure	Describes governance for information technology
Process	Describe a governance process

Figure 4-3. Interview Data Categories

4.1.2 Documentary Data Source

Documentary data was collected from a variety of publicly accessible and internal VDOT sources. As with the interview data, the collected documentary data were included in the research database; the documents were placed in the reference article repository, which was accessible to only members of the researcher's dissertation committee. Also, the documentary data was included in the categorization analysis performed by the researcher. Finally, the documentary data was assessed for supporting the presence of one or more systems characteristics. The inclusion of the documentary data in the categorization and systems characteristic analysis was an aspect of ensuring the data's integrity by triangulation.

4.2 BACKGROUND

Highwayes shall be layd in such convenient places as are requisite accordinge as the Gov. and Counsell or the Commissioners for the monthlie corts shall appoynt, or accordinge as the parishioners of every parish shall agree.
— Virginia House of Burgesses (1632)

> *Our mission is to plan, deliver, operate and maintain a transportation system that is safe, enables easy movement of people and goods, enhances the economy and improves our quality of life.*
> — *Virginia Department of Transportation (2014a)*

Interestingly, VDOT's history begins the dawn of the twentieth century and is closely aligned with the United States' increasing dependence on the internal combustion engine for its transportation. Using predominately publicly available information, the subchapters below provide a brief history of the creation and evolution of VDOT (Chapter 4.2.1), an explanation of how the agency is organized (Chapter 4.2.2), and an identification of the agency's significant constituencies and priorities (Chapter 4.2.3).

4.2.1 History

The Virginia Department of Transportation is an Agency of the state government of Virginia within the Transportation Secretariat of the Executive Branch (see Figure 4-5). VDOT traces its history to 1906 when the Virginia General Assembly (the government's legislative branch) created the State Highway Commission. This legislation authorized the governor to appoint a commissioner who is subject to confirmation by the General Assembly (Virginia General Assembly 2017). The commissioner had to be a citizen of Virginia, a civil engineer, and experienced in road-building. The General Assembly provided the commissioner with the following authority:

> *Shall have a general supervision of the construction and repair of the main traveled roads in the state; the Commissioner may recommend to the local road authorities of any county, and to the Governor, needed improvements in the public roads; he shall supply technical information on road building to any citizen or officer of the state, and from time to time publish for public use such information as will be generally useful for road improvement. (VDOT 2006, 20)*

In 1922, the General Assembly divided the state into eight districts[7] (the current nine districts are shown in Figure 4-4). During a 1927 state government reorganization, the General Assembly created the Department of Highways, which was a state agency. In 1974, the agency authority was expanded to include rail and public transportation[8] and was named the Virginia Department of Highways and Transportation; the General Assembly renamed the agency most recently in 1986 to the Virginia Department of Transportation. Concurrently, the General Assembly expanded the state highway board and called it the Commonwealth Transportation Board; in 1990 the Secretary of Transportation was designated the Chair of the Commonwealth Transportation Board, and VDOT's Commissioner was designated the Vice-Chair (VDOT 2016a). In 2015, the legislature adjusted the membership of the Commonwealth Transportation Board removing the VDOT Commissioner as the Vice Chair and designating a senior non-legislative citizen to be appointed. Further, the Governor was provided authority to remove any Commonwealth Transportation Board member for cause, e.g. malfeasance, misconduct, conflict of interest, etc. In addition, funding was changed to a priority ranking system (Commonwealth of Virginia 2015)

[7] The Northern Virginia District was added in 1984

[8] In 1992, the legislature removed rail and public transportation from VDOT and created the Department of Rail and Public Transportation as an Agency under the Secretary of Transportation.

4.2.2 *Organization*

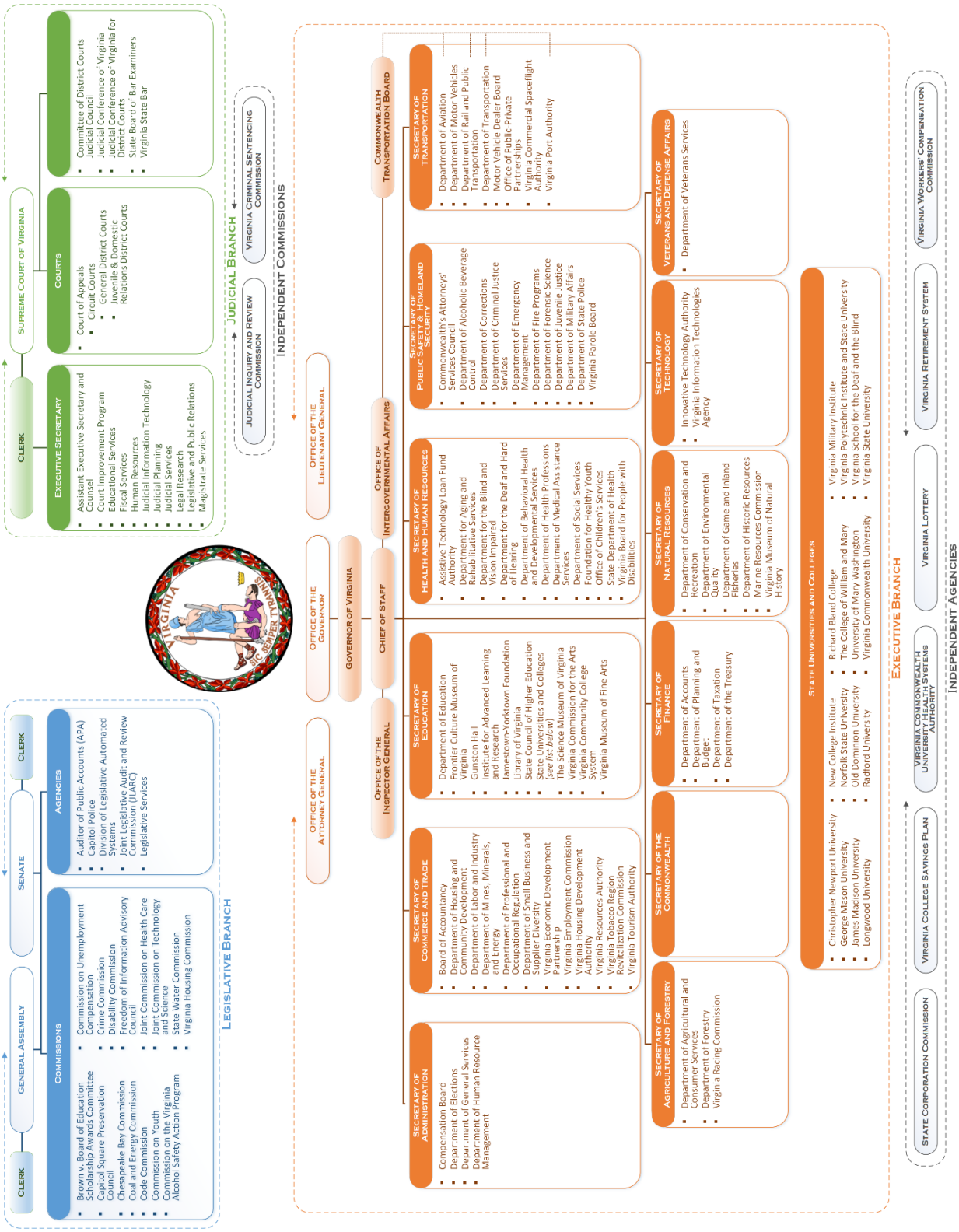
Figure 4-4. VDOT District Map (VDOT 2014b)

Figure 4-6 shows VDOT's organization as of mid-2017. As shown, the agency's Commissioner directly manages the Deputy Commissioner, Chief Engineer, Human Resources, and Assurance and Compliance. The Deputy Commissioner is responsible for the Chief of Administration, Chief Financial Officer, Chief of Policy, and the managers of several administrative areas including communications, civil rights, strategy, public-private partnerships, and the research council. The Chief Engineer is responsible for the operations of the districts and through the Deputy Chief Engineer, the VDOT's engineering areas, e.g. construction, planning, materials, bridges, traffic engineering. The Chief of Administration manages the Information Technology Division, which consists of Development, Division Relationship Management, Enterprise Architecture, IT Governance and Provisioning, and Maintenance and Operations (see Figure 4-7).

There are two important norms that the VDOT organization chart can only imply. First, VDOT is an engineering organization; this is evident from the use of the term 'Chief' in several

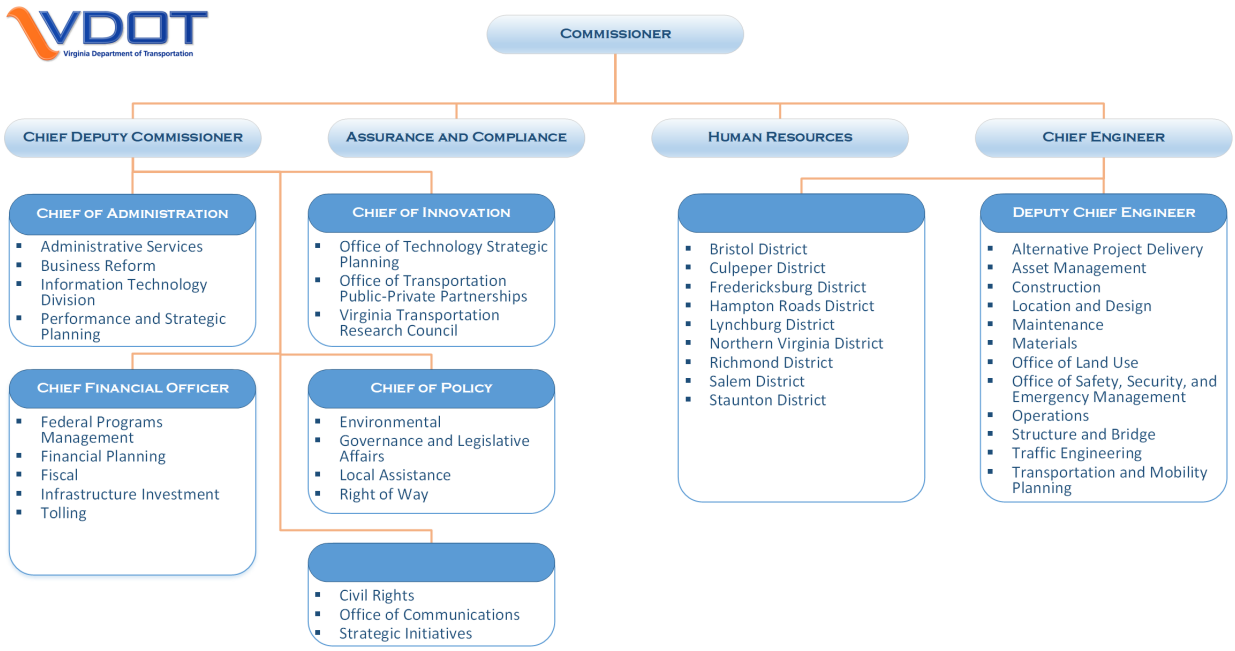
roles on the organization chart[9]. The engineering norm is grounded in the agency's historical founding when a civil engineer led the organization; when throughout VDOTs history, many of its managers were Virginia Military Institute graduates; and presently that many of the agency's leadership are Professional Engineers. Second, VDOT is a federation. The organization chart shows that the districts are currently the responsibility of the Chief Engineer (this reporting arrangement has varied; the Commissioner has been responsible for the districts). The districts are semi-autonomous organizations within VDOT that are expected to adhere to the policies established by VDOT's 'Central Office,' which is in Richmond and consists of the various divisions and offices shown on the organization chart under the Deputy Commissioner and Deputy Chief Engineer. Further, as an executive branch agency, VDOT operates within a federation. Therefore, VDOT is part of a legislative-based federation and is operationally a geographically-based federation.

[9] While the title 'Chief' is currently in widespread use, prior executives have used the title 'Assistant Commissioner.'



Source - Contents adapted from Commonwealth of Virginia (2017f), Hade (2017a), Hade (2017b), and Thomasson (2017)

Figure 4-5. Organization of the Virginia State Government



Source - Contents adapted from VDOT (2017)

Figure 4-6. Organization of the Virginia Department of Transportation

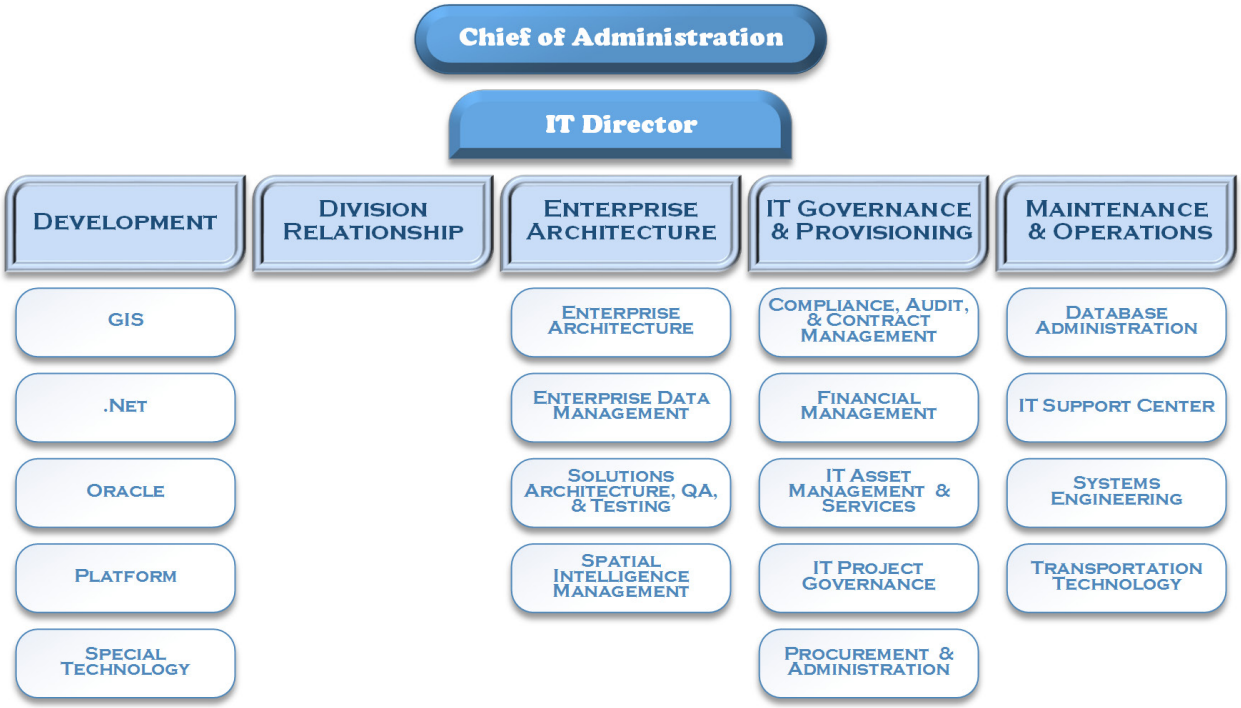


Figure 4-7. Organization of the VDOT Information Technology Division

4.2.3 *Key Stakeholders and Priorities*

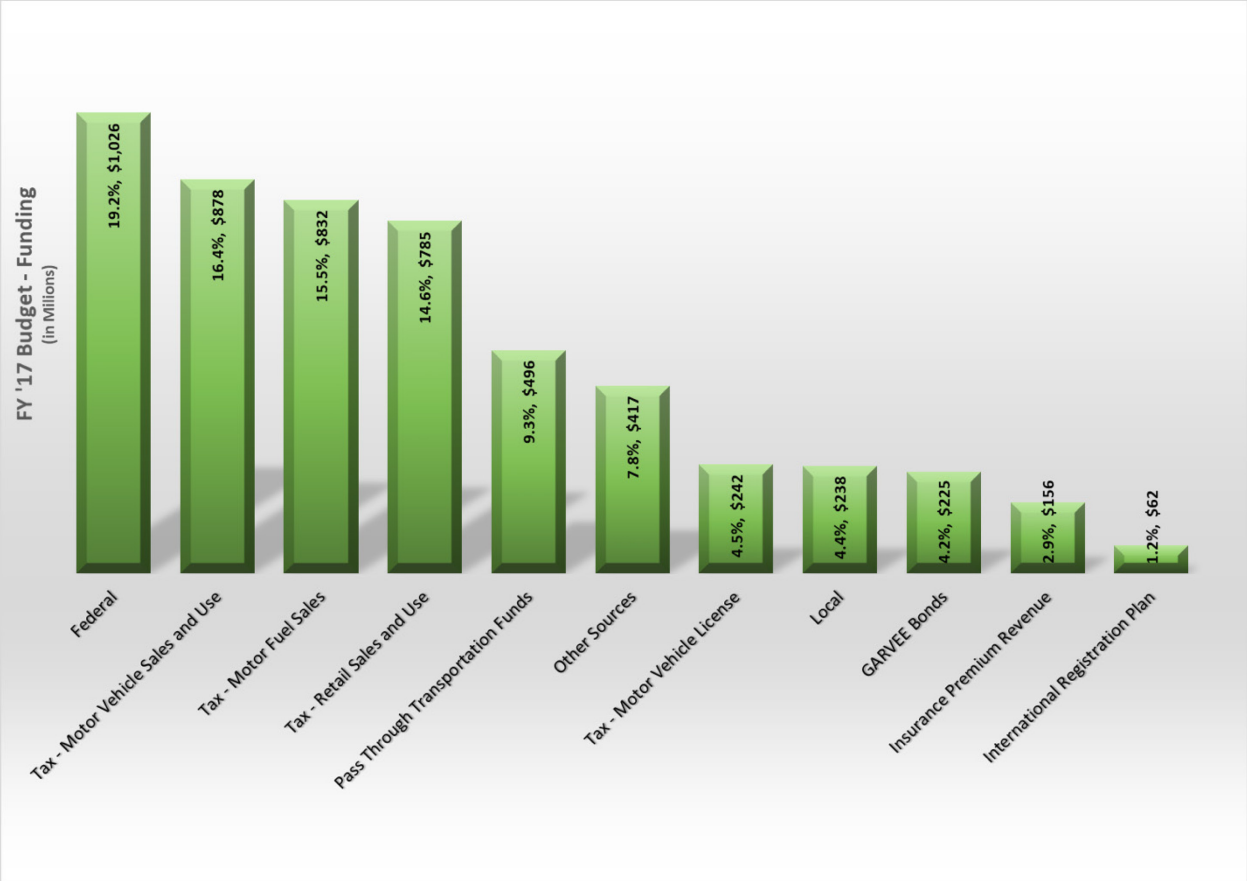
Analyzing VDOT's fiscal year 2017 budget can provide an understanding of VDOT's complexity, significant stakeholders, and priorities. The Commonwealth of Virginia's fiscal year begins on July 1. When compared to the corporations on the Fortune 500 list, VDOT's fiscal year 2017 budget revenues of 5.358 billion dollars (VDOT 2016b) would place VDOT in the 479th position (Fortune.com 2017). In that position, VDOT would be slightly larger than the Western & Southern Financial Group, which is a Cincinnati-based financial service and insurance business that has nearly 2,200 employees. VDOT would be slightly smaller than the Englewood, Colorado-based CH2M Hill, whose 22,000 employees work on large-scale engineering projects such as the Panama Canal expansion. Other well-known corporations whose revenues are about the same as VDOT (i.e., between about five and six billion dollars) include Levi Strauss, Keurig Green Mountain, Magellan Health, Caesars Entertainment, Adobe Systems, Williams-Sonoma, M&T Bank Corporation, Neiman Marcus Group, Big Lots, Simon Property Group, Booz Allen Hamilton Holding, Owens Corning, Western Union, St. Jude Medical, Alaska Air Group, J. M. Smucker, Mattel, United Rentals, Marathon Oil, Harley-Davidson, Dr. Pepper Snapple Group, and JetBlue Airways. Most of these corporations are well known throughout the country and commonly considered very large organizations. The scope of these organization's activities throughout the United States, and in many cases internationally, is accomplished through complex organizing and processes, i.e. each of these corporations is a complex system. VDOT significantly differs from these Fortune 500 corporations in two ways: the political boundaries of the state of Virginia confine VDOT's operations, and the Virginia legislature has granted VDOT near exclusive authority within the

state to perform its activities[10]. Nevertheless, VDOT's fiscal year 2017 funding places it on par with the Fortune 500 corporations previously described. Therefore, when considering VDOT as a holistic organization rather than as an element of the government of the state of Virginia, it is a complex system, i.e., VDOT accomplishes its activities through complex organizing and processes.

Comparing VDOT to Fortune's ranking of corporations by revenue equates VDOT's funding to a Fortune 500 corporation's revenue. While this equivalence is valid from the perspective of an accountant's Balance Sheet, it is not equivalent from the perspective of entities from whom these revenues originate, e.g. customers, creditors, shareholders. Figure 4-8 shows the relative contribution of the sources of VDOT's funding. The largest source of funds is the United States government (19.2%), taxes on motor vehicle sales and use (16.4%), and taxes on fuel (15.5%) (VDOT 2016b, 9). VDOT receives dedicated funds through tolls and other fees that are passed through to transportation authorities in Northern Virginia and Hampton Roads (9.3%). The agency makes use of GARVEE bonds (4.2%), which is a financing vehicle authorized in the Code of the United States that enables states to borrow against future expected (although not guaranteed) federal highway funding. From the perspective of

[10] While its operations are within the State of Virginia, VDOT participates in regional and national organizations providing information and leadership to other departments of transportation. Also, VDOT is actively devolving certain transportation programs to local governments and regional bodies throughout Virginia. VDOT is becoming the transportation administrator whose priorities are set by others, Commonwealth Transportation Board, localities, etc.

funding, VDOT's significant stakeholders are the United States government[11], Virginia tax-payers[12], and the Virginia Legislature[13].



Source - Contents adapted from VDOT (2016b)

Figure 4-8. Fiscal Year 2017, Sources of Transportation Funds

Figure 4-9 shows how VDOT allocates funding to its programs and operations. As shown, nearly 65% of the funds are used for construction and maintenance programs, which is about $3.5 billion for the purchase of materials and related services, e.g. consulting, design,

[11] Federal funding must first be authorized by the United States Congress and President. These authorized funds are provided to VDOT by the Federal Highway Administration of the Department of Transportation.
[12] Taxes are paid by citizens, residents, visitors, and/or organizations that have a presence within the state, e.g. maintain a residence, own an asset located in the state, perform an activity in a facility in the state, perform a transaction within the state (selling merchandise from Virginia and/or that is delivered within Virginia).
[13] The Virginia Legislature and Governor amend the Code of Virginia to establish taxes and to dedicate tax receipts for the agency, as necessary.

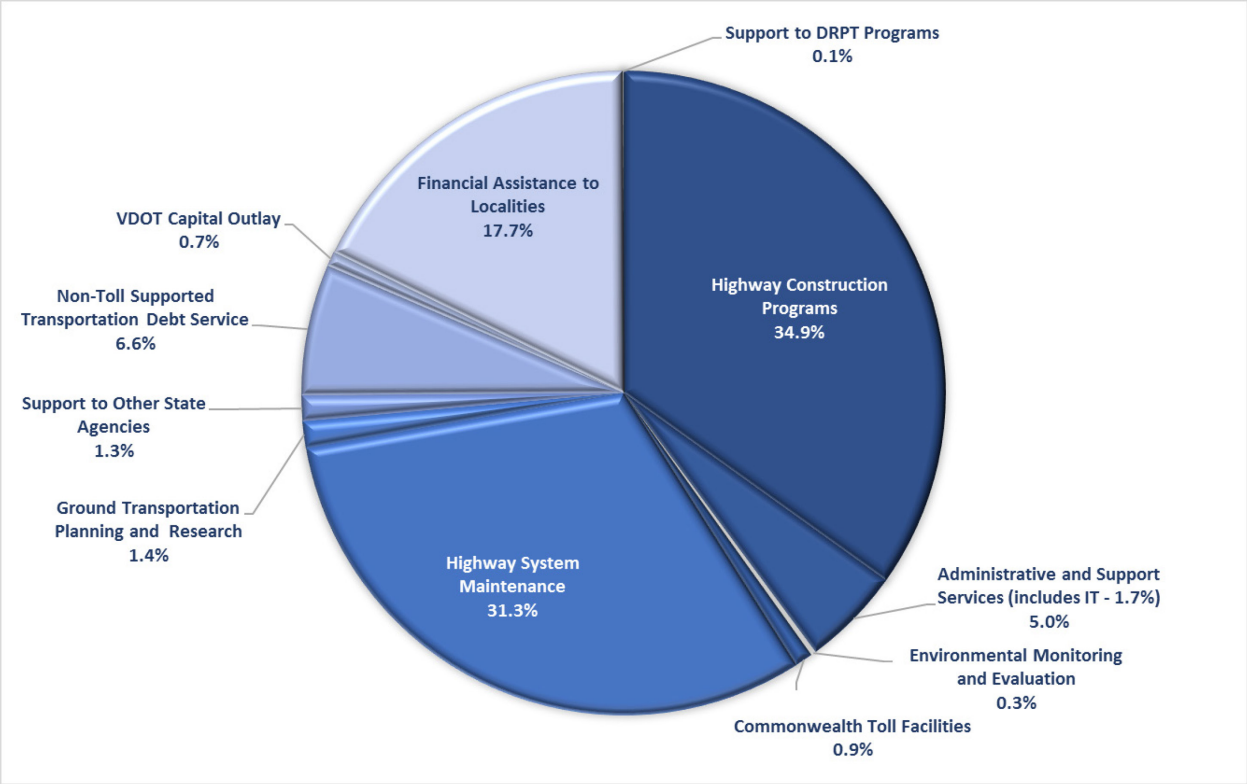
contractors. The next largest allocation is for locality assistance and authorities. These nearly one-billion dollars provide funding to cities and towns for improvements or maintenance of roads or transportation facilities, for certain recreational access programs, and for dedicated tax revenues to transportation authorities in Northern Virginia and Hampton Roads. VDOT spends slightly over $200 million for its internal administrative and support services of which nearly $90 million is for information technology. In addition to these internal support services, VDOT spends about $70 million dollars for activities that other state agencies provide to support VDOT's programs. These agencies include the Department of Motor Vehicles, the Virginia Commercial Space Flight Authority, the Virginia State Police, the Department of Minority Business Enterprise, the Office of the State Inspector General, and the Department of Emergency Management. From the perspective of spending, VDOT's significant stakeholders include the transportation industry[14], Virginia municipalities and residents, and certain Virginia state agencies, departments, and authorities.

VDOT is required to maintain the existing transportation infrastructure and then to construct new infrastructure. Figure 4-9 clearly shows this priority: the largest funded areas are highway system maintenance, highway construction, and assistance to localities, which receives about 80% of the agency's funding. As shown in Figure 4-10, most new construction funding is for specialized state and federal projects[15], transportation authorities, and projects

[14] VDOT issues contracts for construction projects via competitive bids to over 300 firms and indirectly to hundreds of sub-contracting firms. VDOT also engages transportation consultant firms to assist in various capacities such as design and project inspections. Also, VDOT works with various industry associations such as the Heavy Construction Contractor Association, the Virginia Asphalt Association, and the Virginia Transportation Construction Alliance.

that the state had funded before the change in the funding prioritization rules in 2016. Figure 4-10, shows that most maintenance funding is for the secondary road system[16], primary road system[17], and locality assistance, and the interstate road system. This is followed by construction and maintenance pass-through funding for the transportation authorities in Northern Virginia and Hampton Roads[18]. The least allocation of new construction and maintenance funds is to existing infrastructure or projects of regional importance: high priority[19], transportation operation services[20], and state of good repairs[21].

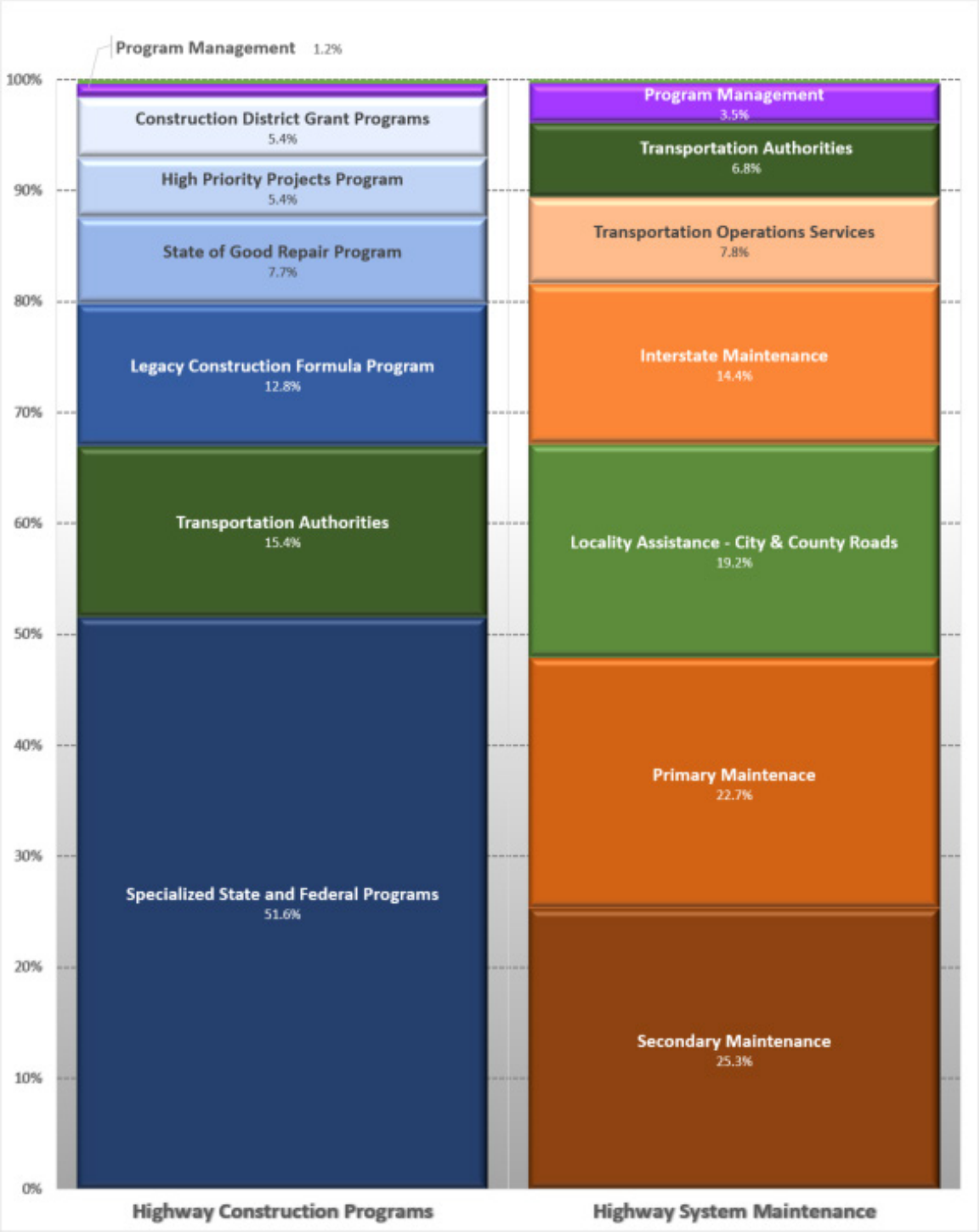
[16] Secondary roads are the roads throughout Virginia designated as a county route. Virginia is one of the few states that maintains county roads.
[17] Primary roads are the roads throughout Virginia designated as a US route or a state highway.
[18] Virginia Law stipulates that the Hampton Roads funding may only be used for new construction projects.
[19] High Priority projects are projects that are significant for statewide corridors or regional networks.
[20] Transportation Operation Services seek to improve the transportation system's mobility, safety security, and reliability of the time needed to travel through the transportation system.
[21] The State of Good Repairs is a program that rebuilds or replaces structurally deficient state-owned bridges. The program also rehabilitates interstate and primary road pavement.



Source - Contents adapted from VDOT (2016b)

Note: Figure 4-10 below shows the details of the Highway Construction Programs and Highway System Maintenance funding

Figure 4-9. Use of Transportation Funds - Fiscal Year 2017



Source - Contents adapted from VDOT (2016b)

Figure 4-10. Highway Construction and System Maintenance Funding - Fiscal Year 2017

> *The challenge facing IT organizations is to optimize these factors [budget, infrastructure, resources] and achieve the maximum value for the organization.*
> *— Business Consultant (2014)*

> *The [VITA] services delivery model is based on a service catalog where agencies pay for the hardware and services used throughout the year. This has benefited many of the smaller state agencies. … However, agencies with more mature IT organization, such as VDOT, have had challenges adapting to a centralized model.*
> *— Business Consultant (2014)*

In December 2015 VDOT's staff received an email announcement from the Chief of Administration that a new leader of the Information Technology Division (ITD) would be starting at VDOT the next month. The announcement was not a usual personnel welcome where this newly announced leader was succeeding the current ITD leader. Rather, this leadership announcement was the culmination of over twenty months planning into how to restructure ITD, i.e. how to align ITD's behaviors with VDOT executives' desirable behaviors for VDOT's IS and IT assets.

VDOT's Information Technology Division has a long and proud history; as described by VDOT executive Z03,

> … When VDOT ran our ITD shop solely - I would say that there were times when we were great at IT and delivering projects: keeping project owners happy; having a help desk; just generally keeping the customer happy; having the newest desktop, whatever the newest thing was - always being on top of that in a leading edge way, while not using unnecessary things; and then being so forward thinking and on the cutting edge of what is out there in technology and always bringing that into VDOT. …people would say we were number one for a long time. We may still be up there in the top five; but I would say, we are living on our old reputation because, in contrast, we no longer control all ITD decisions or projects or new technological advances that have application for VDOT.

The Governor, the Federal Highway Administration, and the transportation industry have recognized VDOT's IT Division for its IT solutions. The most long-lasting of these recognitions have been VDOT's use of technology to improve the transparency for the public of VDOT's transportation projects. A decade ago, the agency needed a means to improve the perception of the public of its competence of managing and delivering transportation projects; it also needed to incentivize itself to improve its project delivery. ITD was enlisted to design and deploy VDOT's Dashboard, which is a website that provides project performance indicators. In responding to this strategic imperative, ITD created an innovative solution that foreshadowed contemporary business analytic technology.

Based on the Dashboard project (and other projects), ITD has benefited from its stakeholders' perception of the division's delivery effectiveness and inventiveness; however, this stakeholder perception has camouflaged the growing gap between the Information Technology Division's performance and VDOT's desired IT delivery performance. For instance, VDOT senior manager Z02 explained that,

> Up to about two years ago, there was no governance; the IT Director [at that time] decided what projects ITD would do. An example of the problems with the old process is Virginia Roads; it was an idea of the Commissioner, and the IT Director decided that we would do it. He [the IT Director] authorized the project and had resources moved from projects that were underway. The business owners of the affected projects were not told of the new [Virginia Roads] project, and there were many questions about the delays to their project. They [the business owners] did not know that work on the Virginia Roads project would also give them features for their project. I believe that we thought the Virginia Roads project would be done in a couple of months; it took a year.

At the beginning of 2014, VDOT hired a business consulting firm to assess ITD and identify areas for improvement (Business Consultant 2014, 5). In their final report, the consultants identified ITD's strengths, which included:

1. … [ITD has] demonstrated an ability to deliver quality solutions when given clear direction from agency leadership;
2. … [ITD has completed] several projects that have had a positive influence on the public's perception of the agency;
3. … [ITD] supports the largest user of information and technology within the Commonwealth of Virginia;
4. … [ITD has] a strong and dedicated management team who has a tremendous focus on customer satisfaction;
5. … [ITD has] managers that have a sense of accountability for when things have gone off track in the past;
6. …[ITD] participates in knowledge-sharing initiatives with other agencies in the Commonwealth, … as well as other departments of transportation and transportation organizations; and
7. … [ITD's] enterprise data management team supports all activities related to the compilation and reporting of performance data to the Federal Highway Administration (Business Consultant 2014, 7).

The business consultants found several challenges within the IT Division in four broad areas: 1. strategic alignment, governance, and IT pipeline management; 2. organizational

structure; 3. application delivery process; and 4. resource utilization and management. The strategic alignment and governance challenges included:

1. there is not a strategic vision for technology to support VDOT's overall agency strategic vision;
2. there is limited governance structure representing the perspectives of both the business and ITD to help approve and prioritize application delivery requests according to an agency strategic vision;
3. there are limited controls and workflows that govern the IT request approval process;
4. there is a lack of well-defined application architecture, guiding principles, and standard decision-making and prioritization criteria; and
5. there is a lack of an established set of information technology metrics and reporting mechanisms to provide agency leadership and business stakeholders with visibility into ITD's performance (Business Consultant 2014, 8).

In assessing how ITD operated, senior IT manager Z05 described ITD staff's perspective at the end of 2015 as follows,

> … you want to know what are the rules by which we are going to operate; … you found that there were very few rules that were there, and the rules that were there were very old and viewed with contempt and not viewed as serving the staff that needed to execute them. … we did not have that foundation by which to make decisions. We did have that baseline. So, what you have was more of an anarchy situation where every project was running its way, trying to make it work, trying to achieve outcomes and results as best they could without really having the guidance of a strong policy function to support them.

4.4 Reimagining the Information Technology Division

There are no secrets to success. It is the result of preparation, hard work and learning from failure.
— Colin Powell (2002)

My model for business is the Beatles. They were four guys who kept each other's kind of negative tendencies in check. They balanced each other, and the total was greater than the sum of the parts. That's how I see business: Great things in business are never done by one person. They're done by a team of people
— Steve Jobs (2003)

Among the interview data is an understanding from the participating executives and managers of VDOT's use of the consultant's assessment and recommendations for the IT Division. Working with the consultant's report, VDOT's senior leadership worked to redefine the agency's approach to incorporating and using IT assets. The executives and senior managers (the senior management team) incorporated enterprise architecture, separated IT strategic planning from the IT Division, and negotiated responsibilities and organization relationships. While the executives viewed the planning for the IT Division to be a reimagining of IT governance and management, the senior management team viewed this effort as devising a new IT management structure; they did not view their work as re-imagining VDOT's corporate governance. As VDOT executive Z03 explained, "Technology is moving quicker now than we can keep up with … So, when you go in and say governance, it is very hard to separate governance from operations."

As the senior management team shaped the plans for the IT Division, nothing changed within ITD: the ITD staff continued reporting to the same managers, using the then existing processes, and working the in-progress projects. However, there were two organizational

changes: VDOT did not initiate new projects; and the Commissioner announced the creation of the Office of Technology Strategic Planning (OTSP) on June 15, 2015. The Commissioner stated that OTSP would be led by the then current ITD manager and would report to the Chief Deputy Commissioner. In the announcement, the Commissioner explained the responsibilities of OTSP as follows:

> In addition to business integration responsibilities, the Office will also develop the department's information technology strategic plan, strategic goals, and objectives, and will include the Information Security function to ensure effective assessment of technology security controls and eliminate any potential conflicts of interest (VDOT 2015).

Concurrent with creating OTSP, VDOT's Enterprise Application Office[22] was transferred to the Virginia Department of Accounts. The Commissioner explained this Commonwealth-level IT organization change on VDOT's planning for ITD,

> VDOT is in the process of implementing recommendations from a 2014 study of Information Technology Division's delivery of technology solutions. One recommendation was to create a Business Integration Office to serve as a liaison between the application business user and the programmer/developer. … While VDOT hoped to evolve the Enterprise Application Office as the business integration function, the migration to DOA removed that option (VDOT 2015).

In creating OTSP, VDOT divided IT responsibilities three ways: ITD is responsible for IT policies, implementing IT, and operating IT; OTSP is responsible for the IT security policies, IT portfolio curation, and the IT strategic plan; and the Strategic Technology Investment Board (STIB) is responsible for oversight of the IT portfolio, i.e. ITD and OTSP present IT initiatives to

[22] VDOT partnered with the Department of Accounts to implemented a fiscal management system, known as Cardinal. By 2014 over fifty percent of state agencies had transitioned to using Cardinal and VDOT's Enterprise Application Office was responsible for the technical support. Planned for some time, the Department of Accounts assumed full responsibility of Cardinal in the summer of 2015 and the VDOT staff in the Enterprise Application Office were transferred to the Department of Accounts. All state agencies were transitioned to Cardinal in early 2016.

the STIB for approval to initiate the proposed IT effort. VITA staff member Z06 explained that the IT Strategic Plan is required by VITA of all Executive-branch agencies and is a significant part of VITA's governance oversight. The IT Strategic Plan includes VDOT's significant IT initiatives for multiple fiscal years. VITA staff member Z06 explained,

> The IT strategic planning includes multiple fiscal years, not just the current fiscal year. … We [VITA] have a group called the IT Investment Management Group where agencies must develop information technology strategic plans once a year. Now, they can modify those plans throughout the year, but we endeavor to get them to develop their strategic plan, which would be all contracts over $250,000 and all projects over $250,000 to be included in their strategic plan in advance.

Further, the IT Strategic Plan is intended to be a component of the agency's portfolio management. VITA staff member Z06 observed,

> …Strategic planning should belong in the IT Division, done by both the person who has to balance current operations with new efforts. Just like on the construction side, the Chief Engineer has to balance current operations with new construction.

In operationalizing OTSP, VDOT purposefully aligned the strategic planning and portfolio curation processes with VITA's processes. Further, in creating the STIB, VDOT mirrored the Chief Engineer's practice to work with many stakeholders, including senior VDOT managers and executives, to establish the strategic construction priorities.

By the end of 2015, the senior management team completed its planning and purposefully began recruiting leadership, which culminated with December's announcement of the Director of IT and an announcement in January of the hiring of an Enterprise Architect; the remainder of the IT Director's team would be in place by June 2016. In creating an Enterprise Architect, VDOT sought to provide a forward-looking technology expertise that

would ensure that the existing technology was leveraged throughout the organization and that the appropriate technology was brought in to VDOT to provide needed business capabilities. Executive Z03 explained,

> The enterprise architect keeps the inventory of what we have [platforms/applications] and the ways that those technologies can be used to meet future needs. This gives us an expert that is familiar with capabilities that we already own and helps business owners see how a need can be met with existing systems; it fully uses technology capabilities; it saves on new purchases and additional licenses; it adds uniformity rather than making every system unique and standalone

The senior management team had redefined VDOT's desired approach to IT assets. As explained by executive Z03,

> We have reinvented ITD - and OTSP's role is to be that "strategic look out" for technology; looking at the footprint of what technology and applications we have today and where we need to go. We also created the enterprise architect (within ITD) to work in concert with OTSP to do the vision part (and to be a "check" on ensuring we have the right vision), and then BTO [Business Transformation Office] is doing the process re-engineering.

The executives and senior management team also created the STIB to provide independent governance of IT within VDOT. As described by executive Z03,

> We took all the decision-making from one person and VITA [Virginia Information Technologies Agency] and established the STIB [Strategic Technology Investment Board] to give independent governance which would dovetail with VITA and the statewide technology board. The plan is for the STIB to be over ITD and OTSP, and for the STIB to have a technology expert – the enterprise architect.

4.5 The Levers of Governance

> *Give me a lever long enough and a fulcrum on which to place it, and I shall move the world.*
> — *Archimedes (c. 287 BC – c. 212 BC)*

Mind is the great lever of all things; human thought is the process by which human ends are ultimately answered.
— Daniel Webster (1825)

VDOT spent most of 2015 working with a business consultant to reimagine the IT Division. The interview data contains the senior management teams understanding of the planning and the future aspirations for the evolution of the IT Division and its associated governance:

1. *The project selection process for IT and construction mirror each other. The performance metrics are similar – on time, on budget. -senior executive Z01*
2. *The [IT] process is similar to the construction process; it is concerned with prioritizing, cost estimation, and duration. – senior manager Z02*
3. *"The enterprise architect keeps the inventory of what we have [platforms/applications] and the ways that those technologies can be used to meet future needs." –senior executive Z03*
4. *… being sure that we sunset things so that we do not end up with 15-year old systems that we are dependent on, that we know that the 'XYZ' system is going to expire three years from now, so let's plan for it and get ahead of the game. The idea is that they [OTSP] will review the portfolio and make some decisions with the input of the architects; the architects would be putting a plan forward for the Strategic Technology Board to review and approve regarding what applications we are going to sunset and when. – senior manager Z02*
5. *… [VDOT is] moving to a situation where more and more new projects, the true projects, are going to be filled by consultants [a Statement of Workstyle of delivery] and then VDOT staff will be doing more of the small-scale enhancements and the maintenance work. – senior manager Z02*
6. *… if it [an IT project] is under $250,000 it stays within VDOT's purview; if it is over $250,000, then VITA comes into the approval process, as well as the statewide technology committee. … There are procurement rules that relate to whether you are going to design something in-house or you are going to hire a third-party turn-key solution – executive Z03*

The senior leadership team recognized that ITD required governance. Senior executive Z01 described governance as the means "to control people to prevent bad decisions," and

senior manager Z02 observed that governance is "well-defined processes and controls." IT manager Z04 observed that management often views governance as "overhead, undue process, or unnecessary documentation." Then, IT manager Z04 offered that governance should be viewed to "facilitate things like reliability, availability, and predictability." Echoing the utility of governance, senior IT manager Z05 sees governance as "one of the levers that can be used to achieve the organizational mission."

The sub-chapters below use the interview data and some documentary data to provide a view of governance for VDOT (Chapter 4.5.1), the IT Division (Chapter 4.5.2), and for VDOT's IT (Chapter 4.5.3).

4.5.1 Agency

The Code of Virginia, policies issued by other executive-branch agencies, and auditing and oversight constrain all Virginia executive-branch agencies, including VDOT, in establishing the agency's policies and processes. This constraint on policy and practice-making flexibility exists for the entire agency and to ITD. Procurement is an example of policies and processes that another agency issues, which apply to VDOT as a whole and apply to ITD. The Department of General Services (DGS) issues procurement policies and some procurement processes, and VITA issues procurement policies and processes for procuring IT products and services. VDOT's procurement process consists of the DGS prescribed policies and processes and, where permitted, some VDOT specific policies and processes. For example, executive Z03 explained that VDOT does not have an administrative appeals process (for the procurement of goods and services) for situations where a vendor is defaulted; however, VDOT uses the DGS protest process, if needed, at the point of the award, if a vendor has an issue:

> So, one of the things it says in the DGS manual [APSPM] is that agencies can develop an agency hearing process if a vendor wants to dispute a default; but, it is left to the agency to develop that process. So, today, we do not have a hearing process for vendor defaults. Conversely, if you are getting ready to award a contract, there is a defined protest process. So, some of these processes are already built in, and we use them and others must be defined specific to the agency.

Virginia's legislative branch has two bodies that audit state agencies[23]: Auditor of Public Accounts (APA) and the Joint Legislative Audit and Review Commission (JLARC). The APA traces its origin to the creation by the House of Burgess in 1621 of the Auditor of Public Accounts. Today, the Virginia Constitution states, "An Auditor of Public Accounts shall be elected by the joint vote of the two houses of the General Assembly for the term of four years. His powers and duties shall be prescribed by law" (Commonwealth of Virginia 2017e). The APA is responsible for auditing any state entity or office that handles state funds. In 1973, the Code of Virginia was amended to create JLARC. The amendment authorized JLARC to assess state agencies' operations and practices to ensure that appropriations are used as intended, to ensure that resources are used efficiently, and to perform special studies requested by the legislature (Commonwealth of Virginia 2017b). The relationship between the APA and JLARC is established in the Code of Virginia:

[23] VDOT and VITA are both subject to audits by the APA and JLARC. VITA staff member Z06 explained that, "There are people within VITA who have the authority to come in and do audits, and then then those audits result in audit points that the agency must fix. … We [VITA] get audited periodically [by the APA and JLARC] on our processes; so, the auditors get audited." Interestingly, VITA provides an example of the external governance effects of audits: When VITA was initially created in 2003, the agency reported to the independent Commonwealth Technology Board, and VITA's leader (the Commonwealth CIO) was appointed by the board. The audits and oversight reports provided information to the legislature and in 2010, the legislature abolished the Commonwealth Technology Board, established the Secretary of Technology in the executive branch, placed VITA within this secretariat, and provided the Governor with the authority to appoint the Commonwealth CIO.

1. the Auditor of Public Accounts is a nonvoting ex officio member of JLARC (Commonwealth of Virginia 2017a);
2. JLARC may request and receive assistance from the staff of the APA (Commonwealth of Virginia 2017c); and
3. under specific conditions, JLARC may assume the duties of the APA (Commonwealth of Virginia 2017d).

VDOT's Matrix organization structure creates policy and process challenges that have contributed to audit findings. For example, executive Z03 described an audit challenge for VDOT:

> VDOT is established as a matrix organization… So, the concept is a matrix organization has a central hub, which we call central office, and then it has regions that carry out the core mission. In a matrix organization, the way VDOT should operate is that central office sets policies and guidance and has oversight, and the districts operate and run the business; they execute program delivery, and they use the guidance that is developed by the central office to do that. That is how we should be operating. … What has happened in the past is auditors reviewed payroll, and they discovered that VDOT was handling a process a number of different ways. An example may have been where staff in one region were paid for overtime or granted compensatory leave, while another region did not pay or give time for overtime worked. It is not a fair practice, but it demonstrates some of the difficulties of being decentralized.

Many years ago, VDOT's Location and Design division created a process for defining and issuing its policies and processes. These documents were called Instructional and Informational Memorandums (I&IM). The process is viewed as an exemplar throughout the agency and is being adopted by many VDOT divisions. However, the agency does not have an overarching process to ensure the appropriateness of a division's assertion of authority over an area.

4.5.2 IT Division

The senior management team reimagined the IT Division aligning it with the Construction division's emphasis on projects being on time and budget. Until the change in ITD leadership, ITD based its process on a traditional Software Development Lifecycle (waterfall) methodology, and ITD consisted of a Project Management Office, development teams, and operations. Senior IT manager Z05 assessed the existing processes as follows:

> We had a governance function within VDOT IT. Historically, that governance function was a two-in-the-box type of model. You have a project manager who is chartered to execute a program. Then you create a parallel organization that we are calling governance to make sure that the project manager does what he is supposed to do and that if he does not do his job, then the governance person does the job. So, you have a two-headed syndrome where you have people pulling in two different directions; you have a lack of trust between the governance function and the project delivery function; you have a tremendous waste where you have two resources doing the job of one.

In reinventing ITD's processes, the ITD leadership team adapted the Scrum-Agile process. Consultants were brought in to coach and tailor the Scrum-Agile processes for use within VDOT's culture. In taking this approach, the ITD leadership team tacitly embedded governance into ITD as opposed to layering governance on top of ITD. Senior IT manager Z05 described the leadership team's governance approach:

> ... governance is most effective when it is embedded as part of your day-to-day work. So, it is not something that you layer on top; it is not something that distributed people have accountability for; it is not something that you can impose on a different team, say you are responsible for governance, and everybody else is responsible for work. That does not work because governance has to be an integral part of how we operate. ... So, there is a certain level of self-governance, which is how do the people on the team operate together; how do they hold themselves accountable for following the rules that we set on which we operate. There's the governance at the team level, which is how the teams interact together and govern their selves and their behavior to accomplish work and goals. ... As they figure out how they want to operate, then we are codifying those best practices into our policies and procedures, and then we will apply governance to make sure we are following those rules. The exception to that is with VITA ... we are bound by their governance, their rules.

In evolving the new ITD governance, VDOT's leadership and ITD's leadership is cognizant of the difficult balance between prescriptive governance processes and the flexibility individuals need for creativity. Leadership explains this problem as follows,

1. *I think that you have to have rules, you have to have ultimate rules that people live with them, but the rules kill creativity. ... probably the thing that I do care about the most is your ability to be creative, think outside of the box, know what is going on in the world, and to know enough about VDOT to apply. – executive Z03*
2. *... one of the reasons why organizations have strong governance is because they have established rules, they have habits, there is a certain amount of momentum. That can be both a good thing and a bad thing. It can be a bad thing in that it limits creativity; it limits your ability to react because you get a sense of this is the bureaucracy, this is what we do, this is how we do it, and no questions asked. ... The best structure is something in the middle and having a good amount of creative tension where you are providing guidelines or rules and systems of reuse without being overly restrictive where the individuals that are operating do not feel like they have the ability to adapt and react to what the business truly needs. – senior IT manager Z05*

Senior IT manager Z05 provided an example of the need to ensure that the governance goals are consistent:

> When you are doing commercial project management a lot of the projects that you are delivering is for a profit. So, you are trying to set each project a profit goal, and each project has to deliver according to its business case which is why the commercial entity is doing that project. So, that is one set of criteria to optimize profit from the project. Now, to the project manager you are also going to say, "You are in charge of customer satisfaction"; so that project manager is measured and their success is dependent on achieving customer satisfaction. He [the project manager] might look at that and say, "OK, my outcome is to achieve high customer satisfaction because that is how I can be personally successful. At the same time the organization wants me to maximize profit so how do I reconcile those two competing outcomes – one to the benefit of the organization and one to the benefit of myself." So, that is an example where you have a disconnect in terms of the governance being applied where it is being applied to achieve two different ends that might be in conflict.

The ITD leadership team not only worked to change ITD's immediate culture through the introduction of Scrum-Agile, but it is also seeking to provide for VDOT's future IT needs. This effort has two challenges. First, VITA constrains ITD's decision-making because VITA prescribes certain processes, use of technologies, and is involved in project approval and oversight. These VITA processes can add considerable time to the decision-making and eliminate certain IT solutions from being considered. Second, the quickly evolving cloud-based IT solutions are affecting IT governance as explained by senior IT manager Z05,

> Governance is going to be easier in one respect because you just put it in the cloud. So, you do not have the governance around some of those infrastructure decisions that you had to make before. However, it is also going to be harder in a sense too because you lose those choices and some of the options that you can make. Let's say a security standard changes and your cloud provider does not support that- what do you do then? They are going to say, "thank you very much; this is what we sell." You buy from McDonald's they said they would give it to you in plastic hamburger wrappers, and your organization does not like plastic, then it is not going to work.

4.5.3 IT Operations

The goal of IT operations is to manage and operate VDOT's IT assets. To achieve this, IT Operations seeks to align the operation of the IT assets with VDOT's business needs; maintain

agreed on, achievable service levels; employ predictable, consistent processes; efficiently operate the IT assets; and continually monitor and improve the operational services that are provided (Arraj 2013). According to IT manager Z04, VDOT's IT assets consist of "20 or 30 different product types that are probably managed 20 or 30 or 40 different ways."

There are challenges to meet these goals. First, senior IT manager Z05 explained that there are competing forces with upper management,

> On the one hand, they [upper management] intellectually understand that there needs to be some governance. … At the same time, there is an emotional reaction to say, "You know I want it now and why can't I have it now." Those are the two competing desires that we know we need to work with.

IT manager Z04 describes a second challenge that arises from staff inadvertently introducing problems,

> Everybody, 9/10 of the people that I have met, always has good intent. No one goes to break something intentionally, but it happens. Having those checks and controls helps to safeguard that we are meeting some of the bare minimum requirements to make sure that we are not introducing things that are unintended into the environment or are not accidentally breaking things.

The variety of IT product types that are operated by ITD provide the third challenge: these products make use of different IT; IT manager Z04 illustrates this challenge for configuration management[24],

[24] Configuration Management is the processes that ensure that the correct software or hardware are placed into an environment. The processes include ensuring the viability of the software, the acceptance by the business owner of the asset, and that appropriate staff perform the necessary deployment activities.

> I have seen organizations say that everybody has to do it [configuration management] the same way. … if we were solely a mainframe shop and only operated on a mainframe platform, then you could probably lay that type of strategy out because it [configuration managements] pretty much happens all in the same manner. However, when you start getting into other technology stacks like .Net and Java, there are tools to help facilitate [configuration management for each technology stack]. The way the tools operate or how you may try to leverage the tools to help facilitate a one-size fit all methodology for configuration management may not make sense.

Since VDOT expects its ITD leadership to use limited resources to support a growing collection of IT solutions that use a variety of technologies, it is reasonable to expect the ITD staff to support a variety of technologies. Further, the ITD leadership team needs to understand what is occurring with each of VDOT's IT solutions, which implies that the ITD leadership team needs a common view across all IT solutions regardless of the underlying technology. IT manager Z04 described the use of a flexible framework,

> *I am looking at while it would be great and simple for everything to operate the same one way, what I am looking at is this is what the result needs to be … [rather than making everyone do this in the same way], you have to push down, these are the objectives, these are what you are trying to accomplish, and this is the why. A framework is set up in such a way that there is a little bit of room for interpretation without you completely going off the reservation. That is why I think governance can take the form of thou shalt/thou shalt not. I really think the better governance is the one where you set out tenets, the framework, and the operational parameters that you want to operate in without being so detailed – because there will be times that it becomes situational.*

Z04 described the use of a framework that encompasses ITD's tenets as necessary for VDOT's IT operations. IT manager Z04 explained that an IT operations framework provides two benefits:

1. *In an ideal world, everybody would understand everything and would be interchangeable; that is not realistic. Technology changes too quickly. So, we have to rely on using the same repeatable process across technology stacks so that it is easier for someone to learn or facilitate it [the process] as opposed to every different technology stack having a completely different process. … because when it [a process] is repeatable, it is easier for someone to learn; therefore, someone who has not had training in Java can learn the process because the process is very similar to the .Net process. They have become a little bit agnostic to the technology they are facilitating, but are very knowledgeable about the repeatable process they are executing.*
2. *Governance gives me a framework to officially push back. I do not want to push back just to be pushing back; I want to have a vehicle to change behavior so that people get out of the mindset of "people are here to serve at the will or whim of someone else based on what their needs are." … I want to make sure that our services and our choices are understood and documented so that folks can then operate based on what we have laid out – [governance] provides better transparency.*

The IT Operations framework that IT manager Z04 is advocating for VDOT's IT operations is not a single IT management activity. Rather, IT manager Z04 explains that because of the rapid advance in IT and the maturing of VDOT,

> Governance cannot be a once and done activity - it has to continue to evolve, continue to grow, continue to reach a level of maturity in the organization, but even when it [governance] reaches that desired level of maturity, you still have to evolve [because of the changing technology and changing business requirements].

Senior IT manager Z04 explained that such a change occurred within an organization where he had worked,

> … [the] company bought banks. So, those acquisitions changed the requirements for governance because we now have different levels of oversight. We used to be just a credit card company; but, as we got into banks, things like the OCC [the Office of the Controller of the Currency, U.S. Department of the Treasury] came into play. The federal reserve came into play. We may have done things in one particular way, but, to remain compliant with these governing organizations – governing meaning financial governance - we had to change what our internal processes were to meet the spirit of it.

4.6 DATA SUMMARY

The VDOT case data provides insight into a large governmental organization (as a publicly traded organization, it would be on the Fortune 500 list (see Chapter 4.2.3)) whose relationship with information technology, including the governance of IT assets, was at an inflection point. The challenge of re-imagining VDOT's IT organization and governance provided VDOT's leadership a moment to focus on its governance and management assumptions and structures, i.e. what are the important socially constructed concepts related to IT governance and management. This focus is manifest in the emergent coding categories in the case study data. Figure 4-11 shows the prevalence of each of the coding categories within the research data. Importantly, the research data provides evidence of the interrelationship of governance areas (commonality), of the use of monitoring methods (controls), and of the influence of external organizations on VDOT's governance (external). Also, the research data includes the meaning of governance (definition) and the use of governance (process and controls). Finally, the research data includes some insight into governing technology (infrastructure), explanations of using governance (exemplars). With this insight, the research data was further analyzed.

Figure 4-12 shows the degree to which the research data is related to each system characteristic. The relative size of each segment within a system characteristic circle indicates the proportion of the related research data for that category within the system characteristic[25]. The diameter of each system characteristic circle represents the proportion of the research

[25] The relative segment size was calculated as $\{\alpha_{coded\ category}\}/\{A_{system\ characteristic}\}$; where $A_{system\ characteristic} \in \{research\ data\}$; and $\alpha_{coded\ category} \in \{A_{system\ characteristic}\}$

data that is related to that system characteristic[26], i.e. the largest circle has the most number of research data that is related to that system characteristic, and the smallest circle has the least number of related research data. The ranking of the research data's representation of each systems characteristic is as follows: differentiation (30%), interrelationship (29%), teleology (22%), regulation (21%), transformation (17%), hierarchy (12%), and holism (7%). While none of the interviewees imagined VDOT's governance as a system, the analysis of the research data has revealed the presence of each characteristic that in toto constitute a governance system.

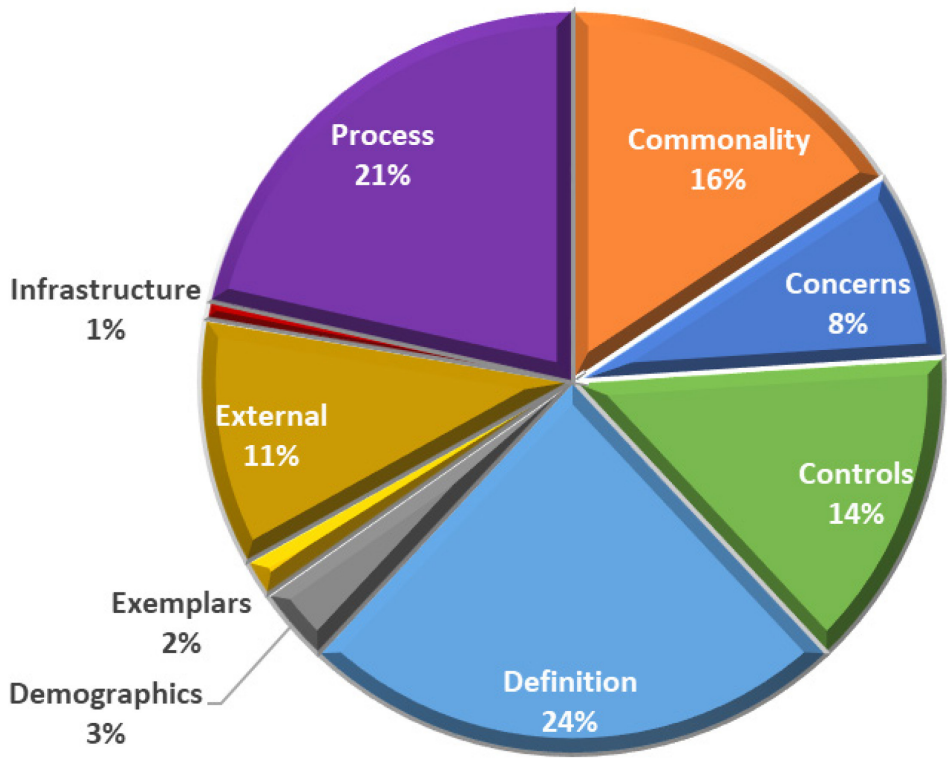


Figure 4-11. Case Data Categories – Prevalence in Research Data

[26] The ranking value was calculated as $\{A_{system\ characteristic}\}/\{research\ data\}$; where $A_{system\ characteristic} \in \{research\ data\}$

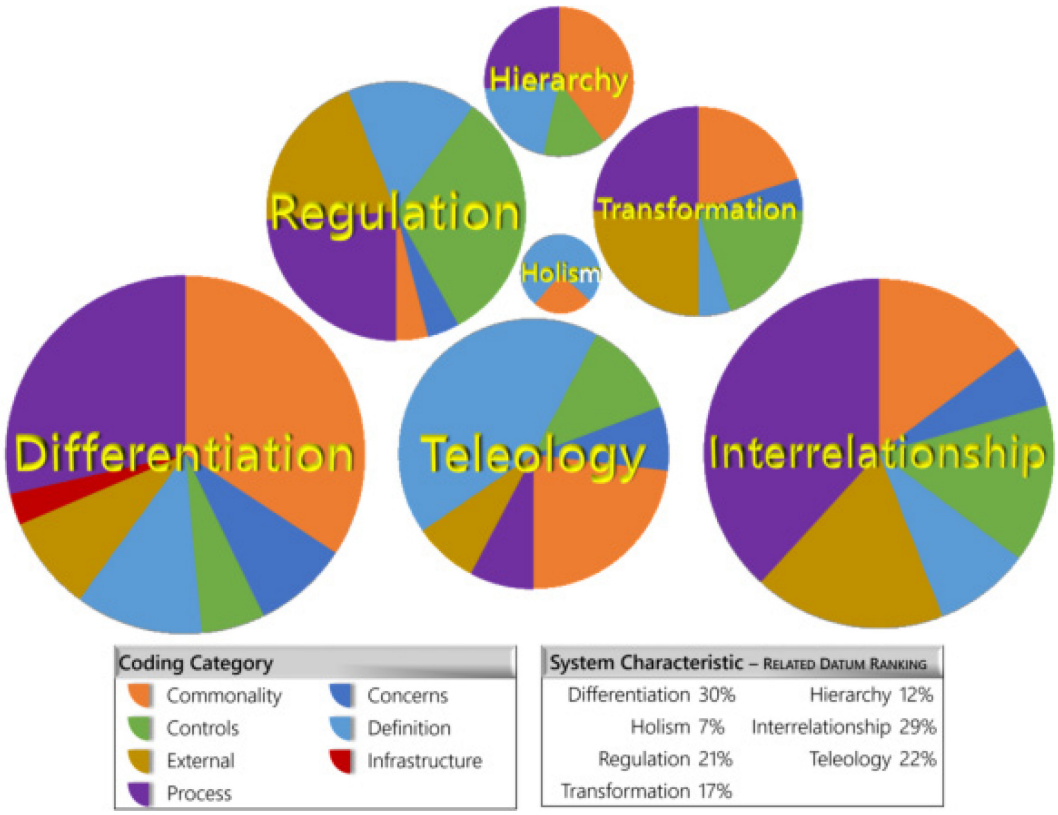


Figure 4-12. Case Data Related to Systems Characteristics

Chapter 5 – DISCUSSION

There's no way to remove the observer - us - from our perceptions of the world.
— Stephen Hawking (2011)

I am enough of an artist to draw freely upon my imagination. Imagination is more important than knowledge. Knowledge is limited. Imagination encircles the world.
— Albert Einstein (1929)

You can't depend on your eyes when your imagination is out of focus.
— Mark Twain (1889)

Figure 4-12 provides evidence that the case's research data describe the characteristics of a system: differentiation, hierarchy, holism, interrelationship, regulation, teleology, and transformation (see Chapter 1.1.1 for a discussion of each characteristic). Chapter 5.1 shows how the research data is related to each system characteristic (puzzle piece). Chapter 5.2 colligates the puzzle pieces into a picture of VDOT's governance puzzle. Next, Chapter 5.3 describes the conceptual function (encapsulated complexity) that enables the transformation of the governance puzzle into a governance model. Chapter 5.4 uses systems thinking to segregate governance and management within the governance puzzle. Finally, Chapter 5.5 presents the governance model.

5.1 THE GOVERNANCE SYSTEM PUZZLE PIECES

The nice thing about doing a crossword puzzle is, you know there is a solution.
— Stephen Sondheim (2011)

Our whole life is solving puzzles
— Erno Rubik (1944 -)

This subchapter uses the research data to explicitly illustrate each system characteristic (summarized in Figure 5-1): differentiation, hierarchy, holism, interrelationship, regulation, teleology, and transformation. This result of this subchapter are individual pieces of a puzzle that will be used in subsequent subchapters to describe IS and IT governance.

	Definition	Data Examples	
		Source	Example
Differentiation	each of a system's elements has a specialization that contributes to the system achieving its purpose	Figure 4-5, Figure 4-6, Figure 4-7	**Unique within collection: Commonwealth Transportation Board** (prioritization of transportation projects), **VITA** (policy and oversight of IT), **JLARC** (oversight and auditing); VDOT - financial planning, internal auditing, IT, procurement, technology strategic planning; VDOT ITD - enterprise architecture, governance, operations
		Executive Z03	**Specialization of another element:** where permitted by the DGS procurement policies, VDOT has its own procurement policies and processes
		Senior Executive Z01 Senior Manager Z02	the existing governance element for construction project selection was applied to ITD – prioritization, estimation, and the monitoring of the project being on time and on budget
		IT Manager Z04	**Consolidation of elements:** working towards a governance framework that is flexible enough to address disparate technology stacks (.net, Java, cloud, etc.), which enables the use of similar repeatable processes
Hierarchy	a system can be an element of another system, thus creating a hierarchy of systems	Figure 4-5, Figure 4-6, Figure 4-7	a governance system hierarchy: the state government, a state agency, and an agency division
		Senior IT Manager Z05	▪ governance hierarchy extends through the IT division to the teams and the individual team members ▪ advantages and challenges of adopting cloud solutions
		IT Manager Z04	governance system hierarchy can also extend to the organization's technology stacks
Holism	the system has a characteristic that is not present in any of its elements, i.e. the whole is greater than the sum of its parts	Senior Executive Z01	▪ "… drives decision-making" ▪ "… prevent bad decisions" ▪ "guardrails for our employees to ensure consistency."
		Senior Manager Z02	"…enables the meeting of metrics and targets"
		IT Manager Z04	"bringing a level of efficiency into an organization where that may not exist"
		Senior IT Manager Z05	▪ "industry as a whole has learned the hard lessons that a lack of governance is not a good thing – that is not something to be desired" ▪ "… the consequences of poor governance are so great in terms of broken code and wasted money"
		VITA Staff Member Z06	"[we] ensure that the public understands that we are doing our best to ensure their dollars that they entrust to us are being used wisely. This is why we were created - because of the catastrophic failures of the late 1990s"
		Business Consultants Report	Challenges in the IT Division because of limited governance: prioritizing delivery requests, limited controls for the IT request process, lack of well-defined architecture, lack of metrics

	Definition	Data Examples	
		Source	Example
Interrelationship	a system consists of a related, dependent collection of elements that interact to achieve the system's product(s)	Executive Z03	▪ the ITD procurement decision to use ITD staff or a third-party turn-key solution is dependent on the procurement policies provided by DGS and VITA ▪ senior management team's re-imagining of ITD included a dependency between ITD, OTSP, and BTO
		VITA Staff Member Z06	"The legislature also mandated the establishment of information technology strategic plans that have to be submitted [by each agency] to VITA and approved by the Commonwealth CIO"
Regulation	how a system makes necessary adjustments so that the system will realize its goal(s)	Executive Z03	▪ … people would say we were number one for a long time." ▪ IT governance was aligned with construction governance
		VITA Staff Member Z06	▪ VITA performs audits on agencies and is also audited by the APA and JLARC ▪ APA and JLARC audits resulted in the Commonwealth legislature abolishing the Commonwealth Technology Board, establishing the Secretary of Technology, placing VITA within that Secretariat, and providing the Governor with the authority to appoint the Commonwealth CIO
Teleology	a system is goal-seeking	Senior Executive Z01	▪ "… drives decision-making" ▪ "… prevent bad decisions" ▪ "guardrails for our employees to ensure consistency."
		Executive Z03	▪ … people would say we were number one for a long time. We may still be there in the top five…" ▪ IT governance was aligned with construction governance
		Senior Manager Z02	"… enables the meeting of metrics and targets"

	Definition	Data Examples	
		Source	Example
Transformation	using inputs from either the environment or within itself, a system creates desired outputs	Senior Manager Z02	"… I would really think that if we get to the point where we are [ISO 9000] certified, we would be in a good place with the General Assembly … I think you would stave off a lot of the audits and special studies that get done on VDOT that take a lot of time and effort. I think it would stave off a lot of problems with the General Assembly that we have had with them over the years that we would get a good relationship."
		Executive Z03	"Administrative services – that is the most governed area, there are DGS manuals on how to do procurement"
			"There are procurement rules that relate to whether you are going to design something in-house or you are going to hire a third-party turn-key solution"
			"If it [an IT project] is under $250,000 it stays within VDOT's purview; if it is over $250,000, then VITA comes into the approval process, as well as the statewide technology committee."
		Senior IT Manager Z05	"The exception to that [VDOT ITD governance] is with respect to VITA because VDOT is an agency under the umbrella of VITA, which is the Virginia IT agency, we are bound by their governance, their rules. So, we have to apply by state statute."
		VITA Staff Member Z06	"We [VITA] have developed a standard for determining qualification. Actually, we were required to develop that. The Auditor of Public Accounts, which is the legislature's oversight arm, required that we develop that and we have. VITA has been audited to my understanding three times since they were established. We get audited periodically on our processes. So, the auditors get audited."
			"The legislature established VITA to be the oversight of the governance of the IT projects of the Commonwealth. You have auditors from VITA looking to make sure things are being run the way they should be and insisting on corrections and changes. Then the legislature has auditors looking at VITA processes to make sure they are being adhered to. The APA's findings are public, so anybody can take a look at her findings at any time."
		Senior Manager Z02	"VITA governance processes and oversight was established because there were agencies that were not performing or not establishing what the legislature felt was adequate oversight and governance. This manifested itself in the failure of several multi-million-dollar projects, which drove the Legislature to come up with some new oversight organization that would be accountable, if not directly, indirectly, to the legislature."

Figure 5-1. System Characteristic within the Research Data

5.1.1 Differentiation

Differentiation describes the characteristic of a system in which each of the system's elements has a unique specialization that contributes to the system achieving its purpose. The presence of differentiation is found throughout the research data, and illustrates three different manners of differentiation: 1) unique within the collection, 2) specialization of another element, and 3) consolidation of elements.

5.1.1.1 *Unique within the Collection*

In addition to showing managerial organization, Figure 4-5, Figure 4-6, and Figure 4-7 show the specialization of the elements that comprise the government of the Commonwealth of Virginia, the elements that comprise VDOT, and the elements that comprise VDOT's IT Division. Among the specializations within the Commonwealth are the oversight and prioritization of transportation projects provided by the Commonwealth Transportation Board, the policy and oversight of IT provided by the Virginia Information Technologies Agency, and the oversight and auditing provided by the Joint Legislative Audit and Review Commission.

VDOT's organization also shows the specialization of its elements. Among these specializations are administration (procurement and information technology), engineering (planning, constructing, and maintaining the transportation infrastructure), finance (financial planning, tolling, and federal program management), assurance (internal auditing), and technology strategic planning. Similarly, ITD's specializations include enterprise architecture, governance, operations, and provisioning.

5.1.1.2 *Specialization of Another Element*

In addition to the unique specialization within a system's collection of elements, an element can be a specialization of another element. Executive Z03 described this form of specialization within procurement. The Department of General Services specialization includes providing procurement policies and processes that VDOT must use. However, as Z03 explained, these policies enable VDOT to establish its policies and processes, i.e. VDOT has established a distinct specialized procurement element that is dependent on and related to the DGS element. Senior executive Z01 and senior manager Z02 described another means for

specialization: adapting an existing element. In this instance, the existing governance element for construction project selection was applied to ITD – prioritization, estimation, and the monitoring of the project being on time and budget.

5.1.1.3 Consolidation of Elements

IT manager Z04 explained that existing specialized elements could be consolidated. Z04 described the goal of working towards a governance framework that is flexible enough to address disparate technology stacks (.net, Java, cloud, etc.), which enables the use of similar repeatable processes and eliminates the need for similar technology-specialized elements.

5.1.2 Hierarchy

A system can be an element of another system, thus creating a hierarchy of systems. In some systems, the hierarchy of systems is the same as the organizational hierarchy, which is the case when observing the Commonwealth of Virginia's government as a system. Figure 4-5, Figure 4-6, and Figure 4-7 represent a governance system hierarchy: the state government, a state agency, and an agency division. Since the state government, state agencies, and agency divisions are a system, they each have a hierarchy: Figure 4-5 shows the state government hierarchy: branches, secretariats, and agencies; Figure 4-6 shows VDOT's agency hierarchy: executive (Commissioner and Chiefs) and units (divisions and districts); and Figure 4-7 shows the hierarchy within the VDOT IT Division: leadership and delivery units.

In some systems, the hierarchy of systems is not coexistent with the organizational hierarchy. Within the VDOT research data are two such instances: teams and team members; and technology and extra-organizational technology. Senior IT manager Z05 provided an example of the system hierarchy extending to teams and team members. He explained that

the governance hierarchy extends through the IT division to the teams and the individual team members: there is self-governance (how do individuals hold themselves accountable) and team governance (how do teams interact and behave to accomplish their goals). IT manager Z04 described the situation in which the systems hierarchy extends through technology explaining the governance ideal of harmonizing policies and processes so that they are technology agnostic instead of being tailored to the technology; however, since this harmonization is a goal to be achieved, the implication is that the governance hierarchy extends to technologies. Senior IT manager Z05 concurred on this hierarchical level in describing the advantages and challenges of adopting cloud solutions: some of the infrastructure governance is abstracted to the cloud provider, and some governance options cannot be provided because of the cloud provider's governance service offerings.

5.1.3 Holism

Holism refers to the characteristic of a system in which the system itself has a characteristic that is not present in any of its elements. The evidence in the research data is tangential. VDOT executives and managers characterized governance with providing consistent, quality decisions throughout the organization, which is an attribute of the set of decisions and not of each instantiated decision. For instance, senior executive Z01 explained that "governance drives decision-making", "prevents bad decisions," and further described governance as the "guardrails for our employees to ensure consistency;" senior manager Z02 explained that governance "enables the meeting of metrics and targets;" and senior IT manager Z05 offered that governance is "a system of rules." Beyond decision-making, IT manager Z04 ascribed governance with "bringing a level of efficiency into an organization

where that may not exist." As with decision-making, organizational efficiency reflects the set of actions and not each action.

The research data also describes the holistic characteristic of governance through the issues that arise when an organization does not have a governance system, i.e., what does an organization lose when governance is not present? Senior IT manager Z05 explained that "industry as a whole has learned the hard lessons that a lack of governance is not a good thing – that is not something to be desired." Z05 reflected that, "… the consequences of poor governance are so great in terms of broken code and wasted money." The idea that a governance system is valuable was also echoed by VITA staff member Z06 who described the Commonwealth's impetus to create VITA, "[we] ensure that the public understands that we are doing our best to ensure their dollars that they entrust to us are being used wisely. This is why we were created - because of the catastrophic failures of the late 1990s." Echoing the problems that arise when governance is not present, the business consultants cited challenges in the IT Division because of limited governance. For instance, the consultants cited challenges prioritizing delivery requests, limited controls for the IT request process, lack of well-defined architecture, and lack of metrics.

5.1.4 Interrelationship

A system consists of a related, dependent collection of elements that interact to achieve the system's product(s). The interview data provide examples of governance element dependencies. In the first instance, VDOT executive Z03 explained that the ITD procurement decision to use ITD staff or a third-party turn-key solution is dependent on the procurement policies provided by VITA. Z03 also described that the senior management team's re-imagining

of ITD included a dependency between ITD, OTSP, and BTO, "we have invented ITD and OTSP to be that strategic look out for technology and looking at the footprint where we need to go. We also created the architect to work in concert with OTSP to do the vision part, and then BTO is doing the process re-engineering." VITA staff member Z06 described another dependency among the governance system elements, "the legislature also mandated the establishment of information technology strategic plans that have to be submitted [by each agency] to VITA and approved by the Commonwealth CIO." Z06 characterized the strategic plan as one of VITA's oversight governance elements.

5.1.5 Regulation

Within a system is some means (regulator) by which the system makes necessary adjustments so that the system will realize its goal(s). The interview data contains compelling evidence of the regulation methods present within the governance system. VDOT's executives reacted to the IT division's performance. Executive Z03 felt that VDOT's IT performance was relying on its reputation, "... people would say we were number one for a long time. We may still be there in the top five; but I would say, we are living on our reputation." Consultants were hired to review and recommend changes to IT governance and management. A VDOT senior management team used the consultant's recommendations and reimagined IT governance. The resulting IT governance was aligned with construction governance, and an agency governance stasis was established, i.e. the governance system was adjusted so that it could again achieve its goals.

Another regulation method identified in the interview data is the use of audits and controls. For instance, an external audit by the APA can result in VDOT assessing its

governance and management policies and processes. VITA staff member Z06 explained that this is also true for VITA who performs audits on agencies and is also audited by the APA and JLARC. Z06 recalled that these audits resulted in the Commonwealth legislature abolishing the Commonwealth Technology Board, establishing the Secretary of Technology, placing VITA within that Secretariat, and providing the Governor with authority to appoint the Commonwealth CIO.

5.1.6 Teleology

A distinguishing system characteristic that endows a collection of elements to be considered a system is teleology – that the collection of elements seeks the desired goal. As previously described in Chapters 5.1.3 and 5.1.5, the interview data contains several compelling explanations of the teleology of VDOT's governance system. In describing governance as a body of rules, senior executive Z01 and senior manager Z02 defined governance teleology as ensuring consistent, quality decision-making, i.e. ensuring that the desirable behaviors are consistently achieved. IT manager Z04 asserted that the teleology of governance is to drive organizational efficiency. Importantly, the reaction of VDOT's executives to the IT division's performance provides another insight into VDOT's understanding of governance teleology. At the end of significant analysis and planning, VDOT asserted that the teleology of ITD's governance is to deliver the correct effort on-time and on budget, which has been the governance teleology of VDOT's transportation-related projects (and which emphasized that the desirable behaviors throughout VDOT are to deliver the correct effort on-time and on budget).

5.1.7 Transformation

Using inputs from either the environment or within itself, a system creates desired outputs. As described in Chapter 5.1.6, the research data describes governance as producing desirable behaviors. VDOT is specifically seeking that the correct efforts be delivered on time and budget. It is these desirable behaviors that are the output of the governance system, and it is the governance system that transforms the various external inputs into these desirable behaviors. Using the interview data, Figure 5-2 contains example inputs and Figure 5-3 contains example outputs.

Interviewee	Input	Description
Senior Manager Z02	Legislature	"… I would really think that if we get to the point where we are [ISO 9000] certified, we would be in a good place with the General Assembly … I think you would stave off a lot of the audits and special studies that get done on VDOT that take a lot of time and effort. I think it would stave off a lot of problems with the General Assembly that we have had with them over the years that we would get a good relationship."
Executive Z03	DGS	"Administrative services – that is the most governed area, there are DGS manuals on how to do procurement"
	Procurement Policies	"There are procurement rules that relate to whether you are going to design something in-house or you are going to hire a third-party turn-key solution"
	VITA	"If it [an IT project] is under $250,000 it stays within VDOT's purview; if it is over $250,000, then VITA comes into the approval process, as well as the statewide technology committee."
Senior IT Manager Z05	VITA	"The exception to that [VDOT ITD governance] is with respect to VITA because VDOT is an agency under the umbrella of VITA, which is the Virginia IT agency, we are bound by their governance, their rules. So, we have to apply by state statute."
VITA Staff Member Z06	Auditor of Public Accounts	"We [VITA] have developed a standard for determining qualification. Actually, we were required to develop that. The Auditor of Public Accounts, which is the legislature's oversight arm, required that we develop that and we have. VITA has been audited to my understanding three times since they were established. We get audited periodically on our processes. So, the auditors get audited."
	Audits	"The legislature established VITA to be the oversight of the governance of the IT projects of the Commonwealth. You have auditors from VITA looking to make sure things are being run the way they should be and insisting on corrections and changes. Then the legislature has auditors looking at VITA processes to make sure they are being adhered to. The APA's findings are public so that anybody can take a look at her findings at any time."
	Legislature	"VITA governance processes and oversight was established because there were agencies that were not performing or not establishing what the legislature felt was adequate oversight and governance. This manifested itself in the failure of several multi-million-dollar projects, which drove the Legislature to come up with some new oversight organization that would be accountable, if not directly, indirectly, to the legislature."

Figure 5-2. Interview Data Example Governance System Inputs

Interviewee	Output	Description
Senior Executive Z01	Desirable Behaviors	"Governance should be simple, clear, not restrictive. It is guard rails for our employees to ensure consistency."
		"Intent is to control people to prevent bad decisions."
Senior Manager Z02	Desirable Behaviors	"[Governance] enables the meeting of metrics and targets."
		"… being sure that we sunset things, so we do not end up with 15-year old systems that we are absolutely dependent on that we know that XYZ system is going to expire 3-years from now, so let's plan for it and get ahead of the game."
		"good governance gets down to … you kind of got to map out what do you do, what are your processes, make sure people understand why you are doing it."
		"You have to have proper controls in place to make sure that things are moving through the process pretty smoothly or you have to be able to tell when things are out of line with a control or a metric or whatever it is you want to call it, you have to have something in place for that."
Executive Z03	Desirable Behaviors	"The enterprise architect keeps the inventory of what we have [platforms/applications] and the ways that those technologies can be used to meet future needs."
		"So, rules almost cover everything. So, there is the whole process for the approval of new projects…"
		"The idea was to separate ITD and day-to-day IT operations from OTSP where strategic planning and 'IT future visioning' would occur. However, the re-design also established a Strategic Information Technology Board where oversight and adoption of the overarching IT activities would occur for both ITD and OTSP. A key component of the SITB is the consideration of new technology application requests. … Projects are prioritized and moved forward for SITB consideration. STIB members consider the facts, the needs of the agency - so politics is stripped out of the voting process. STIB members represent executive leaders who are able to rise above their particular needs and vote on projects that will be most beneficial for the agency."
		"There are times it is ok to have different ways of operating, but there are times when it is important that you be consistent."
IT Manager Z04	Desirable Behaviors	"… a vehicle to change behavior so that people get out of the mindset of people are here to serve at the will or whim of someone else based on what their needs are. … I want to make sure that our services and our choices are understood and documented so that folks can then operate based on what we have laid out."
		"… repeatable processes, because when it is repeatable, it's easier for someone to learn"
		"… the tenets, the framework, the operational parameters that you want to operate in without being so detailed – because there will be times that it becomes situational."
		"… these are the objectives, these are what you are trying to accomplish, and this is the why, and allow enough flexibility that you are still meeting what the overall goal is, but allow some customization for the lack of a better term, or flexibility so that they do not have to operate in the same exact manner."
Senior IT Manager z05	Desirable Behaviors	"…self-governance, which is how do the people on the team operate together; how do they hold themselves accountable for following the rules that we set in which we operate. There's the governance at the team level, which is how the teams interact together and govern their own selves and their own behavior to accomplish work and goals."
		"At the core, you want to know what are the rules by which we are going to operate"
		"Because one of the reasons why organizations have strong governance is because they have established rules, they have habits; there is a certain amount of momentum."

Interviewee	Output	Description
		"To govern you have to first say what are we going to govern too. So, you cannot govern in a vacuum you have to establish, you have to write it down"
VITA Staff Member Z06	Authority	"…the legislature gave authority to the CIO to develop and propagate the project management standard, which has policy and procedures for Agency IT managers and Agency heads."
		"The legislature established VITA to be the oversight of the governance of the IT projects of the Commonwealth. And you have auditors from VITA looking to make sure things are being run the way they should be and insisting on corrections and changes. And then the legislature has auditors looking at VITA processes to make sure they are being adhered to.] Correct. And the APA's findings are public, so anybody can take a look at her findings at any time."
		"There are groups within VITA who have the authority to come in and do audits."
	Desirable Behaviors	"…establishment of and the administration of policies and procedures."

Figure 5-3. Interview Data Example Governance System Outputs

5.2 THE VDOT PUZZLE

The art of simplicity is a puzzle of complexity.
— Douglas Horton (1891 – 1968)

Once I get on a puzzle, I can't get off…I have to keep going to find out ultimately what is the matter with it at the end. That's a puzzle drive.
— Richard P. Feynman (1997)

Chapter 5.1 examined the research data and related segments of the research data to a puzzle piece. An assemblage of these pieces is provided in Figure 5-6, which is a picture of VDOT's governance puzzle. The representation of each puzzle piece in Figure 5-6 is summarized in Figure 5-5 and described in the sub-chapters that follow.

For clarity, the breadth of the system hierarchy is not shown in Figure 5-6; rather, the system hierarchy that includes the VDOT governance system is tacit in the environment and shown in Figure 5-4. The hierarchy is as follows:

1) the Commonwealth government system, which contains the system element referred to as the Executive branch system;

2) the Executive branch system, which contains many agency system elements including the element that is referred to as the VDOT system; and

3) the VDOT system, which contains many business area system elements including the element that is referred to as the governance system (while the governance system is an element of the VDOT system, it also is hierarchical, having a presence within other hierarchical layers).

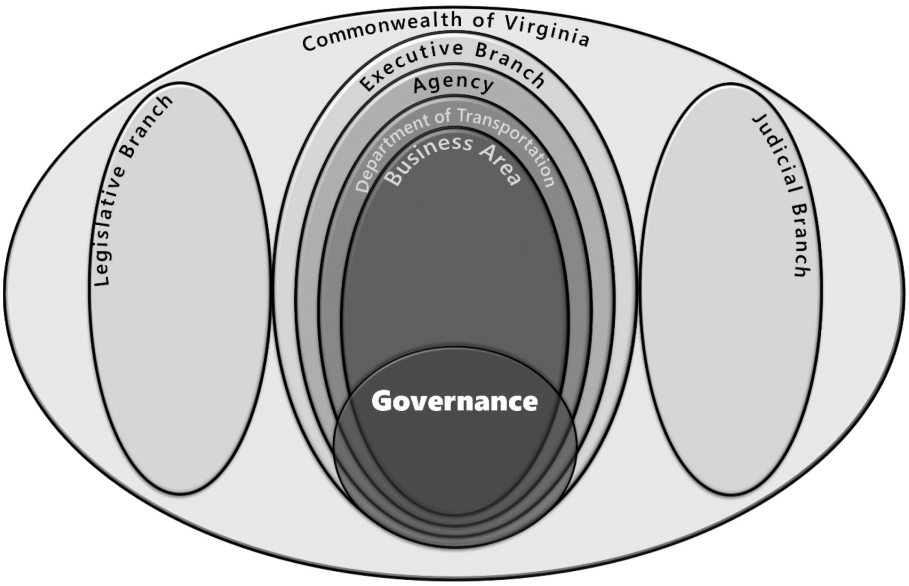


Figure 5-4. Commonwealth of Virginia Hierarchy of Systems

Puzzle Piece	Represented in Figure 5-6
Differentiation	▪ The green oval represents specialization within the environment ▪ The green rectangles represent specialized governance
Hierarchy	▪ The relationship of the green rectangles to one another represent the hierarchy within the VDOT governance system
Holism	▪ The green oval represents the boundary that constitutes the entire VDOT governance system
Interrelationship	▪ The blue and green arrows between the green rectangles represent the interrelationships of the system elements
Regulation	▪ The light green and the gold audit arrows represent an internal and an external feedback mechanism, respectively ▪ The blue arrows represent an internal feedback mechanism

Puzzle Piece	Represented in Figure 5-6
Teleology	▪ The green arrows between the green rectangles represent a goal or an aspect of a goal
Transformation	▪ The gray arrows and the gold arrow represent the inputs to all elements of the VDOT governance system ▪ The green audit arrow represents an input to the specialized governance element ▪ The green arrows between the rectangles represent outputs and inputs to the specialized governance elements ▪ The blue arrows between the rectangles represent outputs and inputs to the specialized governance elements

Figure 5-5. Puzzle Pieces Representation in the VDOT Governance Puzzle

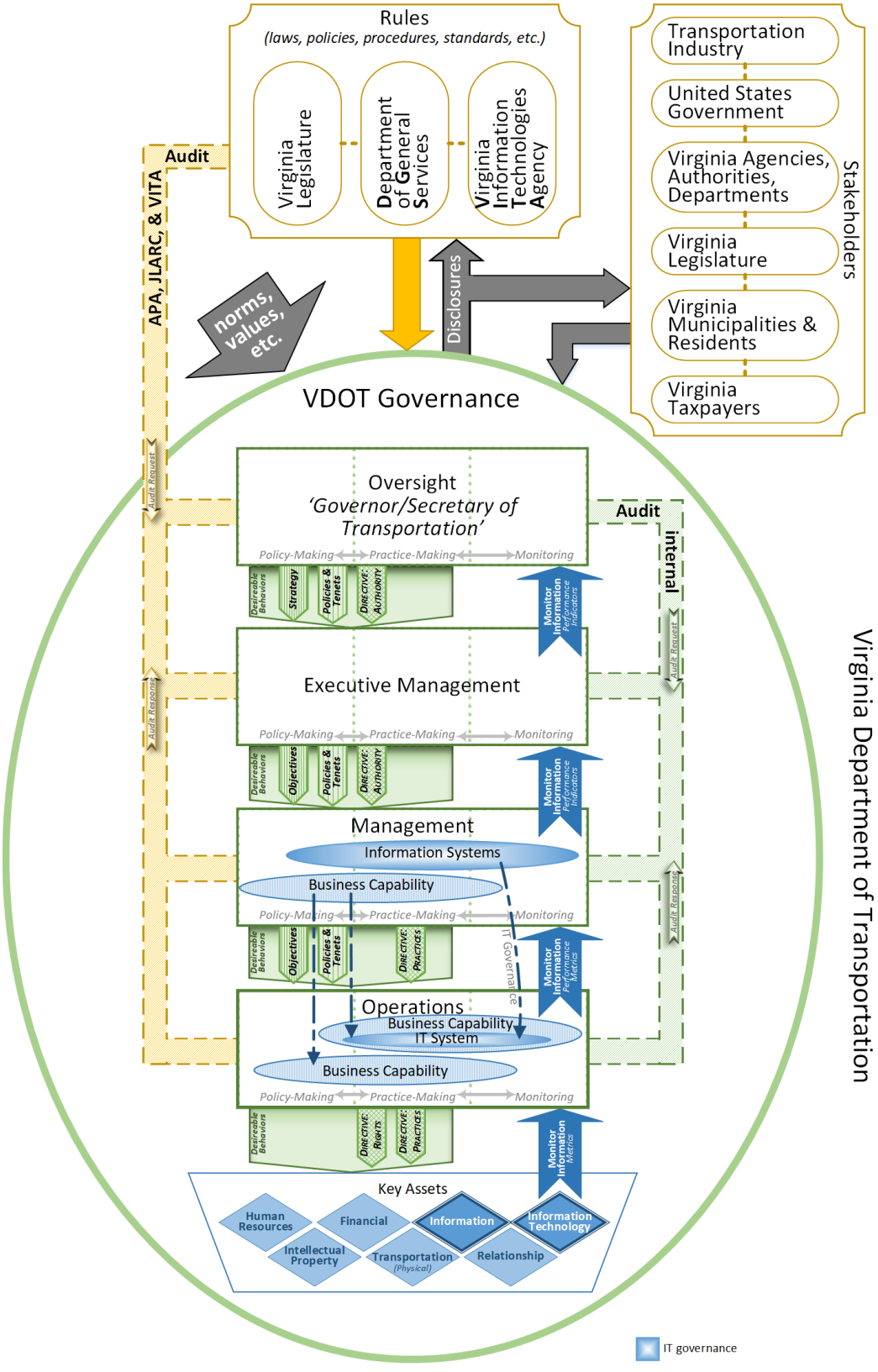


Figure 5-6. A Colligation of the VDOT Governance Puzzle

5.2.1 *Differentiation*

Chapter 5.1.1 describes the different manners that VDOT's governance is differentiated: unique within the collection, specialization of another element, and consolidation of elements. This differentiation puzzle piece is present within the VDOT puzzle in two ways. First, the green oval delineates the governance system from its environment and represents that the governance system is a distinct, different element within its environment (unique within the collection). The green rectangles represent the second manner of differentiation. Each rectangle is a specialized aspect of VDOT's governance. The Oversight rectangle represents the role of the Governor and Secretaries whose concerns are the breadth of all executive branch organizations (unique within the collection). The Executive rectangle represents the role of the VDOT Commissioner and the Chiefs whose concerns are governing all VDOT organizations and ensure that applicable laws, standards, and policies are incorporated in VDOT's governance (unique within the collection). The Management rectangle represents the role of the VDOT organizational leaders whose concerns are governing an area within VDOT and incorporating applicable laws, standards, and policies (unique within the collection, specialization of another element, or both). The Operations rectangle represents the role of VDOT management whose concerns are governing a key asset(s) and incorporating the applicable standards and policies (specialization of another element, consolidation of elements, or both).

5.2.2 *Hierarchy*

Chapter 5.1.2 describes VDOT's governance hierarchy, which is associated with the Virginia executive branch and VDOT organization structure as well as ITD teams. The green

rectangles in Figure 5-6 represent the hierarchy puzzle piece. The Oversight rectangle represents the executive branch governance system, i.e., the Governor and Secretary of Transportation governance system (the orange ovals in Figure 4-5). The Executive rectangle represents VDOT's top-most governance system, i.e., the Commissioner and Chiefs (the blue ovals in Figure 4-6). The Management rectangle represents VDOT's business area governance system, i.e. the Division Administrators (the blue boxes and bulleted divisions and offices in Figure 4-6). The Operations rectangle represents VDOT's lower-most governance system, i.e., the governance for a key asset such as VDOT's human resource system, .NET, or GIS (some of the blue and white boxes in Figure 4-7).

5.2.3 Holism

Chapter 5.1.3 describes the research data that is related to the holistic puzzle piece. This puzzle piece is represented in Figure 5-6 by the green oval, which delineates the governance system from its environment and implies that everything within this boundary is the entirety of the governance system.

5.2.4 Interrelationship

Chapter 5.1.4 describes the research data that underlies the interrelationship puzzle piece, which is represented by the blue and green arrows that are between the green rectangles in Figure 5-6. The dark green arrows represent that an element produces desirable behaviors elements that are used by the subsequent element. These elements include the strategy or objectives, as appropriate to the producing element's purpose, to guide the subsequent element's activities; the necessary authority for the subsequent element to perform its activities; the policies and tenets that the subsequent element is to use; and when

appropriate to the producing element's purpose, the processes that the subsequent element is to use. The blue arrows and the light green audit arrow represent monitoring information that is provided by an element to a predecessor element. The difference between the blue arrows and the light green arrow is that the blue arrows represent information that is a purposeful output of the producing element while the green arrow is information that is produced on an ad hoc, as requested basis.

5.2.5 Regulation

Chapter 5.1.5 describes the regulation puzzle piece providing two regulatory methods: monitoring and auditing. This puzzle piece is represented by the blue arrows and the audit arrows in Figure 5-6. The monitoring method is represented by the blue arrows that regularly convey information from the accountability monitoring part of an element to its predecessor element's accountability monitoring part. On receiving this monitoring information, an element's accountability monitoring-part provides the information to the policy-making and practice-making parts that adjust the elements outputs as needed, i.e. when necessary an element uses the received monitor information to adjust the desirable behaviors output element(s).

The auditing method also provides information from an element. However, unlike the monitoring method, auditing information is ad hoc and produced when requested. Further, the audit request can be from either another element (light green arrow) or an external authority (light gold arrow). On receiving this audit information, the governance element responds, as appropriate, with adjusted desirable behaviors output element(s); the external authority responds, as necessary, with adjusted rules (laws, policies, procedures, standards, etc.).

5.2.6 *Teleology*

Chapter 5.1.5 discusses the research data that is related to the teleology puzzle piece. This puzzle piece is represented in Figure 5-6 by the green arrows that are between the green rectangles. The green arrows are associated with a part of the green rectangle: policy-making and practice-making. The purpose of the policy-making part is to provide the strategy, objectives, and the policies and tenets of the desirable behaviors elements. The purpose of the practice-making part is to provide the authority and process of the desirable behaviors elements. The set of green arrows between two elements (green rectangles) represents the desirable behaviors elements that the predecessor element provides for all subsequent elements to authorize, constrain, and guide the element's actions.

5.2.7 *Transformation*

The transformation puzzle part consists of two essential parts: inputs and outputs. Chapter 5.1.7 provides exemplar data for these inputs and outputs, which are represented in Figure 5-6 by the blue, green, gray, and gold arrows. Some of the inputs are from the governance system's environment and are available for use by all governance elements. One such input is VDOT's social and organizational norms and values (represented by a gray arrow). Another generally available input is from VDOT's stakeholders (represented by a gray arrow), e.g. funding, transportation priorities, etc. The final generally available input (represented by the gold arrow) are rules such as laws, policies, processes, and standards. There are other inputs that are produced by a governance element for use by another element. These include the desirable behaviors elements (represented by the green arrows), the monitoring information (represented by the blue arrows), and the ad hoc audit information (represented

by the light green arrow). The governance system transforms these various inputs into three outputs: ad hoc audit information, disclosures, and a set of desirable behaviors.

5.3 Encapsulated Complexity

Life is really simple, but we insist on making it complicated.
— Confucius (408BC – 479BC)

We are losing the ability to understand anything that's even vaguely complex.
—Chuck Klosterman (2004)

The puzzle pieces in Figure 5-6 is a representation of VDOT's governance system. The representation is characterized by a repeating pattern of governance elements (the green rectangles, green arrows, and blue arrows), which have shared characteristics:

1. each rectangle receives generally available inputs, e.g. laws, standards, policies, VDOT norms and values, etc.;
2. each rectangle contains policy-making, practice-making, and accountability monitoring parts;
3. each rectangle produces a similar set of desirable behaviors: strategy and objectives, policies and tenets, and directives;
4. each rectangle produces and receives monitor information;
5. each rectangle receives audit requests: internal and external (APA, JLARC, and VITA); and
6. each rectangle produces audit responses.

However, each of these seemingly similar governance elements is different: each has a different purpose that satisfices the needs of the element's location within the VDOT governance system hierarchy. Therefore, these governance elements cannot simply be combined into a single governance element without losing characteristics of VDOT's governance system. A means is needed that can render the VDOT puzzle into a governance model. Another way to express this is to assert the need to generalize across the governance elements (the four green rectangles), where the result of the generalization would be a governance model. A means by which this can be done is through the concept of encapsulated complexity.

5.3.1 The Everyday use of Encapsulated Complexity

The notion of encapsulated complexity is common in everyday life and scientific inquiry. The concept of encapsulated complexity is a new extension of the older concept of encapsulation from object-oriented design and programming (Kifer, Lausen, and Wu 1995, 797-802; Micallef 1988, 10-40; Pagejones 1992; Özdemir, Herfs, and Brecher 2016).

To introduce the concept of encapsulated complexity, consider that people use a water fountain for a drink of clean water and accept the unseen complexity beyond the controller and spicket that deliver the presumed potable water. This drinking water delivery system has two elements: the on-demand individual delivery element and the potable water delivery element. The purpose of the on-demand individual delivery element is to provide potable water when required by the user. The element's inputs are the connection to the location's water delivery infrastructure and the user's manipulation of the controller, e.g. lever, button, etc. The output is the potable water. This element encapsulates complexity, e.g. the valve, the plumbing, the

coolant system, etc. The purpose of the potable water delivery element is the delivery of usable, healthy water. Its input is water, and its output is the healthy water delivered with sufficient pressure. The potable water delivery element contains complexity that is seldom observed by the water drinker, e.g., the plumbing elements within the facility (facility delivery), the plumbing delivery elements that transport the potable water to the facility (community delivery), the water delivery elements that provide the potable water and the pressure to move it (community delivery), the water collection and treatment elements (collection and treatment), and the hydrological cycle. This potable water delivery system has a hierarchical taxonomy of purpose: facility delivery, community delivery, water collection and treatment, and hydrology.

Empirical scientific inquiries also make use of encapsulated complexity. For instance, Davis's influential study *Perceived Usefulness, Perceived Ease of Use, and User Acceptance of Information Technology (Davis 1989)* investigated users' perceptions of email, text editing, and charting applications. Davis's study focuses on the interaction between the user and the information system and accepts the complexity beyond that interaction. This is revealed in the research design; it uses two very different information technologies (IBM mainframe-based IT and IBM PC-based IT) without concern of the influence of the information technology on the observations. Within a work environment, an information system is a single element whose purpose is to satisfice an information need of that work environment. The system's inputs are data and directives (for example commands and instructions), and its output is information. An information system element contains layers of complexity that are rarely understood in toto, e.g. the user interface (exchange of information), the application programming and operating

system (programming that is responsible for coordinating application programs and managing the resources of the information technology), the electronic elements (processing), the encoding and decoding of data (translation), and the storage and movement of data (information persistence). The hierarchy of purpose includes the exchange of information between a user and the element, the orchestration and coordination of actions, the processing of actions, the translation of information, and the persistence of information.

The concept of encapsulated complexity is found among the research data. As discussed in Chapters 5.1.2 and 5.2.2, the organization diagrams presented in Figure 4-5, Figure 4-6, and Figure 4-7 represent a hierarchical taxonomy of purpose within the Commonwealth of Virginia: legislative, executive, agency, and division[27]. The purpose of the legislative system is to enact laws and perform oversight of the executive system; the executive system implements the laws and performs oversight of the agencies; the agency system operationalizes the laws and performs oversight of the authorized Commonwealth constituencies, and the division system delivers the product or service. IT manager Z04 provided another example of encapsulated complexity:

> In an ideal world, everybody would understand everything in my area and would be interchangeable. That is not realistic. Technology changes too quickly. So, we have to rely on using the same repeatable process across technology stacks so that it is easier for someone to learn or facilitate it as opposed to every different technology stack having a completely different process.

[27] For the sake of simplicity, the various agency sub-organizations are referred to as a division; however, an agency can have various sub-organizations, e.g. division, district, department, bureau, etc.

Z04 is describing how a repeatable process that is extended across technologies encapsulates the complexity of the underlying technology, and thereby magnifies the staff's effectiveness and enables the organization to achieve its governance goals.

5.4 Governance versus Management versus Operations

> *Today the management, monitoring, and governance of a business are increasingly seen as separate functions to be done by separate bodies, even if some of the membership of those bodies overlaps. This is the corporate equivalent of the separation of powers. Management is the executive function, responsible for delivering the goods. Monitoring is the judicial function, responsible for seeing that the goods are delivered according to the laws of the land, that standards are met, and ethical principles observed. Governance is the legislative function, responsible for overseeing management and monitoring and, most important, for the corporation's future, for strategy, policy, and direction.*
> *— Charles Handy (1992)*
>
> *The board does not exist to advise or assist management, but to empower, charge, and evaluate management. … The board does not exist to react to CEO requests, to have its agenda management-driven, or to be either management's adversaries or its cheerleaders any more than the CEO's job exists for these reasons with respect to his or her subordinates.*
> *— John Carver (Carver 2003)*
>
> *By definition, governance is about making decisions and handling exceptions. Yet too rigid an approach may limit innovation and the autonomy of individual managers to make the best decision for their parts of the business.*
> *— Floren Robinson and Justin M. Brown (2012)*

The Virginia Department of Transportation is a complex socially constructed reality that, for the purposes of this study, consists of three elements: governance, management, and operations (see Figure 5-7). In the everyday imagination, the boundary between governance and management is often blurred. This blurriness was expressed by executive Z03 who commented that when you "say governance, it's very hard to separate governance from operations." Using a system's imagination, this study posits that the governance and

management elements shared inputs and tight coupling explains this blurriness. As described in Chapters 5.1.7 and 5.2.7 and shown in Figure 5-7, VDOT's governance and management elements use exogenous factors. Important examples of these inputs that originate from outside of VDOT include laws and regulations[28], stakeholders' needs, constituents' needs, and standards. The governance and management elements also use endogenous factors such as contracts and obligations, skills and experience, and VDOT's norms and values.

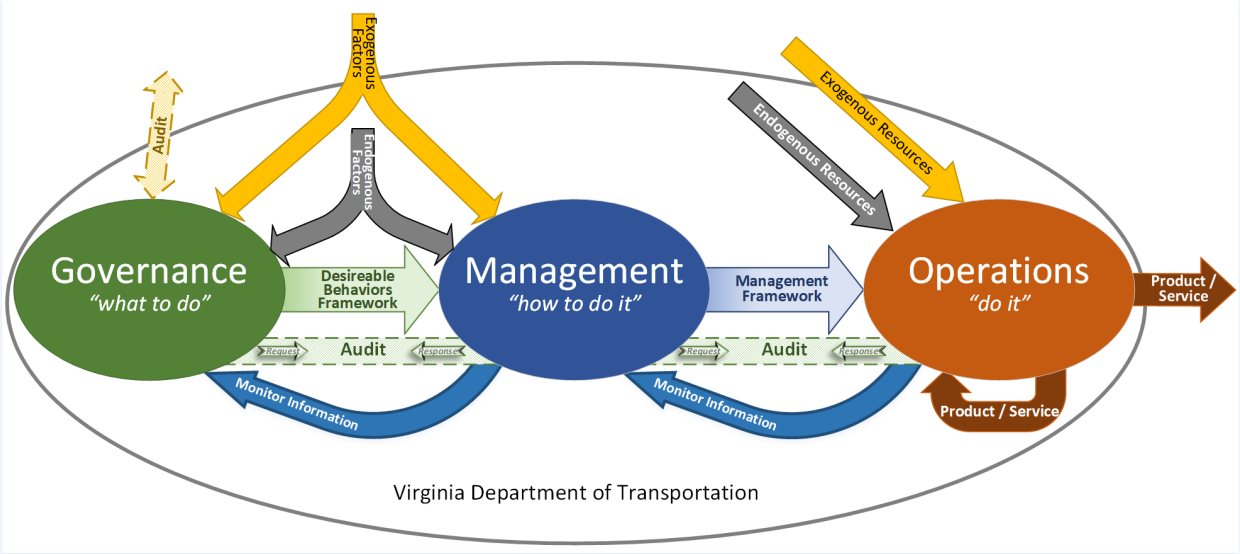
The purpose of the governance element is to establish VDOT's long-term goals and decision-making, i.e. to set '*what*' VDOT is to do. As discussed in Chapter 5.2.6, the governance element produces VDOT's framework of desirable behaviors (the framework includes such items as the authority to take actions, strategy, goals, and directives). The purpose of the management element is to establish VDOT's structure and oversee and direct the day-to-day functions, i.e. to set '*how*' VDOT does its activities; it produces VDOT's Management Framework. As described in Chapter 5.2.5, the governance and management elements receive data from monitoring controls and audits, which are used to make appropriate adjustments to the element's framework. In the case when an external entity initiates an audit, the resulting audit data can similarly be used by that external entity to make appropriate adjustments to exogenous factors, which then causes adjustments to the governance element's framework, management element's framework, or both frameworks. In

[28] While VDOT's purpose and authority is embedded in Virginia laws, it is subject to federal laws and regulations as well as other sections of the Code of Virginia and regulations that are enforced by other areas of Virginia's government.

this way, monitoring and auditing provide the self-regulation capability of the governance and management elements.

The purpose of the operations element is to perform VDOT's functions. The inputs to this element are the Management Framework and resources. The output of the element is VDOT's product and services. Some of these products and services are used within the operations element. The element also provides data to monitoring controls and audits.

Viewing VDOT from the insular perspective of operations, the differentiated use of the exogenous and endogenous factors as well as the specialized purposes of governance and management are conflated in the received Management Framework, which explains the common argument that governance and management are synonymous. When viewed with a holistic systems imagination, the Management Framework that is received by the operations element arises from the attainment of the governance element's purpose and then the attainment of the management element's purpose, i.e., the framework used by the operations element is dependent on the governance element providing its Desirable Behaviors Framework to the management element so that the management element can provide the Management Framework to the operations element – the management element cannot obtain its purpose without the product of the governance element.



Note: Figure 5-8 shows the details of the Governance element shown above

Figure 5-7. VDOT's Governance-Management-Operations Model

5.5 The Governance System

I am not bound to win, but I am bound to be true. I am not bound to succeed, but I am bound to live by the light that I have. I must stand with anybody that stands right, and stand with him while he is right, and part with him when he goes wrong.
— attributed to Abraham Lincoln (1809-1865)

It is not simply a case of having a set of procedures and processes, nor is it just about having controls in place. Reliance on a poor control is often worse than having no control at all. [The trustees must have] … a clear understanding of the business and what can go wrong.
— Tony Rawlins (2001)

Chapter 5.2 paints a picture of VDOT's governance, which is depicted in Figure 5-6. However, this depiction differentiates governance into distinct elements (represented by the green rectangles) that are aligned with VDOT's organizational hierarchy. Applying a system's imagination, these distinct governance elements can be viewed as a single system whose differentiated parts (policy-making, practice-making, and accountability monitoring) are aligned with the desirable behaviors elements outputs and the monitoring input and output.

Therefore, using this reimagination of a governance system, the governance system shown in Figure 5-7 consists of policy-making, practice-making, and accountability monitoring parts as shown in Figure 5-8.

The purpose of the policy-making part is to establish VDOT's aims, e.g. strategy, objectives, etc. The inputs are the governance factors described previously, the practices from the practice-making part, and the information from the accountability monitoring part. Similarly, the practice-making part establishes VDOT's governance tenets, policies, and methods. The practice-making part establishes what practices are to be used; the part does not establish how these practices are to be used. The inputs to the practice-making part are the previously described endogenous and exogenous factors, the aims from the policy-making part, and the information from the accountability monitoring part. The purpose of the accountability monitoring part is to observe VDOT's governance and to provide information to the policy-making and practice-making parts so that these parts can make necessary adjustments. The accountability monitoring part uses the governance factors, the aims from the policy-making part, the practices from the practice-making part, and external entity audit requests.

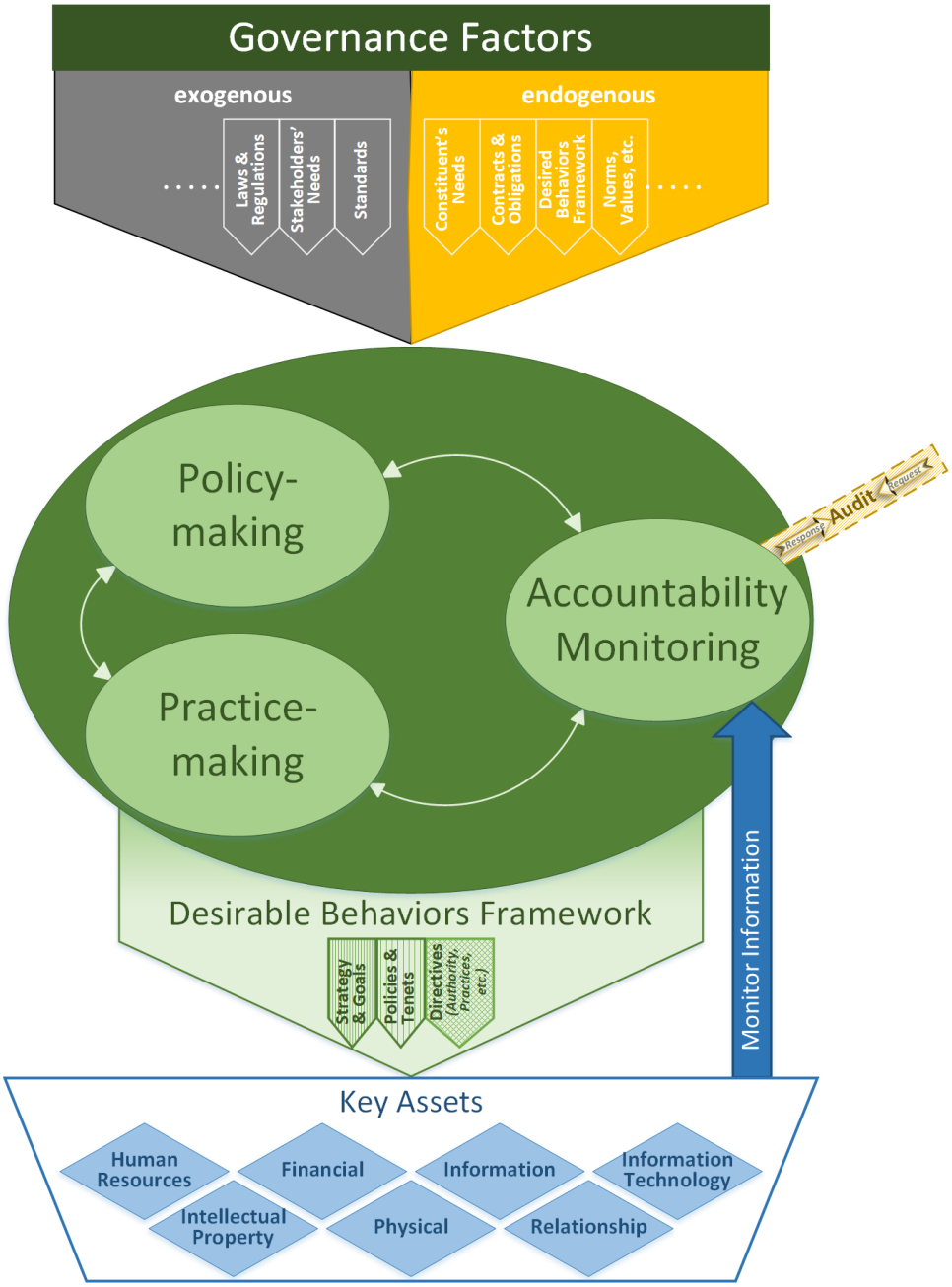


Figure 5-8. Governance System Model

5.5.1 IS Governance

As stated previously, the purpose of the governance system is to describe *what* VDOT is to do, which means that the resultant Desirable Behaviors Framework needs to address VDOT in toto and each of VDOT's key assets specifically. To fully achieve its purpose, the governance

system encapsulates complexity and has a hierarchy of purpose (see Figure 5-9): key assets in toto, key assets in a group, and a key asset. At its most encompassing, the purpose of the governance system is to describe what to do across VDOT for *key assets in toto*. Next, the governance system's purpose is focused on the unique needs of *asset groups* by describing **what** *to do for all key assets within a group*[29]. At the lowest level of the hierarchy of purpose, the governance system describes *what to do with a specific key asset*. For example, consider the governance of VDOT's annual budget allocation from the Commonwealth. At the highest level, VDOT governance describes what the organization is to do with its budget allocation[30]. VDOT's IS governance describes what major IS initiatives must be evaluated, i.e. within IS governance[31], determine that an initiative aligns with the organization-level governance and therefore can make use of the key asset - budget. Finally, at the lowest level, the IS governance for the Fiscal Management system[32] describes what requests should be evaluated.

[29] An asset group consists of a unique collection of VDOT's key assets. A relationship function, $f(x)$, determines the key asset elements in each group. The relationship function consists of business rules that are derived from the directives in the Desirable Behaviors Framework.
[30] VDOT's choices of what to do with the key asset cash (budget) is initially stipulated by VDOT's overall governance. This is shown at the top level of Figure 5-9 (see "Organization").
[31] VDOT's IS governance tailors VDOT's budgeting governance for all Information and IS assets. IS governance is shown in Figure 5-9 (see the box in the middle of the figure labeled "IS Governance").
[32] VDOT's Fiscal Management system is an example of an Information System asset. Such assets are shown at the lowest level of Figure 5-9 (see "Example: Fiscal Management System" at the bottom of the figure.

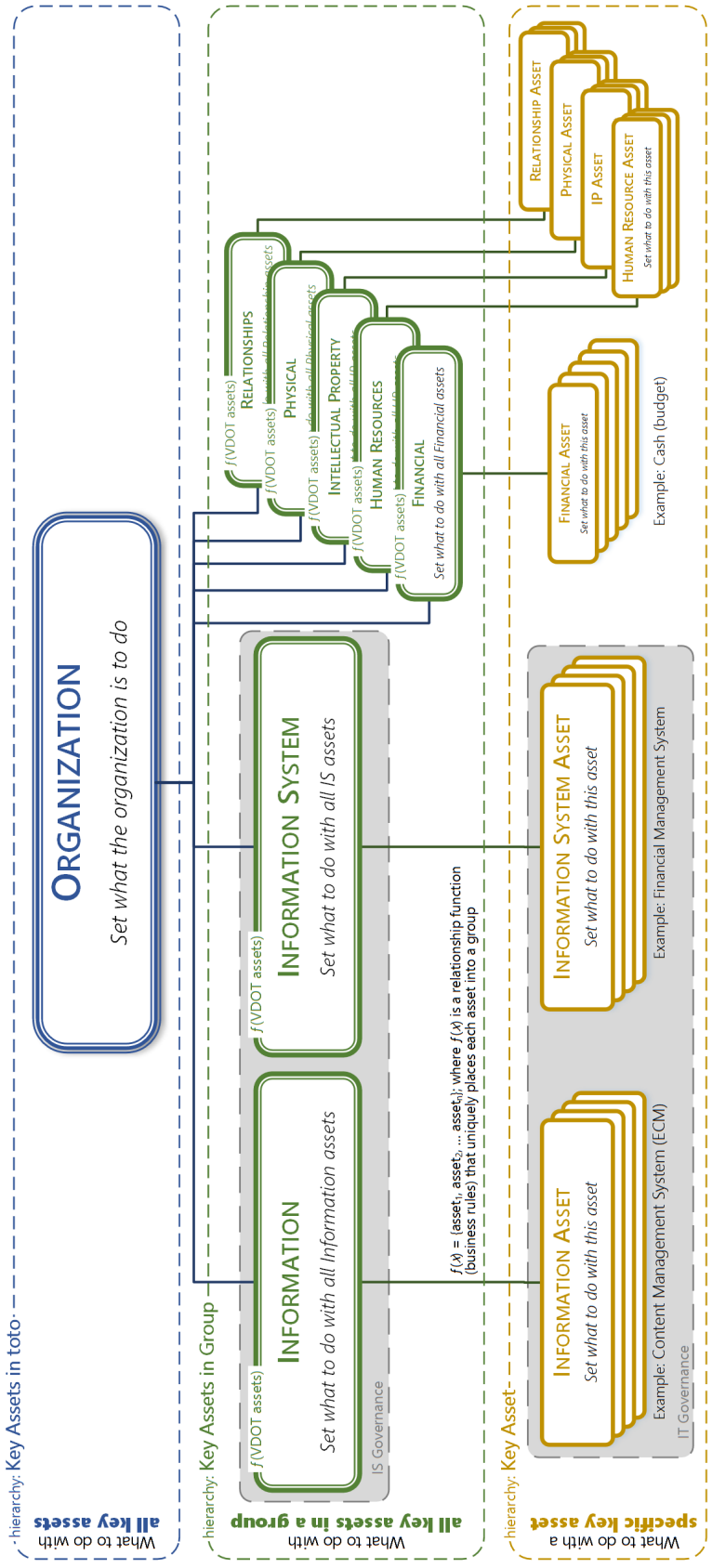


Figure 5-9. Governance Hierarchy of Purpose

This study defines information systems as those systems within VDOT that have at least one product that is intended to satisfice the information needs of at least one other VDOT system. Information technology is defined as a system that consists of an underlying tangible digital electronic-based device (hardware) and intangible sequences of instructions for that hardware (software) that enable any of the storage, transmission, or manipulation of data. However, for the purposes of this study, information systems governance is defined as the governance of all VDOT's information assets and all information systems assets that contain information technology. Further, information technology governance, which is a subset of IS governance, is defined as the adaptation of IS governance to the unique needs of an individual IT asset[33].

Information systems governance determines what VDOT is to do with all information assets and information systems assets. Figure 5-10 shows the IS governance model; It is similar to the governance model in Figure 5-8. The IS model includes only the information and information technology key assets. It also includes specific exogenous factors that apply to VDOT, e.g. Industry standards and VITA standards and policies. Among the endogenous factors that the IS model receives is the Desirable Behaviors Framework, which VDOT's ITD management uses to provide the IS specific governance, and was described by senior IT manager Z05, "ITD is the policy granting agency for VDOT; so, we own the policy, if we see the

[33] Such an adaptation is not necessary for all IT assets; rather, IT governance exists only when there is a unique circumstance for an IT asset that cannot be accommodated by the prevailing IS governance and altering the IS governance would not be appropriate for all other IT assets. For instance, traditionally, VDOT IS governance incorporated SDLC or waterfall methodologies; however, the introduction of an IT asset in which a Scrum Agile methodology would be used would require a different methodology governance, which would not be appropriate for the other IT assets (this is not an unknown situation, some organizations introduce Scrum Agile on a single platform, create and adjust IT governance, and over time replace the existing SDLC IS governance).

need for a new policy, then it is under our responsibility and purview to change it." For example, VDOT-wide information systems governance can include the strategy of hosting VDOT's information technology, e.g. in a data center that VDOT administers, in a data center that a third-party administers, in the cloud, etc. Other examples include the information systems project portfolio curation policy, i.e. what are the policies to select an information system project. An IS governance choice can include the industry standard(s) that VDOT will adopt, e.g. CMMi, ITIL, Scrum-Agile, etc. IS governance can also specify VDOT's change management practice, i.e. *what* the organization requires before something can be placed into the technical IS operational environment for the appropriately governed use by VDOT. IT manager Z04 provided a glimpse into the complexity of change management,

> First of all, you have to have a [configuration management database] CMDB. Having an inventory of your hardware and software assets, how frequently you are changing them, what business functions they support. That is foundational for a good change management process. So, having a CMDB, change management feeds off that, and then release management. So, release management is planning for our bundling changes that need to go in [to the production environment].

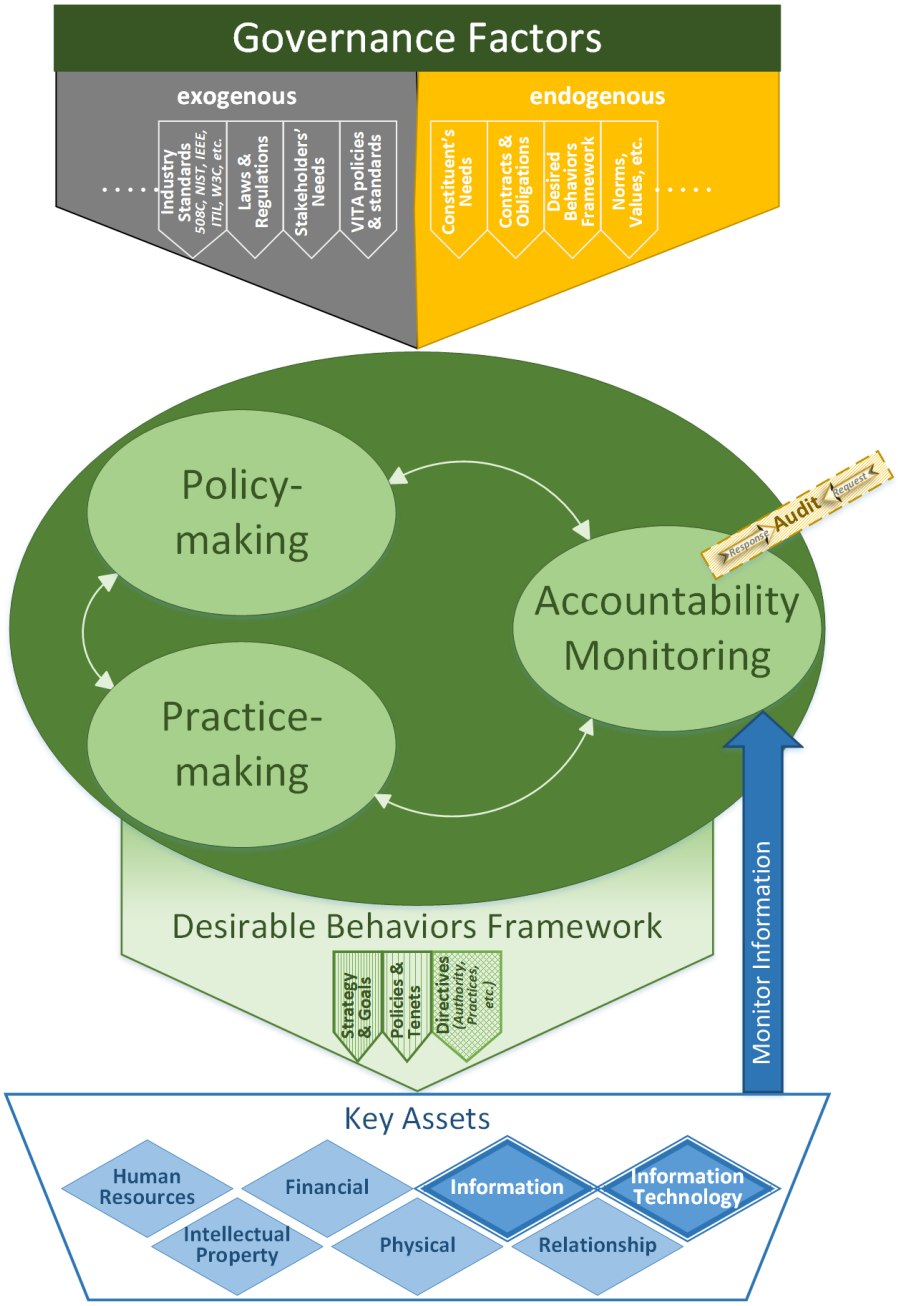


Figure 5-10. Exemplar VDOT IS Governance Model

5.5.2 IT Governance

Information technology governance stipulates what is to be done with a VDOT information technology asset that has unique needs. An example of the introduction of an IT that has unique needs is the choice to use a cloud-based SaaS (Software as a Solution) such as

Salesforce.com for an organization's customer relationship management (CRM) solution. Recently, VDOT implemented a CRM solution for its call center. VDOT chose to make use of Microsoft's CRM product and to host it within its managed IT infrastructure. This choice is consistent with VDOT's governance. However, had VDOT selected Salesforce.com for the basis of the call center solution, VDOT's governance assumptions and choices may not apply to this SaaS IT. For instance, VDOT assumes that its IT operates on equipment that it owns and is in a facility that it controls and manages. Senior IT manager Z05 corroborated this challenge to using cloud-based IT,

> Governance is going to be easier in one respect because you just put it in the cloud, so you do not even have the governance around some of those infrastructure decisions that you had to make before. But it is also going to be harder in a sense too because you lose those choices and some of the options that you can make. Let's say a security standard changes; your cloud provider doesn't support that- what do you do then? They are going to say thank you very much; this is what we sell. You buy from McDonald's they said they would sell it to you in plastic hamburger wrappers and your organization doesn't like plastic, then it's not going to work.

VDOT has experience with a change to this assumption when in 2003 Virginia created the Virginia Information Technologies Agency, which has responsibility for cybersecurity, IT infrastructure, and IT governance for executive branch agencies. Before 2003, VDOT purchased, housed, and managed its IT. Once VITA was in operation, VDOT transferred its IT infrastructure to VITA and became subject to VITA's IT governance; the governance challenges this introduced continue to persist, e.g. leveraging cloud services, evolving security needs such as enabling non-VDOT staff to work appropriately within VDOT systems, etc. VITA's data center had been managed by a single infrastructure provider; however, VITA is in the beginning of changing to multiple infrastructure providers. Executive Z03 expresses the

challenges with VITA's governance of the data center and the uncertainty of what will occur with the change to multiple infrastructure vendors, "… we do not know what is going to happen with this VITA change and what degree we are going to re-inherit IT that we moved to [the data center in] Chester; will it move back to us and we will manage it again? …"

Figure 5-11 shows an example of VDOT's IT governance for its use of Microsoft SharePoint. This model is like Figure 5-10. The IT governance model shows additional exogenous factors, e.g., Microsoft standards and best practices and the Library of Virginia policies and standards. The IT model also shows specific key assets: the information asset is the content repository, and the information technology is SharePoint. These reflect the specialized governance needs for SharePoint: information architecture (IA), records management, unstructured data (documents, pictures, videos, etc.), etc. SharePoint can be deployed within VDOT's data center, in Microsoft Azure (Infrastructure as a Service), or as Office 365 (SaaS). SharePoint can also be deployed as a combination of these topologies. This implementation choice provides governance challenges that are relevant to the technology and can require specialized IT governance; it can also require adjustments to the IS governance to adjust organizational governance, e.g. security policies, availability policies, etc.

While information systems governance is concerned with VDOT's assets that contain information technology (e.g., SharePoint, Human Resource Management System, transportation asset maintenance system, etc.), the governance of other VDOT assets (e.g., agency records, bridge plans, budget, etc.) can affect IS governance. For instance, financial governance policies can influence the earlier mentioned project portfolio curation policy; human resource governance can influence the adoption of an industry standard, etc. Executive

Z03 explained that procuring IT services is affected by procurement policies, "There are procurement rules that relate to whether you are going to design something in-house or you are going to hire a third-party turn-key solution." Information systems governance can also influence the governance of other VDOT assets.

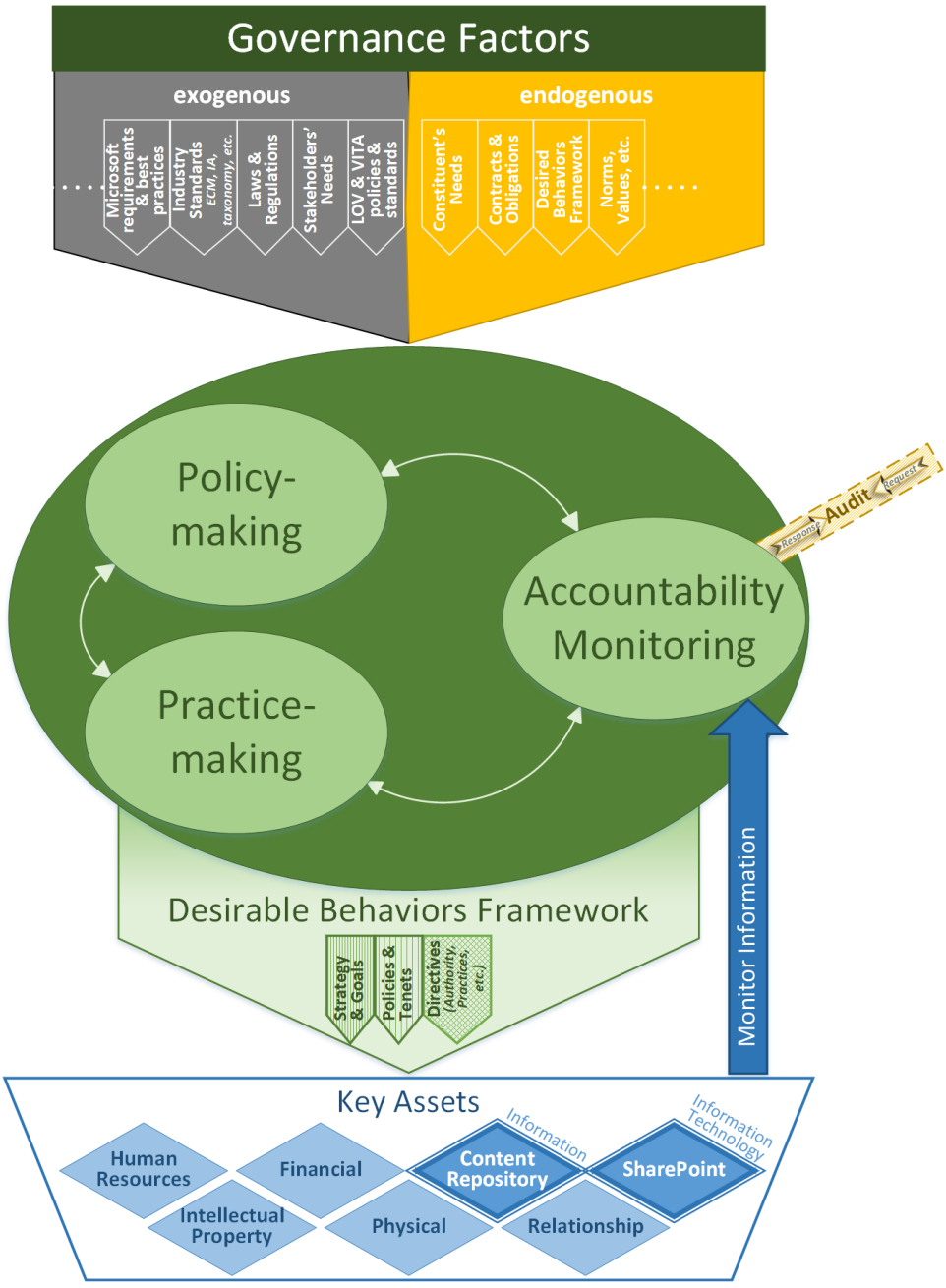


Figure 5-11. Exemplar VDOT IT Governance Model

In summary, by observing VDOT with a systems imagination, VDOT can be described as having three peer elements: governance, management, and operations. The governance element consists of holistic organization-wide governance and specialized governance. The specialized governance addresses the needs of groups of related key-assets; each group asset governance is further specialized for the needs of a specific key-asset. IS governance pertains to two of these asset groups: information assets and information systems assets. VDOT's IT governance provides the exceptional, differentiated governance choices necessitated by the characteristics and requirements of VDOT's IT assets.

The use of a systems imagination to observe VDOT provided four understandings.

1. The use of a systems imagination differentiated governance and management: governance provides the Desirable Behaviors Framework that management requires so that it can provide the Management Framework to operations.
2. The use of a systems imagination identified auditing and monitoring as mechanisms within VDOT that inform governance and management about adjustments needed to their respective framework, i.e. auditing and monitoring are a feedback mechanism.
3. The use of a systems imagination showed that VDOT's governance consists of peer areas that are specialized for a VDOT asset (e.g., capital asset governance, financial governance, human resource governance, etc.) and IS governance is the area that is specialized for IT assets.

4. The use of a systems imagination showed that IS governance provides for the unique needs of an IT through a specialized area of governance that is called IT governance.

Chapter 6 - CONCLUSION

If management is about running the business, governance is about seeing that it is run properly.
— Robert I. Tricker (1984)

A person who studies scientific books with a view to knowing the truth, ought to turn himself into a hostile critic of everything that he studies … if he takes this course, the truth will be revealed to him, and the flaws … in the writings of his predecessors will stand out clearly
— Alhazen (c. 965 – c. 1040 CE) (Sabra 1966)

A motivation of this research is that the use of a systems imagination could provide new puzzles that describe governance. In pursuit of a governance systems puzzle the research first observed the corpus of published governance studies; Chapter 2.2 analyzed this literature. Next, the research observed governance within the Virginia Department of Transportation, a socially constructed organization: Chapter 4 describes this set of empirical, qualitative data and Chapter 5 presents the analysis of the data. The analysis of the IT literature and the qualitative data set enables the answering of the research questions posed in Chapter 1.3, which are summarized in Figure 6-1 below. This chapter proceeds as follows: Chapter 6.1 reviews the answers to the research questions; Chapter 6.2 reviews the significance of the governance system; Chapter 6.4 reviews the implications for Information Systems research and practice; and Chapter 6.5 discusses the limitations of this research and future research opportunities.

Objective	Research Question ID	Question	Findings	
Identify the extent of inclusion of the General Systems Theory in IT governance studies	R1	Which, if any, IS studies on IT governance have made use of systems thinking?		
	a.	Within the IS studies that have been identified, which essential General Systems Theory features have been used (explicitly or implicitly)?	Implicit use of all Systems Characteristics	
	b.	Within the IS studies on IT governance, what essential IT governance features have been identified or what IT governance features have IS researchers identified as essential, and what are the relationships among these features?	▪ Desirable Behaviors ▪ Performance Measurement ▪ Risk Management	▪ Resource Management ▪ Strategic Alignment ▪ Value Delivery
	c.	What is the significance of the correlation, if any, between the essential General Systems Theory features identified in R1.a and the essential IT governance features and relationships identified in R1.b?	▪ Loose correlation with all Systems Theory features ▪ No correlation between IT governance features and Hierarchy or Holism; correlated with all other Systems Theory features	
Positing a systems model of IT governance for subsequent research	R2	In observing an exemplar organization:		
	a.	What General Systems Theory features are observed (explicitly or implicitly)?	▪ Differentiation ▪ Hierarchy ▪ Holism ▪ Interrelationship	▪ Regulation ▪ Teleology ▪ Transformation
	b.	What essential IT governance features can be identified?	▪ Desirable Behaviors ▪ Performance Measurement ▪ Risk Management	▪ Resource Management ▪ Strategic Alignment ▪ Value Delivery
	R3	Using the IT governance and General Systems Theory features identified in R2, what is a model of IS and IT governance that explains the IS and IT governance observed at the case site?	IS Governance Model	See Figure 5-10
			IT Governance Model	See Figure 5-11

Figure 6-1. Summary of Research Question Answers

6.1 Review of Research Questions

6.1.1 *Inclusion of the General Systems Theory in IT governance studies*

R1 - Which, if any, IS studies on IT governance have made use of systems thinking?

As discussed in the sub-chapter below, no IS studies on IT governance were identified that made explicit use of systems thinking. However, there are several studies that implicitly use systems thinking features.

6.1.1.1 *Which essential General Systems Theory features have been used?*

R1a - Within the IS studies that have been identified, which essential General Systems Theory features have been used (explicitly or implicitly)?

In examining the extant IT governance research, no evidence was observed of the overt use of the General Systems Theory. This observation is supported by Wilkin and Chenhall (2010, 135) and Buckby, Best, and Stewart (2008, 32) who reviewed the IT governance research corpus and called for researchers to approach IT Governance holistically; as stated in Chapter 2.2.3, "Buckby et al. are implying that IT governance be considered a system, that Systems Theory could be applicable." However, the observation of the IT governance research corpus did find implicit inclusion of General Systems Theory features.

Figure 6-2 summarizes the research data (see Figure 1-10) from the IT governance research corpus. The analysis of the definitions of IT governance had the following findings:

1. There is implicit use of all the system characteristics;
2. There is very strong implicit use of teleology, i.e. IT governance has a purpose; and
3. There is strong, implicit use of interrelationship, regulation, and transformation.

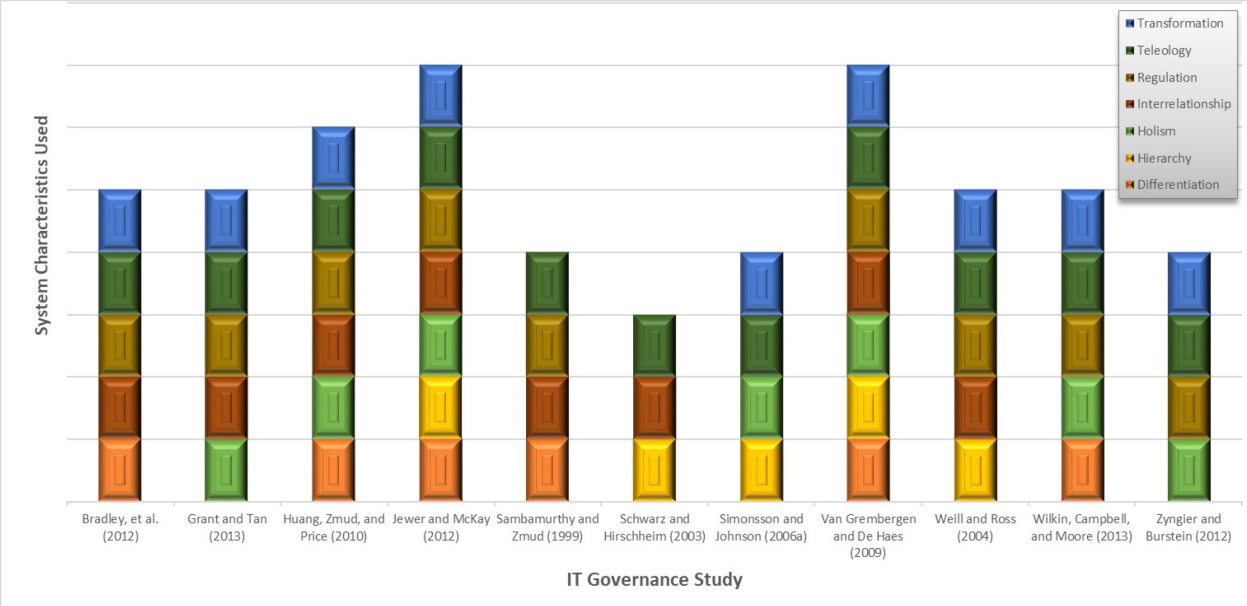


Figure 6-2. IT Governance Research Implicit Use of Systems Characteristics

6.1.1.2 IT Governance Features

R1b - Within the IS studies on IT governance, what essential IT governance features have been identified or what IT governance features have IS researchers identified as essential, and what are the relationships among these features?

The IT Governance Institute identifies five focus areas of IT governance: Performance Measurement, Risk Management, Resource Management, Strategic Alignment, and Value Delivery (ITGI 2003). Buckby, Best, and Stewart (2008); Wilkin, Campbell, and Moore (2013) found that these focus areas are an IT governance research taxonomy, which means that the focus areas can be viewed as essential features of IT governance. Figure 2-8 shows the extent of the IT governance research corpus into each of these features: Strategic Alignment (31%), Resource Management (23%), and Performance Management (20%), Risk Management (12%), and Value Delivery (12%). Weill and Ross (2004) identified desirable behaviors as an IT governance feature (see Figure 2-4). Further, they identified that the object of the desirable behaviors is the organization's key assets (see Figure 2-5). Among the identified organization key assets are Information and information technology.

6.1.1.3 *Relationship between the General Systems Theory Features and the IT Governance Features*

R1c - What is the significance of the correlation, if any, between the essential General Systems Theory features identified in R1.a and the essential IT governance features and relationships identified in R1.b?

Chapter 6.1.1.1 showed that each of the seven General System Theory features has a loose relationship with the IT governance researcher's meaning of IT governance, i.e. the General Systems Theory features are implicit within the researchers meaning of IT governance. Figure 6-3 contains each General Systems Theory feature and its meaning across the columns, and each IT governance feature and its meaning down its rows. A check mark (✓) indicates that there is a correlation of meaning between that row and column's associated features. None of the IT governance features correlate with the Hierarchy or the Holism Systems Theory features. The IT governance feature Desirable Behaviors is included in the IT governance research corpus analysis presented in Figure 6-2; therefore, it is not replicated in Figure 6-3.

IT Governance Feature	General Systems Theory Feature	Differentiation	Hierarchy	Holism	Interrelationship	Regulation	Teleology	Transformation
	Meaning	*Each of a system's elements has a specialization that contributes to the system achieving its purpose*	*A system can be an element of another system, thus creating a hierarchy of systems*	*A system has a characteristic that is not present in any of its elements, i.e. the whole is greater than the sum of its parts*	*A system consists of a related, dependent collection of elements that interact to achieve the system's product(s)*	*How a system makes necessary adjustments so that the system will realize its goal(s)*	*A system is goal-seeking*	*Using inputs from either the environment or within itself, a system creates desired outputs*
Performance Management	*Related to* ▪ *tracking project delivery* ▪ *monitoring IT services*	✓			✓	✓		
Risk Management	*Related to ensuring the appropriate level of assurance for* ▪ *Information security* ▪ *IT assets* ▪ *Systemic/Operational risks*	✓				✓	✓	
Resource Management	*Related to ensuring the optimal use/allocation of* ▪ *IT people* ▪ *IT assets* ▪ *facilities* ▪ *data/information*	✓			✓	✓	✓	✓
Strategic Alignment	*Related to ensuring that IT* ▪ *aligns with business aims* ▪ *efficiently used through the entire organization*				✓	✓	✓	
Value Delivery	*Related to delivering* ▪ *appropriate quality* ▪ *within budget* ▪ *on schedule*						✓	✓

Figure 6-3. Correlated Features of General Systems Theory and IT Governance

6.1.2 *Positing a Systems Model of IT Governance*

6.1.2.1 General Systems Theory Features

R2a - In observing an exemplar organization, what General Systems Theory features are observed (explicitly or implicitly)?

All seven General Systems Theory features (differentiation, hierarchy, holism, interrelationship, regulation, teleology, and transformation) were observed within VDOT's IT governance. Figure 5-1 provides exemplars from the case site research data that represent the presence of each of the General Systems Theory features. Figure 5-5 summarizes, and Chapter 5.2 describes how each General Systems Theory feature is represented in Figure 5-6, A Colligation of the VDOT Governance Puzzle.

6.1.2.2 Essential IT Governance Features

R2b - In observing an exemplar organization, what essential IT governance features can be identified?

The IT governance features observed in VDOT's IT governance include Desirable Behaviors, Performance Management, Risk Management, Resource Management, Strategic Alignment, and Value Delivery. Figure 6-4 summarizes how each IT governance feature is represented in Figure 5-6. The Desirable Behaviors IT governance feature is explicitly within Figure 5-6; it is the output from and input into (the green arrows) each of the green governance elements (the green rectangles).

IT Governance Feature	Represented in Figure 5-6
Desirable Behaviors	▪ The green arrows between the green rectangles represent the desirable behaviors to be achieved by each successive green rectangle
Performance Management	▪ The monitoring segment of the green rectangles represents the process to monitor the project delivery and to track IT services ▪ The blue arrows between the green rectangles represent the needed monitored and tracked information ▪ The light green audit arrow represents the ad hoc monitoring of the project delivery and IT services
Risk Management	▪ The policy-making and process making segments of the green rectangles provide the appropriate policies and processes associated with the Information Security, IT assets, and Systemic/Operational risks ▪ The monitoring segment of the green rectangles represents the process to monitor the Information Security, IT assets, and Systemic/Operational risks ▪ The blue arrows between the green rectangles represent the needed monitored and tracked information ▪ The light green audit arrow represents the ad hoc monitoring of the Information Security, IT assets, and Systemic/Operational risks
Resource Management	▪ The policy-making and process making segments of the green rectangles provide the appropriate policies and processes associated with the IT people, IT assets, facilities, and data/information ▪ The monitoring segment of the green rectangles represents the process to monitor the IT people, IT assets, facilities, and data/information ▪ The blue arrows between the green rectangles represent the needed monitored and tracked information ▪ The light green audit arrow represents the ad hoc monitoring of the IT people, IT assets, facilities, and data/information
Strategic Alignment	▪ The policy-making segment of the green rectangles provide the appropriate policies and processes associated with the business aims ▪ The monitoring segment of the green rectangles represents the process to monitor the efficient use of IT and the achievement of business aims ▪ The strategy and objective green arrows between the green rectangles represent the desirable behaviors to meet the business aims ▪ The blue arrows between the green rectangles represent the needed monitored and tracked information ▪ The light green audit arrow represents the ad hoc monitoring of the efficient use of IT and the achievement of business aims

IT Governance Feature	Represented in Figure 5-6
Value Delivery	▪ The monitoring segment of the green rectangles represents the process to monitor the quality, budget, and schedule ▪ The blue arrows between the green rectangles represent the needed monitored and tracked information ▪ The light green audit arrow represents the ad hoc monitoring of the quality, budget, and schedule

Figure 6-4. IT Governance Features Representation in the VDOT Governance Puzzle

6.1.3 IS and IT Governance Model

R3 - Using the IT governance and General Systems Theory features identified in R2, what is a model of IS and IT governance that explains the IS and IT governance observed at the case site?

The model of IS and IT governance begins with the Governance-Management-Operations Model (see Figure 5-7). The detailed model of the governance element of the Governance-Management-Operations Model is shown in Figure 5-8. The use of this governance model for IS governance is shown in Figure 5-10, and Figure 5-11 shows the model used for IT governance.

6.2 SIGNIFICANCE OF GOVERNANCE AS A SYSTEM

What does a systems perspective on IS/IT governance tell us about IS/IT governance that we did not know before? In other words, what is the value added of a systems perspective regarding IS/IT governance?

The use of a systems imagination enables the focused observation of a phenomenon within the context of a complex phenomenon. This research's use of a systems imagination enabled the extant IT governance research to be expanded as summarized in Figure 6-5.

Significant	Description		
Disambiguation of Governance and Management	Figure 5-7	Governance	Management
	Purpose	What to do with key assets	How to use key assets
	Inputs	▪ Exogenous Factors ▪ Endogenous Factors	▪ Exogenous Factors ▪ Endogenous Factors ▪ Desirable Behaviors Framework
	Products	Desirable Behaviors Framework	Management Framework
Governance Hierarchy of Purpose	The encapsulated complexity of the organizational governance element encompasses purposes of governing: ▪ key assets in toto (organization governance) ▪ key assets in a group (IS governance) ▪ a key asset (IT governance)		
Governance Change Mechanism	▪ Auditing ▪ Governance Monitor Information		

Figure 6-5. Significance of Governance as a System Summary

6.2.1 Disambiguation of Governance and Management

Significantly, this study posits that an organization has a single governance element. This observation is derived from imagining VDOT as a system that has three elements that are also systems: governance, management, and operations (see Figure 5-7). As a system and an element of a system, governance and management have distinct purposes and consist of all necessary elements to achieve that purpose, i.e., each VDOT organization system element is unique and is the only contributor of its product(s) to the overall VDOT organization system's product. Within the VDOT organization system context, the governance element seeks to delineate what the organization is to do with its key assets by transforming the exogenous and endogenous factors into the Desirable Behaviors Framework. Receiving the Desirable Behaviors Framework, the management element seeks to delineate how the organization is to use its key assets by transforming the Desirable Behaviors Framework and the exogenous and endogenous factors into the Management Framework.

6.2.2 *Governance Hierarchy of Purpose*

The systems imagination representation of a single governance element within an organization is consistent with and an expansion of the IT governance literature, which has imagined IT governance as a distinct process within an organization. The single governance element encapsulates the organization's governing complexity, which provides an explanation of the difference between this study and the extent IT governance literature. The encapsulated governance complexity is summarized by the element's hierarchy of purpose (see Figure 5-9), which this research posits is 1) key assets in toto (organization governance), 2) key assets in a group (IS governance), and 3) a key asset (IT governance). For the most part, the extent IT governance literature is concerned with the key assets in a group[34]. The significant difference in this case study is that there is a commonality of governance and that IS governance can be adapted for a specific technology, if necessary.

6.2.3 *Governance Change Mechanism*

Finally, the systems imagination representation of governance reimagines auditing and monitoring as the governance self-regulation mechanisms (see Figure 5-7, Figure 5-8, Figure 5-10, and Figure 5-11). These self-regulatory mechanisms are an expansion of the IT governance literature, which loosely embraces the presence of systems regulation (see Figure 1 10). However, there is a difference in this study's posited system regulation and that loosely found in the extant IT governance literature: IT governance as the organization regulator versus self-regulation of IT governance. The system regulation found in the literature is that IT

[34] In this study, IS and IT are distinct concepts. The extant IT governance literature does not have a unified definition of IS or IT. In general, this study's conception of IS governance is like much of the IT governance literature; however, there are studies that are closer to this study's conception of IT governance.

governance acts as an organization regulator of the IT and information assets; there is a nominal support that IT governance is self-regulatory. This implies that changes to governance can originate from outside, e.g. from management or operations. This study posits that governance is self-regulatory (and thereby provides the organization regulation of the IT and information assets). This means that changes to governance originate from within governance because of the endogenous or exogenous factors, auditing results, or monitoring information. The case study describes two instances of governance self-regulation. In the first instance, the governance monitor provided information about the performance of the IT Division, which caused the governance of the IT Division to be changed. In the second instance, audit reports provided information about VITA, which caused the Commonwealth's IT governance to be changed.

6.3 Conclusion

> *Normal science, the activity in which most scientists inevitably spend almost all their time, is predicated on the assumption that the scientific community knows what the world is like. Normal science often suppresses fundamental novelties because they are necessarily subversive of its basic commitments.*
> *— Kuhn (1996)*

> *It can be said that GST [General Systems Theory] influenced many scientific fields and is still widely known… the terminus system theory is widely and internationally spread among various disciplines, but in some fields the concepts already differ from the originators' attitude.*
> *— Drack and Apfalter (2007)*

Over a two-score year practitioner career, this researcher has observed many organizations and been responsible for implementing IT governance for a variety of IT systems. Among those many assignments, it has been observed that the implementation of IT

governance was an expensive, duplicative task that could be accomplished by leveraging another IT system's governance. However, this was not an idea that was embraced by these organizations. With the current ascendancy of 'Cloud Computing,' it seems that a different organization imagination for IT governance will be needed. An aspiration of this research is to empirically test the utility of a systems imagination for IT governance for the emerging governance needs of the 'Cloud Computing' future - a future where IT governance is critical at all levels of an organization for its success.

This research demonstrates to the IS field that a systems imagination is a tool that can be a part of how the IS science community knows the world and solves its puzzles. By using the systems imagination tool in this research, a vision of VDOT is posited that distinguishes between governance and management (Figure 5-7, VDOT's Governance-Management-Operations Model). Continued use of the tool resulted in the posited governance model (Figure 5-8, Governance System Model), which reimagines auditing and monitoring information as governance self-regulation mechanisms. Also, the systems imagination tool enabled the research to posit the governance hierarchy of purpose (Figure 5-9, Governance Hierarchy of Purpose): (1) key assets in toto (organization governance), (2) key assets in a group (IS governance), and (3) a key asset (IT governance).

Perhaps, this research demonstrates the possibility that the IS community can realize Bertalanffy's aspiration and make use of the General Systems Theory to find a common research language with other sister disciplines.

6.4 Implications for Research

6.4.1 Academic

This research has two implications for the academic IS field: utility of the General Systems Theory and the Governance-Management-Operations Model.

6.4.1.1 Utility of the General Systems Theory

The utility of the General Systems Theory is providing a means to understand complex phenomena and enable focused observations (Drack and Schwarz 2010). This case study demonstrates such an application of the General Systems Theory to understanding IS phenomena within a socially constructed organization. This research used the General System Theory as follows:

1. to describe the observed IT governance phenomenon (see Figure 5-6);
2. to describe VDOT as a system: positing the Governance-Management-Operations Model (see Figure 5-7); and
3. to derive the governance component of the Governance-Management-Operations Model from the observed VDOT governance phenomenon by using the concept of encapsulated complexity, which is associated with the hierarchy systems characteristic.

6.4.1.2 Governance-Management-Operations Model

The Governance-Management-Operations Model (see Figure 5-7) posits that VDOT is an organization system that consists of three distinct elements and that governance is one of these elements. Using a systems imagination, the Governance-Management-Operations Model differentiates governance and management: the purpose of governance is to delineate

what an organization is to do with its key assets, and the purpose of management is to delineate how an organization will use its key assets. In this systems conceptualization of an organization, governance provides necessary input (Desirable Behaviors Framework) to management, i.e. management cannot realize its goals without governance directives.

Conceptualizing governance as a holistic element of an organization, this research differs from the extant IT governance research, which envisions IT governance as a distinct and separate process of an organization. Significantly, this research posits that the governance element is a system that has a hierarchy of purpose:

1. governing for all assets, e.g. human resources, financial, information, IT, etc.
2. governing a group of assets, e.g. IT
3. governing a specific asset, e.g. ERP system

Within this hierarchy of purpose, IS governance is the governing of the organization's IT and information assets (governing a group of assets), and IT governance is the governing of a specific IT (governing a specific asset).

6.4.2 Practitioner

This research has three implications for practitioners: disambiguation of governance and management, governance commonality, and Governing for the shift to $\mathcal{X}aaS$.

6.4.2.1 Disambiguation of Governance and Management

The VDOT case story is an example of an organization that sees governance and management as synonymous with running the organization, i.e. setting the rules to be followed. However, the VDOT case story illustrates the distinctive role of governance and

management within the organization: the record of IT project delivery (governance monitoring) lead to the examination and reorganization of the IT Division (change to the governance directives) and the hiring of new leadership who changed the manner of executing IT Projects (management). The case story is an instance of the purpose of governance being the delineation of what the organization is to do with its assets. Management then uses these governance directives to delineate how the organization is to work with its assets.

6.4.2.2 Governance Commonality

This research posits that an organization has a common governance component that contains necessary elements that meet the governing needs for the organization's key assets. The case story describes the use of common governance: the revised IT governance was based on the existing governance of transportation assets, i.e., the governance directives for IT were made the same as for transportation, e.g. on time and budget. However, the governance practices were not shared; rather, the transportation practices were adapted to the needs of VDOT's information and IT assets. Also, the case story shows that the organization is actively moving from specific governance for each technology to a shared governance for all technologies.

6.4.2.3 Governing for the shift to $\mathcal{X}aaS$

Within the VDOT case story is a hint of the agency's experience with a notable change in governance responsibility for IT assets: changing from autonomous agency governance to VITA controlled federated governance. This change occurred when the state created VITA and moved responsibility from the agencies for IT assets such as disk storage, email, help desk, network, servers, and telephony to the new agency. There had been considerable evolution in

the governance of IT assets before this case study, and the case story describes the governance stasis that now exists between VDOT and VITA, i.e. it is possible to remove significant governance responsibility from the direct control of the organization and rely on another organization's governance.

This research's posited common organization governance and the IS governance element provides a means for an organization to equally govern IT assets that are controlled by the organization and IT assets that are controlled by another organization, e.g. cloud solutions such as IaaS, Paas, SaaS. The IS governance provides governance for all IT assets without regard to which organization controls the asset. This means that an organization needs to adapt IS governance so that it can work with the specific needs of the asset that is controlled by the other organization (this adaptation is exhibited in the case story through the adjustments VDOT made for the IT Strategic Plan, procurements over $250,000, VITA standards, etc.).

6.5 Future Research

6.5.1 Research Limitations

As is the case with any investigation of phenomena, this research has limitations. By its nature, this case study research investigated a single organization. Further, the research is IT-biased. By design, the observations and documentary data were selected because there was a connection to VDOT's IT organization. As such, the governance models (Figure 5-6, Figure 5-7, Figure 5-8, Figure 5-10, and Figure 5-11) are developed from the perspective of IT executives and managers; there was no managers or staff without an association with IT that participated in the research. While the research data shows a common use of governance for transportation

and IT assets, there is no such evidence between other assets. This is also a limitation of the description of the Desirable Behaviors Framework; the research data does not contain evidence of the components of the Desirable Behaviors Framework for non-IT assets.

6.5.2 Future Opportunities

As described above, this research contributes to the IS field's body of knowledge by demonstrating the utility of the General Systems Theory and positing the Governance-Management-Operations Model. To strengthen the validity of the Governance-Management-Operations Model, the model needs to be empirically tested in other organizations. These empirical testing studies should include organizations that vary in size, industry, and use of technology including organizations that are planning to use cloud-based technologies and those that have incorporated cloud-based technologies. The validity of the Governance-Management-Operations Model needs to be studied in a non-IT context. This research should answer questions such as (1) is the definition of governance appropriate for non-IT key assets, (2) what are the elements of the Desirable Behaviors Framework for non-IT asset governance, and (3) what are the feedback mechanism(s) for non-IT key assets.

The governance model (see Figure 5-8) posits that governance consists of policy-making, practice-making, and monitoring elements. Future research should investigate each of these elements to identify the interrelationship between the elements as well as the elements, if any, of each part. Similarly, the Governance-Management-Operations Model posits the existence of the Management Framework. Future studies should seek an understanding of the elements of this framework.

REFERENCES

CITED SOURCES

Ackoff, Russell L. 1994. "Systems Thinking and Thinking Systems." *System Dynamics Review* 10, no. 2-3: 175-188.

Ackoff, Russell L. 1974. "The Systems Revolution." *Long Range Planning* 7, no. 6 (Dec): 2-20. http://dx.doi.org/10.1016/0024-6301(74)90127-7.

Akhlaghpour, S., et al. 2013. "The Ongoing Quest for the IT Artifact: Looking Back, Moving Forward." *Journal of Information Technology* 28, no. 2 (Jun): 150-166. http://dx.doi.org/10.1057/jit.2013.10.

Allen, B. R., and A. C. Boynton. 1991. "Information Architecture - In Search of Efficient Flexibility." *MIS Quarterly* 15, no. 4 (Dec): 435-445. http://dx.doi.org/10.2307/249447.

Allen, M. W., et al. 2008. "Factors Impacting the Perceived Organizational Support of IT Employees." *Information & Management* 45, no. 8 (Dec): 556-563. http://dx.doi.org/10.1016/j.im.2008.09.003.

Alter, Steven. 2008. "Defining Information Systems as Work Systems: Implications for the IS Field." *European Journal of Information Systems* 17, no. 5 (Oct): 448-469. http://dx.doi.org/10.1057/ejis.2008.37.

---. 2015. "The Concept of 'IT Artifact' has Outlived its Usefulness and Should be Retired Now." *Information Systems Journal* 25, no. 1 (Jan): 47-60. http://dx.doi.org/10.1111/isj.12048.

Angyal, A. 1981. "A Logic of Systems." In *Systems Thinking : Selected Readings*, edited by F. E. Emery, vol 1, 27 - 40. Middlesex, England: Penguin Boks Ltd, Harmondsworth: revised.

Arraj, Valerie. 2013. "ITIL(R): The Basics." Accessed May 1, 2017. https://www.axelos.com/case-studies-and-white-papers/itil-the-basics-white-paper.

Balocco, R., A. Ciappini, and A. Rangone. 2013. "ICT Governance: A Reference Framework." *Information Systems Management* 30, no. 2: 150-167. http://dx.doi.org/10.1080/10580530.2013.773808.

Berger, Peter, and Thomas Luckmann. 1966. *The Social Construction of Reality*. Garden City, N.Y.: Doubleday.

Bertalanffy, Ludwig von. 1950. "An Outline of General System Theory." *The British Journal for the Philosophy of Science* 1, no. 2: 134-165. http://dx.doi.org/10.2307/685808.

---. 1969. *General System Theory: Foundations, Development, Applications*. New York: George Braziller.

Blanton, J. E., H. J. Watson, and J. Moody. 1992. "Toward a Better Understanding of Information Technology Organization - A Comparative Case-Study." *MIS Quarterly* 16, no. 4 (Dec): 531-555. http://dx.doi.org/10.2307/249735.

Boulding, Kenneth E. 1956. "General Systems Theory-The Skeleton of Science." *Management Science* 2, no. 3: 197-208.

Boynton, A. C., and R. W. Zmud. 1987. "Information Technology Planning in the 1990s - Directions for Practice and Research." *MIS Quarterly* 11, no. 1 (Mar): 59-71. http://dx.doi.org/10.2307/248826.

Bradley, Randy V., et al. 2012. "An Empirical Examination of Antecedents and Consequences of IT Governance in US Hospitals." *Journal of Information Technology* 27, no. 2 (Jun): 156-177. http://dx.doi.org/10.1057/jit.2012.3.

Brinkmann, Svend, and Steinar Kvale. 2015. *InterViews : Learning the Craft of Qualitative Research Interviewing*. Third ed. Thousand Oaks, California: Sage Publications.

Brown, Allen E, and Gerald G Grant. 2005. "Framing the Frameworks: A Review of IT Governance Research." *Communications of the AIS* 15: 696-712.

Brown, C. V. 1997. "Examining the Emergence of Hybrid IS Governance Solutions: Evidence from a Single Case Site." *Information Systems Research* 8, no. 1 (Mar): 69-94. http://dx.doi.org/10.1287/isre.8.1.69.

Brown, C. V., and S. L. Magill. 1994. "Alignment of the IS Functions with the Enterprise - Toward a Model of Antecedents." *MIS Quarterly* 18, no. 4 (Dec): 371-403. http://dx.doi.org/10.2307/249521.

Buckby, Sherrena, Peter Best, and Jenny Stewart. 2008. "The Current State of Information Technology Governance Literature." In *Information Technology Governance and Service Management: Frameworks and Adaptations: Frameworks and Adaptations*, edited by Aileen Cater-Steel, 1-43. Hershey, PA: IGI Global.

Burrell, Gibson, and Gareth Morgan. 1979. *Sociological Paragidms and Organisational Analysis*. Portsmouth, New Hampshire: Heinemann.

Business Consultant. 2014. *Review of ITD Solutions - Report of Findings and Improvement Initiatives*.

Business Roundtable. 2012. "Principles of Corporate Governance: 2012." Last modified March 27, 2012. Accessed June 20, 2014, 2014. http://businessroundtable.org/resources/business-roundtable-principles-of-corporate-governance-2012.

Carvalho, João Alvaro. 2000. "Information System? Which One do you Mean?" In *Information System Concepts: An Integrated Discipline Emerging*, 259-277: Springer.

Carver, John. 2003. "What Continues to Be Wrong with Corporate Governance... And How to Fix It." *Ivey Business Journal* 68, no. 1: 1-5.

Checkland, Peter. 1999. *Systems Thinking, Systems Practice: Includes a 30-Year Retrospective*. Chichester: John Wiley.

Churchman, C. West. 1971. *Design of Inquiring Systems: Basic Concepts of Systems and Organization*. New York: Basic Books.

---. 1979. *The Systems Approach*. New York, N.Y.: Dell Pub. Co.

Clark, T. D. 1992. "Corporate Systems Management - An Overview and Research Perspective." *Communications of the ACM* 35, no. 2 (Feb): 60-75.

Commonwealth of Virginia. 2015. "HB 1887 Commonwealth Transportation Board; membership, funding, updates annual reporting, and allocations." Virginia General Assembly. Accessed July 12, 2017, 2017. http://lis.virginia.gov/cgi-bin/legp604.exe?ses=151&typ=bil&val=hb1887.

---. 2017a. "Code of Virginia, Title 30. General Assembly, Chapter 7. Joint Legislative Audit and Review Commission; § 30-56. Joint Legislative Audit and Review Commission; composition; terms; compensation and expenses; office space; quorum; voting on recommendations." Matthew Bender & Company, Inc. a member of the LexisNexis Group. Accessed April 30, 2017, 2017. http://law.lis.virginia.gov/vacode/title30/chapter7/section30-56/.

---. 2017b. "Code of Virginia, Title 30. General Assembly, Chapter 7. Joint Legislative Audit and Review Commission; § 30-58.1. Powers and duties of Commission." Matthew Bender & Company, Inc. a member of the LexisNexis Group. Accessed April 30, 2017, 2017. http://law.lis.virginia.gov/vacode/title30/chapter7/section30-58.1/.

---. 2017c. "Code of Virginia, Title 30. General Assembly, Chapter 7. Joint Legislative Audit and Review Commission; § 30-60. Auditor of Public Accounts to render assistance upon request; his relationship to Commission." Matthew Bender & Company, Inc. a member of the LexisNexis Group. Accessed April 30, 2017, 2017. http://law.lis.virginia.gov/vacode/title30/chapter7/section30-60/.

---. 2017d. "Code of Virginia, Title 30. General Assembly, Chapter 14. Auditor of Public Accounts; § 30-142. Assumption of duties by Joint Legislative Audit and Review Commission upon failure of Auditor to perform; procedure." Matthew Bender & Company, Inc. a member of the LexisNexis Group. Accessed April 30, 2017, 2017. http://law.lis.virginia.gov/vacode/title30/chapter14/section30-142/.

---. 2017e. "Constitution of Virginia, Article IV. Legislature; Section 18. Auditor of Public Accounts." Matthew Bender & Company, Inc. a member of the LexisNexis Group. Accessed April 30, 2017, 2017. http://law.lis.virginia.gov/constitution/article4/section18/.

---. 2017f. "Virginia's Legislature." Accessed June 3, 2017, 2017. http://virginiageneralassembly.gov/virginiaLegislature.php?secid=20&activesec=2.

Crockett, Christopher. 2015. "25 Years of Hubble: The Orbiting Telescope has Transformed Our View of the Cosmos." *Science News* 187, no. 8: 18-21. http://dx.doi.org/10.1002/scin.2015.187008020.

Davis, Fred D. 1989. "Perceived Usefulness, Perceived Ease of Use, and User Acceptance of Information Technology." *MIS Quarterly* 13, no. 3: 319-340. http://dx.doi.org/10.2307/249008.

De Bono, Edward. 1993. *Serious Creativity: Using the Power of Lateral Thinking to Create New Ideas*. 1st ed. New York: Harper Business.

De Haes, Steven, and Wim Van Grembergen. 2009. "An Exploratory Study into IT Governance Implementations and its Impact on Business/IT Alignment." *Information Systems Management* 26, no. 2: 123-137. http://dx.doi.org/10.1080/10580530902794786.

Drack, M., and W. Apfalter. 2007. "Is Paul A. Weiss' and Ludwig von Bertalanffy's System Thinking still Valid Today?" *Systems Research and Behavioral Science* 24, no. 5 (Sep-Oct): 537-546. http://dx.doi.org/10.1002/sres.855.

Drack, M., and G. Schwarz. 2010. "Recent Developments in General System Theory." *Systems Research and Behavioral Science* 27, no. 6 (Nov-Dec): 601-610. http://dx.doi.org/10.1002/sres.1013.

Ein-Dor, Phillip, and Eli Segev. 1982. "Organizational Context and MIS Structure: Some Empirical Evidence." *MIS Quarterly* 6, no. 3: 55-68.

Einstein, Albert. 1929. "What Life Means to Einstein: An Interview by George Sylvester Viereck." *The Saturday Evening Post* 26.

Eriksson, Päivi; Kovalainen, Anne. 2008. *Qualitative Methods in Business Research*. Los Angeles ; London: Los Angeles ; London : SAGE.

Everett, Caleb. 2013. *Linguistic Relativity*. Berlin/Boston, DE: De Gruyter Mouton.

Flood, Robert L., and Michael C. Jackson. 1991. *Creative Problem Solving : Total Systems Intervention*. New York: Chichester : Wiley.

Fortune.com. 2017. "Fortune 500." Time Inc. Accessed February 23, 2017, 2017. http://beta.fortune.com/fortune500/list.

Gharajedaghi, Jamshid, and Russell L Ackoff. 1984. "Mechanisms, Organisms and Social Systems." *Strategic Management Journal* 5, no. 3: 289-300.

Global Status Report on the Governance of Enterprise IT (GEIT) — 2011. 2011. Edited by IT Governance Institute. Accessed July 3, 2014, http://www.isaca.org/Knowledge-Center/Research/ResearchDeliverables/Pages/Global-Status-Report-on-the-Governance-of-Enterprise-IT-GEIT-2011.aspx

Grant, Gerald, and Felix B. Tan. 2013. "Governing IT in Inter-Organizational Relationships: Issues and Future Research." *European Journal of Information Systems* 22, no. 5 (Sep): 493-497. http://dx.doi.org/10.1057/ejis.2013.21.

Gumperz, John J., and Stephen Levinson. 1996. *Rethinking Linguistic Relativity*. Edited by John J. Gumperz and Stephen Levinson. Cambridge, UK: Cambridge University Press.

Hade, Karl R. 2017a. "Diagram of Virginia's Judicial System." Office of the Executive Secretary, Supreme Court of Virginia. Accessed June 3, 2017, 2017. http://www.courts.state.va.us/courts/orgchart_jud_system.pdf.

---. 2017b. "Office of the Executive Secretary." Office of the Executive Secretary, Supreme Court of Virginia. Accessed June 3, 2017, 2017. http://www.courts.state.va.us/courtadmin/aoc/oes/home.html.

Handy, Charles. 1992. "Balancing Corporate Power: A New Federalist Paper." *Harvard Business Review* 70, no. 6: 59-72.

Harari, Oren. 2002. *The Leadership Secrets of Colin Powell*. 1st ed. New York: McGraw-Hill.

Hawking, Stephen. 2011. *The grand design*: Random House Digital, Inc.

Henderson, J. C., and H. Venkatraman. 1993. "Strategic Alignment: Leveraging Information Technology for Transforming Organizations." *IBM Systems Journal* 32, no. 1: 472-484. http://dx.doi.org/10.1147/sj.382.0472.

Hess, H. M. 2005. "Aligning Technology and Business: Applying Patterns for Legacy Transformation." *IBM Systems Journal* 44, no. 1: 25-45.

Hirschheim, Rudy, and Heinz K. Klein. 2012. "A Glorious and Not-So-Short History of the Information Systems Field." *Journal of the Association for Information Systems* 13, no. 4: 188-235.

Huang, R., R. W. Zmud, and R. L. Price. 2010. "Influencing the Effectiveness of IT Governance Practices through Steering Committees and Communication Policies." *European Journal of Information Systems* 19, no. 3 (Jun): 288-302. http://dx.doi.org/10.1057/ejis.2010.16.

ITGI. 2003. "Board Briefing on IT Governance, 2nd Edition." *IT Governance Institute*. Accessed October 3, 2015. http://www.isaca.org/restricted/Documents/26904_Board_Briefing_final.pdf.

---. 2015. "ITGI Fact Sheet." Accessed October 4, 2015, 2015. http://www.isaca.org/About-ISACA/Press-room/Documents/2015-ITGI-fact-sheet.pdf.

Jackson, Michael C. 1991. *Systems Methodology for the Management Sciences*, Contemporary Systems Thinking, edited by Robert L. Floyd. New York: New York : Plenum Press.

Jewer, J., and K. N. McKay. 2012. "Antecedents and Consequences of Board IT Governance: Institutional and Strategic Choice Perspectives." *Journal of the Association for Information Systems* 13, no. 7: 581-617.

Jobs, Steve. 2003. On 60 Minutes Overtime. CBS News. Accessed May 11, 2017. https://youtu.be/ZUfzXz23ndo.

Kearns, G. S., and A. L. Lederer. 2000. "The Effect of Strategic Alignment on the Use of IS-based Resources for Competitive Advantage." *Journal of Strategic Information Systems* 9, no. 4 (Dec): 265-293. http://dx.doi.org/10.1016/s0963-8687(00)00049-4.

Kifer, M., G. Lausen, and J. Wu. 1995. "Logical-Foundations of Object-Oriented and Frame-Based Languages." *Journal of the Association for Computing Machinery* 42, no. 4 (Jul): 741-843. http://dx.doi.org/10.1145/210332.210335.

King, J. L. 1983. "Centralized versus Decentralized Computing - Organizational Considerations and Management Options." *Computing Surveys* 15, no. 4: 319-349.

Kuhn, Thomas S. 1996. *The Structure of Scientific Revolutions*. 3rd ed. Chicago: The University of Chicago Press.

Laszlo, Ervin. 1996. *The Systems View of the World: A Holistic Vision for Our Time*: Hampton Press Cresskill, NJ.

Lawler, E. E., and D. L. Finegold. 2005. "The Changing Face of Corporate Boards." *MIT Sloan Management Review* 46, no. 2 (Winter): 67-70.

Leavitt, Harold J., and Thomas L. Whisler. 1958. "Management in the 1980's." *Harvard Business Review* 36, no. 6: 41-48.

Lee, A. S., M. Thomas, and R. L. Baskerville. 2015. "Going Back to Basics in Design Science: From the Information Technology Artifact to the Information Systems Artifact." *Information Systems Journal* 25, no. 1 (Jan): 5-21. http://dx.doi.org/10.1111/isj.12054.

Li, Wang, and Pervaiz Alam. 2007. "Information Technology Capability: Firm Valuation, Earnings Uncertainty, and Forecast Accuracy." *Journal of Information Systems* 21, no. 2 (Fall): 27-48.

Loh, Lawrence, and N. Venkatraman. 1992. "Diffusion of Information Technology Outsourcing: Influence Sources and the Kodak Effect." *Information Systems Research* 3, no. 4: 334-358.

Luftman, Jerry, and Barry Derksen. 2012. "Key Issues for IT Executives 2012: Doing More with Less." *MIS Quarterly Executive* 11, no. 4: 207-218.

Major Currents in Information Systems. 2008. edited by Leslie Willcocks and Allen S Lee. London: Sage Publications Ltd.

Markus, M. Lynne. 1983. "Power, Politics, and MIS Implementation." *Communications of the ACM* 26, no. 6: 430-444.

Markus, M. Lynne, and Allen S. Lee. 1999. "Special Issue on Intensive Research in Information Systems: Using Qualitative, Interpretive, and Case Methods to Study Information Technology -- Forward." *MIS Quarterly* 23, no. 1: 35-38.

Maslow, Abraham H. 1969. *The Psychology of Science : A Reconnaissance*. 1st Gateway ed.. ed. Chicago: Chicago : H. Regnery.

McKinney Jr, Earl H., and Charles J. Yoos II. 2010. "Information about Information: A Taxonomy of Views." *MIS Quarterly* 34, no. 2: 329-A325.

Micallef, J. 1988. "Encapsulation, Reusability and Extensibility in Object-Oriented Programming-Languages." *Journal of Object-Oriented Programming* 1, no. 1 (Apr-May): 12-&.

Morgan, Gareth, and Linda Smircich. 1980. "The Case for Qualitative Research." *Academy of Management Review* 5, no. 4: 491-500. http://dx.doi.org/10.5465/AMR.1980.4288947.

Myers, Michael D. 2009. *Qualitative Research in Business and Management*. Los Angeles: Sage.

Newman, J. 2001. "Some Observations on the Semantics of "Information"." *Information Systems Frontiers* 3, no. 2 (Jun): 155-167. http://dx.doi.org/10.1023/a:1011439305567.

Olson, Karin. 2011. *Essentials of Qualitative Interviewing*. 6 vols., Qualitative Essentials, edited by Janice Morse. Walnut Creek, Calif.: Left Coast Press.

Olson, Margrethe H., and Norman L. Chervany. 1980. "The Relationship between Organizational Characteristics and the Structure of the Information Services Function." *MIS Quarterly* 4, no. 2: 57-68.

Online Etymology Dictionary, ed. 2014a. *Online Etymology Dictionary*.

---, ed. 2014b. *Online Etymology Dictionary*.

Orlikowski, W. J., and C. S. Iacono. 2001. "Research Commentary: Desperately Seeking The "IT" In IT Research - A Call to Theorizing the IT Artifact." *Information Systems Research* 12, no. 2 (Jun): 121-134. http://dx.doi.org/10.1287/isre.12.2.121.9700.

Oxford English Dictionary, ed. 2014. *Oxford English Dictionary*: Oxford University Press.

Özdemir, D, W Herfs, and C Brecher. 2016. "Simulation in Machine Tool Design From Systems for Experts to Encapsulated Complexity." Paper presented at the International Conference on Competitive Manufacturing, Stellenbosch, South Africa, January 27-29, 2016.

Packer, Martin J. 2011. *The Science of Qualitative Research*. New York: New York : Cambridge University Press.

Pagejones, M. 1992. "Comparing Techniques by Means Of Encapsulation and Connascence." *Communications of the ACM* 35, no. 9 (Sep): 147-151. http://dx.doi.org/10.1145/130994.131004.

Peebles, Phillip James Edwin. 1980. *The Large-Scale Structure of the Universe*: Princeton University Press.

Peterson, Ryan. 2004a. "Crafting Information Technology Governance." *Information Systems Management* 21, no. 4 (Fall): 7-22. http://dx.doi.org/10.1201/1078/44705.21.4.20040901/84183.2.

---. 2004b. "Integration Strategies and Tactics for Information Technology Governance." In *Strategies for Information Technology Governance*, edited by W. VanGrembergen, 37-80. Hershey, PA: Idea Group Publishig. <Go to ISI>://WOS:000288791900003.

Petter, S., W. DeLone, and E. R. McLean. 2012. "The Past, Present, and Future of "IS Success"." *Journal of the Association for Information Systems* 13, no. 5: 341-362.

Popper, Karl R. 1959. *The logic of Scientific Discovery*. New York: Basic Books.

Redd, Nola Taylor. 2015. "Hubble at 25: The Iconic Space Telescope's Greatest Discoveries." Last modified April 26, 2015. http://www.csmonitor.com/Science/2015/0426/Hubble-at-25-The-iconic-space-telescope-s-greatest-discoveries.

Robinson, Floren, and Justin M. Brown. 2012. "How to Make Your Company Think Like a Customer." *Accenture Outlook*, no. 1: 10.

Rosenblueth, Arturo, Norbert Wiener, and Julian Bigelow. 1943. "Behavior, Purpose and Teleology." *Philosophy of Science* 10, no. 1: 18-24. http://dx.doi.org/10.2307/184878.

Russell, Bruce. 2012. "A Priori Justification and Knowledge." Accessed April 29, 2013, 2013. http://plato.stanford.edu/archives/fall2012/entries/apriori/.

Sabra, Abdelhamid I. 1966. "Ibn al-Haytham's Criticisms of Ptolemy's Optics." *Journal of the History of Philosophy* 4, no. 2: 145-149.

Sachs, W. M. 1981. "Toward Formal Foundations of Teleological Systems Science." In *Systems Thinking : Selected Readings*, edited by F. E. Emery, vol 1, 399 - 421. Middlesex, England: Penguin Boks Ltd, Harmondsworth: revised.

Sambamurthy, V., and R. W. Zmud. 2000. "Research Commentary: The Organizing Logic for an Enterprise's IT Activities in the Digital Era - A Prognosis of Practice and a Call for Research." *Information Systems Research* 11, no. 2 (Jun): 105-114. http://dx.doi.org/10.1287/isre.11.2.105.11780.

Sambamurthy, V., and Robert W. Zmud. 1999. "Arrangement for Information Technology Governance: A Theory of Multiple Contingencies." *MIS Quarterly* 23, no. 2: 261-290.

Sarker, S., and A. S. Lee. 2006. "Does the Use of Computer-based BPC Tools Contribute to Redesign Effectiveness? Insights from a Hermeneutic Study." *IEEE Transactions on Engineering Management* 53, no. 1 (Feb): 130-145. http://dx.doi.org/10.1109/tem.2005.861806.

Sauer, C., A. Gemino, and B. H. Reich. 2007. "The Impact of Size and Volatility - On IT Project Performance." *Communications of the ACM* 50, no. 11 (Nov): 79-84. http://dx.doi.org/10.1145/1297797.1297801.

Schwarz, A., and R. Hirschheim. 2003. "An Extended Platform Logic Perspective of IT governance: Managing Perceptions and Activities of IT." *Journal of Strategic Information Systems* 12, no. 2 (July): 129-166. http://dx.doi.org/10.1016/s0963-8687(03)00021-0.

Simonsson, Mårten, and Pontus Johnson. 2006a. *Assessment of IT Governance-A prioritization of Cobit*. *Proceedings of the Conference on Systems Engineering Research*. Las Angeles, California: Studentlitteratur.

---. 2006b. *Defining IT Governance-A Consolidation of Literature*. Vol. 6. *The 18th Conference on Advanced Information Systems Engineering*. Luxembourg, Luxembourg.

Skyttner, Lars. 2005. *General Systems Theory Problems, Perspectives, Practice*. 2nd ed. Singapore: World Scientific.

Somers, M. J. 2010. "Using the Theory of the Professions to Understand the IS Identity Crisis." *European Journal of Information Systems* 19, no. 4 (Aug): 382-388. http://dx.doi.org/10.1057/ejis.2010.26.

Stamper, Ronald. 1973. *Information in Business and Administrative Systems*. New York: John Wiley & Sons.

Strauss, Anselm L., and Juliet M. Corbin. 1990. *Basics of Qualitative Research : Grounded Theory Procedures and Techniques*. Newbury Park, California: Sage Publications.

Swanson, E. B., and C. M. Beath. 1989. "Reconstructing the Systems-Development Organization." *MIS Quarterly* 13, no. 3 (Sep): 293-305. http://dx.doi.org/10.2307/249004.

Tavakolian, H. 1989. "Linking the Information Technology Structure with Organizational Competitive Strategy - A Survey." *MIS Quarterly* 13, no. 3 (Sep): 309-317. http://dx.doi.org/10.2307/249006.

Taylor, Steven J. 1998. *Introduction to Qualitative Research Methods : A Guidebook and Resource*. 3rd ed.. ed., edited by Robert Bogdan. New York: New York : Wiley.

Tesch, Renata. 1990. *Qualitative Research : Analysis Types and Software Tools*. New York: New York : Falmer Press.

Thomas, R. J., et al. 2009. "How Boards Can Be Better - A Manifesto." *MIT Sloan Management Review* 50, no. 2 (Winter): 69-74.

Thomasson, Kelly. 2017. "Organization of Virginia State Government." Secretary of the Commonwealth of Virginia. Accessed January 20, 2017, 2017. https://commonwealth.virginia.gov/va-government/organization-of-virginia-state-government/.

Tricker, R. Ian. 1984. *Corporate Governance: Practices, Procedures, and Powers in British Companies and their Boards of Directors*. Brookfield, Vt.: Gower Pub. Co.

Tuomi, Ilkka. 1999. "Data Is More Than Knowledge: Implications of the Reversed Knowledge Hierarchy for Knowledge Management and Organizational Memory." *Journal of Management Information Systems* 16, no. 3 (Winter): 103-117.

Tuttle, Brad, and Adrian Harrell. 2001. "The Impact of Unit Goal Priorities: Economic Incentives, and Interim Feedback on the Planned Effort of Information Systems Professionals." *Journal of Information Systems* 15, no. 2 (Fall): 81.

Twain, Mark. 1889. *A Connecticut Yankee in King Arthur's Court*. London, New York: Charles L. Webster & Company.

van der Zee, J. T. M., and Berend de Jong. 1999. "Alignment Is Not Enough: Integrating Business and Information Technology Management with the Balanced Business Scorecard." *Journal of Management Information Systems* 16, no. 2 (Fall): 137-156.

Van Grembergen, Wim, and Steven De Haes. 2009. *Enterprise Governance of Information Technology: Achieving Strategic Alignment and Value*. New York: Springer.

VDOT. 2006. *A History of Roads in Virginia: The Most Convenient Wayes*. Special Centennial ed.: Virginia Department of Transportation. Accessed February 5, 2017. http://www.virginiadot.org/about/resources/historyofrds.pdf.

---. 2014a. "Mission, Shared Values and Code of Ethics." Virginia Department of Transportation. Accessed February 5, 2017, 2017. http://www.virginiadot.org/about/missionandvalues.asp.

---. 2014b. "VDOT District L&D Offices." VDOT. Accessed February 19, 2017, 2017. http://www.virginiadot.org/business/locdes/district_ld_offices.asp.

---. 2015. *Memorandum: Update on Cardinal and Information Technology*: Virginia Department of Transportation.

---. 2016a. "VDOT History Highlights." Virginia Department of Transportation. Accessed February 5, 2017, 2017. http://www.virginiadot.org/about/vdot_history.asp.

---. 2016b. *Virginia Department of Transportation Fiscal Year 2017: VDOT Annual Budget*: Virginia Department of Transportation. Accessed February 18, 2017, http://www.virginiadot.org/about/resources/Final_VDOT_Budget.pdf

---. 2017. "VDOT Organization Chart with Divisions." Virginia Department of Transportation. Accessed July 7, 2017, 2017. http://www.virginiadot.org/about/resources/vdotchartwnames.pdf.

Venkatraman, N. 1997. "Beyond Outsourcing: Managing IT Resources as a Value Center." *MIT Sloan Management Review* 38, no. 3 (Spring): 51-64.

Viereck, George Sylvester. 1929. "What Life Means to Einstein." *The Saturday Evening Post* 26: 17.

Virginia General Assembly. 2017. "Code of Virginia; Title 2.2. Admistration of Government; Chapter 1. Governor; § 2.2-106. Appointment of agency heads; disclosure of resumes; severance." Commonwealth of Vriginia. Accessed April 30, 2017, 2017. http://law.lis.virginia.gov/vacode/title2.2/chapter1/section2.2-106/.

Weber, Ron. 2004. "The Rhetoric of Positivism Versus Interpretivism: A Personal View." *MIS Quarterly* 28: iii-xii.

Webster, Daniel. 1825. "Adress on Laying the Cornerstone of the Bunnker Hill Mounument." In *Washington's Farewell Address, and Webster's Bunker Hill Orations*, edited by Sc.D. William T. Peck: Macmillan Company: 1919. Accessed May 17. 2017, https://books.google.com/books?hl=en&lr=&id=zvYVAAAAYAAJ&oi=fnd&pg=PR11&dq=webster+%E2%80%9CMind+is+the+great+lever+of+all+things%3B+human+thought+is+the+process+by+which+human+ends+are+ultimately+answered%E2%80%9D&ots=rO01rXp78A&sig=u07tH6cdRtKsHstIN6XbxBABB70#v=onepage&q=webster%20%E2%80%9CMind%20is%20the%20great%20lever%20of%20all%20things%3B%20human%20thought%20is%20the%20process%20by%20which%20human%20ends%20are%20ultimately%20answered%E2%80%9D&f=false.

Weill, Peter. 2004. "Don't Just Lead, Govern: How Top-Performing Firms Govern IT." *MIS Quarterly Executive* 3, no. 1: 1-17.

Weill, Peter, and Jeanne Ross. 2005. "A Matrixed Approach to Designing IT Governance." *MIT Sloan Management Review* 46, no. 2 (Winter): 26.

Weill, Peter, and Jeanne W Ross. 2004. *IT Governance: How Top Performers Manage IT Decision Rights for Superior Results*. Boston, Massachusetts: Harvard Business Press.

Wilby, J. 2006. "An Essay on Kenneth E. Boulding's General Systems Theory: The Skeleton of Science." *Systems Research and Behavioral Science* 23, no. 5 (Sep-Oct): 695-699. http://dx.doi.org/10.1002/sres.802.

Wilkin, C. L., J. Campbell, and S. Moore. 2013. "Creating Value Through Governing IT Deployment in a Public/Private-Sector Inter-Organisational Context: A Human Agency Perspective." *European Journal of Information Systems* 22, no. 5 (Sep): 498-511. http://dx.doi.org/10.1057/ejis.2012.21.

Wilkin, C. L., and R. H. Chenhall. 2010. "A Review of IT Governance: A Taxonomy to Inform Accounting Information Systems." *Journal of Information Systems* 24, no. 2 (Fall): 107-146. http://dx.doi.org/10.2308/jis.2010.24.2.107.

Yin, Robert K. 2009. *Case Study Research : Design and Methods*. 4th ed., Applied Social Research Methods Series, edited by Leonard Bickman and Debra J. Rog. Los Angeles, California: Sage Publications.

Zmud, R. W. 1984. "Design Alternatives for Organizing Information-Systems Activities." *MIS Quarterly* 8, no. 2: 79-93. http://dx.doi.org/10.2307/249345.

Zmud, R. W., A. C. Boynton, and G. C. Jacobs. 1986. "The Information Economy - A New Perspective for Effective Information-Systems Management." *Data Base* 18, no. 1 (Fall): 17-23.

Zyngier, Suzanne, and Frada Burstein. 2012. "Knowledge Management Governance: the Road to Continuous Benefits Realization." *Journal of Information Technology* 27, no. 2 (Jun): 140-155. http://dx.doi.org/10.1057/jit.2011.31.

Blumenberg, S. A., and D. J. Hinz. 2006. Enhancing the Prognostic Power of IT Balanced Scorecards with Bayesian Belief Networks. Vol. 8. 39th Annual Hawaii International Conference on System Sciences, HICSS 2006. Hawaii: IEEE.

Dahlberg, T., and H. Kivijarvi. 2006. An Integrated Framework for IT Governance and the Development and Validation of an Assessment Instrument. Vol. 8. 39th Annual Hawaii International Conference on System Sciences, HICSS 2006. Hawaii: IEEE.

Dahlberg, T., and P. Lahdelma. 2007. IT Governance Maturity and IT Outsourcing Degree: An Exploratory Study. 40th Annual Hawaii International Conference on System Sciences, HICSS 2007. Hawaii: IEEE.

De Haes, Steven, and Wim Van Grembergen. 2004. "IT Governance and its Mechanisms." *Information Systems Control Journal* 1: 27-33.

Fairchild, A. M. 2004. Information Technology Outsourcing (ITO) Governance: An Examination of the Outsourcing Management Maturity Model. 37th Annual Hawaii International Conference on System Sciences, HICSS 2004. Hawaii: IEEE.

Gold, Robert S. 2003. "Building the IT Organization Balanced Scorecard." *Information Systems Control Journal* 5: 46-48. Accessed September 19, 2015.

Guldentops, Erik. 2003. "Maturity Measurement—First the Purpose, Then the Method." *Information Systems Control Journal* 4: 15-17. Accessed September 19, 2015.

Guldentops, Erik, Wim Van Grembergen, and Steven De Haes. 2002. "Control and Governance Maturity Survey: Establishing a Reference Benchmark and a Self-Assessment Tool." *Information Systems Control Journal* 4: 21-24. Accessed September 19, 2015.

Hardy, Gary, and Erik Guldentops. 2005. "COBIT 4.0: The New Face of COBIT." *Information Systems Control Journal* 6. Accessed September 18, 2015.

Lambeth, John. 2007. "Using COBIT as a Tool to Lead Enterprise It Organizations." *Information Systems Control Journal* 1: 28-29. Accessed September 19, 2015.

Murray, John P. 2004. "Judging IT Department Performance." *Information Systems Management* 21, no. 2 (Spring): 72-77.

Pederiva, Andrea. 2003. "The COBIT Maturity Model in a Vendor Evaluation Case." *Information Systems Control Journal* 3: 26-29. Accessed September 19, 2015.

Saull, Ronald. 2000. "The IT Balanced Scorecard: A Roadmap to Effective Governance of a Shared Services IT Organization." *Information Systems Control Journal* 2: 31-38. Accessed September 19, 2015.

Van Grembergen, Wim 2000. "The Balanced Scorecard and IT Governance." *Information Systems Control Journal* 2: 40-43. Accessed September 19, 2015.

Van Grembergen, Wim , and Steven De Haes. 2005a. "COBIT's Management Guidelines Revisited: The Kgis/Kpis Cascade." *Information Systems Control Journal* 6: 54-56. Accessed September 19, 2015.

---. 2005b. "Measuring and Improving IT Governance through the Balanced Scorecard." *Information Systems Control Journal* 2: 35-42. Accessed September 19, 2015.

Van Grembergen, Wim , Steven De Haes, and Isabelle Amelinckx. 2005. "Using COBIT and the Balanced Scorecard as Instruments for Service Level Management." *Information Systems Control Journal* 4: 56 -62. Accessed September 19, 2015.

Van Grembergen, Wim, and I. Amelinckx. 2002. Measuring and Managing E-Business Projects through the Balanced Scorecard. 35th Annual Hawaii International Conference on System Sciences, HICSS 2002. Hawaii: IEEE.

Van Grembergen, Wim, Ronald Saull, and Steven De Haes. 2003. "Linking the IT Balanced Scorecard to the Business Objectives at a Major Canadian Financial Group." *Journal of Information Technology Cases & Applications* 5, no. 1: 23-50.

Van Grembergen, Wim, and Rik Van Bruggen. 1997. Measuring and Improving Corporate Information Technology through the Balanced Scorecard Technique. Fourth European Conference on the Evaluation of Information technology. Delft, the Netherlands

Warland, C., and G. Ridley. 2005. Awareness of IT Control Frameworks in an Australian State Government: A Qualitative Case Study. 38th Annual Hawaii International Conference on System Sciences, HICSS 2005. Hawaii: IEEE.

Ben-Menachem, Mordechai, and Ilanit Gavious. 2007. "Accounting Software Assets: A Valuation Model for Software." *Journal of Information Systems* 21, no. 2 (Fall): 117-132.

Im, K. S., K. E. Dow, and V. Grover. 2001. "Research Report: A Reexamination of IT Investment and the Market Value of the Firm - an Event Study Methodology." *Information Systems Research* 12, no. 1 (Mar): 103-117. http://dx.doi.org/10.1287/isre.12.1.103.9718.

Lawler, E. E., and D. L. Finegold. 2005. "The Changing Face of Corporate Boards." *MIT Sloan Management Review* 46, no. 2 (Winter): 67-70.

Li, Wang, and Pervaiz Alam. 2007. "Information Technology Capability: Firm Valuation, Earnings Uncertainty, and Forecast Accuracy." *Journal of Information Systems* 21, no. 2 (Fall): 27-48.

Lin, C., and G. Pervan. 2003. "The Practice of IS/IT Benefits Management in Large Australian Organizations." *Information & Management* 41, no. 1 (Oct): 13-24. http://dx.doi.org/10.1016/s0379-7206(03)00002-8.

Thatcher, M. E., and D. E. Pingry. 2007. "Modeling the Value Paradox." *Communications of the ACM* 50, no. 8 (Aug): 41-45. http://dx.doi.org/10.1145/1278201.1278204.

van der Zee, J. T. M., and Berend de Jong. 1999. "Alignment is Not Enough: Integrating Business and Information Technology Management with the Balanced Business Scorecard." *Journal of Management Information Systems* 16, no. 2 (Fall): 137-156.

Resource Management

Buckby et al.

Broadbent, M. 2003. "The Right Combination." (April 11, 2003). Accessed September 19, 2015.

Broadbent, M., and P. Weill. 1997. "Management by Maxim: How Business and IT Managers Can Create IT Infrastructures." *MIT Sloan Management Review* 38, no. 3 (Spring): 77-92.

Brown, Allen E, and Gerald G Grant. 2005. "Framing the Frameworks: A Review of IT Governance Research." *Communications of the AIS* 15: 696-712.

Bushell, Sue. 2007. "When Egos Dare." (June 5, 2007). Accessed September 19, 2015.

De Haes, Steven, and Wim Van Grembergen. 2006. Information Technology Governance Best Practices in Belgian Organisations. Vol. 8. 39th Annual Hawaii International Conference on System Sciences, HICSS 2006. Hawaii: IEEE.

Hamaker, Stacey. 2000. "Your IT Applications Inventory is All in Your Head: An Observation Related to IT Governance Tools." *Information Systems Control Journal* 5: 21-26. Accessed September 19, 2015.

Karake, Zeinab A. 1992. "An Empirical Investigation of Information Technology Structure, Control and Corporate Governance." *The Journal of Strategic Information Systems* 1, no. 5: 258-265. http:/dx.doi.org/10.1016/0963-8687(92)90015-O.

Karimi, J., et al. 2000. "The Effects of MIS Steering Committees on Information Technology Management Sophistication." *Journal of Management Information Systems* 17, no. 2 (Fall): 207-230.

Keyes-Pearce, Susan V. 2002. Rethinking the Importance of IT Governance in the E-World. 6th Pacific Asia Conference on Information Systems. Tokyo, Japan.

Meyer, N. D. 2004. "Systemic IS Governance, an Introduction." *Information Systems Management* 21, no. 4 (Fall): 23-34. http://dx.doi.org/10.1201/1078/44705.21.4.20040901/84184.3.

Milis, Koen, Stijn Viaene, and Pieter Ribbers. 2006. On How the Feasibility Study Is Influenced by an ICT Project's Main Trigger. Vol. 8. 39th Annual Hawaii International Conference on System Sciences, HICSS 2006. Hawaii: IEEE.

Mukherji, Ananda. 2002. "The Evolution of Information Systems: Their Impact on Organizations and Structures." *Management Decision* 40, no. 5: 497-507. http://dx.doi.org/doi:10.1108/00251740210430498.

Peterson, Ryan. 2001. Configurations and Coordination for Global Information Technology Governance: Complex Designs in a Transnational European Context. 34th Annual Hawaii International Conference on System Sciences, HICSS 2001. Hawaii: IEEE.

---. 2004. "Crafting Information Technology Governance." *Information Systems Management* 21, no. 4 (Fall): 7-22. http://dx.doi.org/10.1201/1078/44705.21.4.20040901/84183.2.

Peterson, Ryan, Pieter Ribbers, and Ramon O'Callaghan. 2000. "Information Technology Governance by Design: Investigating Hybrid Configurations and Integration Mechanisms." Paper presented at the Twenty-First International Conference on Information Systems (ICIS), Brisbane, Australia. http://aisel.aisnet.org/icis2000/41.

Powell, Anne, and Susan E. Yager. 2004. "Exploring Reputation Differences in Information Systems Groups." *Journal of Information Technology Cases & Applications* 6, no. 2: 5-26.

Rau, Kenneth G. 2004. "Effective Governance of IT: Design Objectives, Roles, and Relationships." *Information Systems Management* 21, no. 4 (Fall): 35-42. http://dx.doi.org/10.1201/1078/44705.21.4.20040901/84185.4.

Ribbers, Pieter, Ryan R Peterson, and Marylin M Parker. 2002. Designing Information Technology Governance Processes: Diagnosing Contemporary Practices and Competing Theories. 35th Annual Hawaii International Conference on System Sciences, HICSS 2002. Hawaii: IEEE.

Robinson, Nick. 2007. "The Many Faces of IT Governance: Crafting an IT Governance Architecture." *Information Systems Control Journal* 1: 14-16. Accessed September 19, 2015.

Sambamurthy, V., and Robert W. Zmud. 1999. "Arrangement for Information Technology Governance: A Theory of Multiple Contingencies." *MIS Quarterly* 23, no. 2: 261-290.

Schwarz, A., and R. Hirschheim. 2003. "An Extended Platform Logic Perspective of IT Governance: Managing Perceptions and Activities of IT." Journal of Strategic Information Systems 12, no. 2 (July): 129-166 . http://dx.doi.org/10.1016/s0963-8687(03)00021-0.

Sherer, Susan. 2004. IS Project Selection: The Role of Strategic Vision and IT Governance. 37th Annual Hawaii International Conference on System Systems, HICSS 2004. Hawaii: IEEE.

Sohal, A. S., and P. Fitzpatrick. 2002. "IT Governance and Management in Large Australian Organisations." *International Journal of Production Economics* 75, no. 1-2 (Jan): 97-112. http://dx.doi.org/10.1016/s0925-5273(01)00184-0.

Van Grembergen, Wim, Steven De Haes, and Jan Moons. 2005. "Linking Business Goals to IT Goals and COBIT Processes." *Information Systems Control Journal* 4: 18-22. Accessed September 19, 2015.

Weill, Peter. 2004. "Don't Just Lead, Govern: How Top-Performing Firms Govern IT." *MIS Quarterly Executive* 3, no. 1: 1-17.

Weill, Peter, and Jeanne W Ross. 2004. *IT Governance: How Top Performers Manage IT Decision Rights for Superior Results*. Boston, Massachusetts: Harvard Business Press.

Willcocks, Leslie, David Feeny, and Nancy Olson. 2006. "Implementing Core IS Capabilities:: Feeny–Willcocks IT Governance and Management Framework Revisited." *European Management Journal* 24, no. 1 (Feb): 28-37. http://dx.doi.org/10.1016/j.emj.2005.12.005.

Willcoxson, Lesley, and Robina Chatham. 2006. "Testing the Accuracy of the IT Stereotype: Profiling IT Managers' Personality and Behavioural Characteristics." *Information & Management* 43, no. 6 (Sep): 697-705. http:/dx.doi.org/10.1016/j.im.2004.04.009.

Young, Raymond Christopher, and Ernest Jordan. 2002. "IT Governance and Risk Management: An Integrated Multi-Stakeholder Framework." Paper presented at the Asia Pacific Decision Sciences Institute, Bangkok, Thailand.

Allen, M. W., et al. 2008. "Factors Impacting the Perceived Organizational Support of IT Employees." *Information & Management* 45, no. 8 (Dec): 556-563. http://dx.doi.org/10.1016/j.im.2008.09.003.

Bradley, Joseph. 2008. "Management Based Critical Success Factors in the Implementation of Enterprise Resource Planning Systems." *International Journal of Accounting Information Systems* 9, no. 3: 175-200. http://dx.doi.org/10.1016/j.accinf.2008.04.001.

He, J., B. S. Butler, and W. R. King. 2007. "Team Cognition: Development and Evolution in Software Project Teams." *Journal of Management Information Systems* 24, no. 2 (Fall): 261-292. http://dx.doi.org/10.2753/mis0742-1222240210.

Rose, Jeremy, and Pernille Kræmmergaard. 2006. "Erp Systems and Technological Discourse Shift: Managing the Implementation Journey." *International Journal of Accounting Information Systems* 7, no. 3: 217-237. http://dx.doi.org/10.1016/j.accinf.2006.06.003.

Sauer, C., A. Gemino, and B. H. Reich. 2007. "The Impact of Size and Volatility - on IT Project Performance." *Communications of the ACM* 50, no. 11 (Nov): 79-84. http://dx.doi.org/10.1145/1297797.1297801.

Sharma, Rajeev, and Philip Yetton. 2007. "The Contingent Effects of Training, Technical Complexity, and Task Interdependence on Successful Information Systems Implementation." *MIS Quarterly* 31, no. 2 (Jun): 219-238.

Silva, L., and R. Hirschheim. 2007. "Fighting against Windmills: Strategic Information Systems and Organizational Deep Structures." *MIS Quarterly* 31, no. 2 (Jun): 327-354.

Thatcher, M. E., and D. E. Pingry. 2007. "Modeling the Value Paradox." *Communications of the ACM* 50, no. 8 (Aug): 41-45. http://dx.doi.org/10.1145/1278201.1278204.

Tuttle, Brad, and Adrian Harrell. 2001. "The Impact of Unit Goal Priorities: Economic Incentives, and Interim Feedback on the Planned Effort of Information Systems Professionals." *Journal of Information Systems* 15, no. 2 (Fall): 81.

Worley, C. G., and E. E. Lawler. 2006. "Designing Organizations That Are Built to Change." *MIT Sloan Management Review* 48, no. 1 (Fall): 19-23.

Ataya, Georges. 2003. "Risk-Aware Decision Making for New IT Investments." *Information Systems Control Journal* 2: 12-14. Accessed September 19, 2015.

Bahli, B., and S. Rivard. 2005. "Validating Measures of Information Technology Outsourcing Risk Factors." *Omega-International Journal of Management Science* 33, no. 2 (Apr): 175-187. http://dx.doi.org/10.1016/j.omega.2004.04.003.

Benvenuto, Nicholas A. 2005. "Outsourcing—a Risk Management Perspective." *Information Systems Control Journal* 5: 35-40. Accessed September 18, 2015.

Broadbent, M. 2003. "Understanding IT Governance." *CIO Canada* 1. Accessed September 19, 2015.

Chapin, David A., and Steven Akridge. 2005. "How Can Security Be Measured?" *Information Systems Control Journal* 2: 43-48. Accessed September 18, 2015.

COSO. 2004. "Enterprise Risk Management — Integrated Framework." Accessed September 19, 2015.

Council of Standards Australia and Council of Standards New Zealand. 2004. *Risk Management as/Nzs 4360:2004*. Third ed.: Standards Autsralia/Standards New Zealand.

Du, Stephen, et al. 2006. *The Role of Perceived Control, Attention-Shaping, and Expertise in IT Project Risk Assessment*. Vol. 8. *39th Annual Hawaii International Conference on System Sciences, HICSS 2006*. Hawaii: IEEE.

Gerber, M., and R. von Solms. 2005. "Management of Risk in the Information Age." *Computers & Security* 24, no. 1 (Feb): 16-30. http://dx.doi.org/10.1016/j.cose.2004.11.002.

Gewald, Heiko, and Kay Helbig. 2006. *A Governance Model for Managing Outsourcing Partnerships: A View from Practice*. Vol. 8. *39th Annual Hawaii International Conference on System Sciences, HICSS 2006*. Hawaii: IEEE.

Hadden, Linda B., F. Todd DeZoort, and Dana R. Hermanson. 2003. "IT Risk Oversight: The Roles of Audit Committees, Internal Auditors, and External Auditors." *Internal Auditing* 18, no. 6 (Nov-Dec): 28-30.

Hinz, Daniel J, and Jochen Malinowski. 2006. *Assessing the Risks of IT Infrastructure-a Personal Network Perspective*. Vol. 8. *39th Annual Hawaii International Conference on System Sciences, HICSS 2006*. Hawaii: IEEE.

ITGI. 2005a. "Information Security Governance: Guidance for Information Security Managers." Accessed September 19, 2015.

---. 2005b. "It Governance Domains Practices and Competencies: Information Risks—Whose Business Are They?". Accessed September 19, 2015.

---. 2006. "Information Security Governance: Guidance for Boards of Directors and Executive Management." Accessed September 17, 2015.

Jogani, Anil. 2006. "Governance of Mobile Technology in Enterprises." *Information Systems Control Journal* 4: 25-27. Accessed September 18, 2015.

Johnstone, David, Sid Huff, and Beverley Hope. 2006. *IT Projects: Conflict, Governance, and Systems Thinking*. Vol. 8. *39th Annual Hawaii International Conference on System Sciences, HICSS 2006*. Hawaii: IEEE.

Kliem, R. 2004. "Managing the Risks of Offshore It Development Projects." *Information Systems Management* 21, no. 3 (Summer): 22-27. http://dx.doi.org/10.1201/1078/44432.21.3.20040601/82473.4.

Levine, R. 2004. "Risk Management Systems: Understanding the Need." *Information Systems Management* 21, no. 2 (Spring): 31-37. http://dx.doi.org/10.1201/1078/44118.21.2.20040301/80419.5.

Pareek, Mukul. 2006. "Living with Risk." *Information Systems Control Journal* 6: 35-38. Accessed September 18, 2015.

Pironti, John P. 2006. "Information Security Governance: Motivations, Benefits, and Outcomes." *Information Systems Control Journal* 4: 45-48. Accessed September 18, 2015.

Ross, Steven J. 2006. "Information Security Matters: Converging Need, Diverging Response." *Information Systems Control Journal* 2: 8-9. Accessed September 18, 2015.

SAS. 2004. "Operational Risk Management in the Financial Services Industry." Accessed September 19, 2015.

Stewart, A. 2004. "On Risk: Perception and Direction." *Computers & Security* 23, no. 5 (Jul): 362-370. http://dx.doi.org/10.1016/j.cose.2004.05.003.

von Solms, B., and R. von Solms. 2004. "The 10 Deadly Sins of Information Security Management." *Computers & Security* 23, no. 5 (Jul): 371-376. http://dx.doi.org/10.1016/j.cose.2004.05.002.

von Solms, S. H. 2005. "Information Security Governance - Compliance Management vs Operational Management." *Computers & Security* 24, no. 6 (Sep): 443-447. http://dx.doi.org/10.1016/j.cose.2005.07.003.

Wiederkehr, Bruno. 2003. "IT Security Awareness Programme." *Information Systems Control Journal* 3: 30-32. Accessed September 19, 2015.

Young, Raymond, and Ernest Jordan. 2003. *Passion & IT Governance*. *7th Pacific Asia Conference on Information Systems, PACIS 2003*. Adelaide, Australia: Association for Information Systems.

Abu-Musa, Ahmad A. 2006. "Perceived Security Threats of Computerized Accounting Information Systems in the Egyptian Banking Industry." *Journal of Information Systems* 20, no. 1 (Spring): 187-203.

Bonabeau, E. 2007. "Understanding and Managing Complexity Risk." *MIT Sloan Management Review* 48, no. 4 (Summer): 62-68.

Dhillon, G., and J. Backhouse. 2000. "Information System Security Management in the New Millennium." *Communications of the ACM* 43, no. 7 (Jul): 125-128. http://dx.doi.org/10.1145/341852.341877.

Hu, Q., P. Hart, and D. Cooke. 2007. "The Role of External and Internal Influences on Information Systems Security - a Neo-Institutional Perspective." *Journal of Strategic Information Systems* 16, no. 2 (Jun): 153-172. http://dx.doi.org/10.1016/j.jsis.2007.05.004.

Johnston, A. C., and R. Hale. 2009. "Improved Security through Information Security Governance." *Communications of the ACM* 52, no. 1 (Jan): 126-129. http://dx.doi.org/10.1145/1435417.1435446.

Lainhart Iv, John W. 2000. "COBIT: A Methodology for Managing and Controlling Information and Information Technology Risks and Vulnerabilities." *Journal of Information Systems* 14, no. 1: 21.

Oppliger, R. 2007. "IT Security: In Search of the Holy Grail." *Communications of the ACM* 50, no. 2 (Feb): 96-98. http://dx.doi.org/10.1145/1216016.1216042.

Suh, B., and I. Han. 2003. "The IS Risk Analysis Based on a Business Model." *Information & Management* 41, no. 2 (Dec): 149-158. http://dx.doi.org/10.1016/s0378-7206(03)00044-2.

Tuttle, Brad, and Scott D. Vandervelde. 2007. "An Empirical Examination of COBIT as an Internal Control Framework for Information Technology." *International Journal of Accounting Information Systems* 8, no. 4 (Dec): 240-263. http://dx.doi.org/10.1016/j.accinf.2007.09.001.

Wright, Sally, and Arnold M. Wright. 2002. "Information System Assurance for Enterprise Resource Planning Systems: Unique Risk Considerations." *Journal of Information Systems* 16, no. 1: 99-113.

Strategic Alignment

Buckby et al.

Avison, D., et al. 2004. "Using and Validating the Strategic Alignment Model." *Journal of Strategic Information Systems* 13, no. 3 (Sep): 223-246. http://dx.doi.org/10.1016/j.jsis.2004.08.002.

Beimborn, Daniel, et al. 2007. *The Influence of Alignment on the Post-Implementation Success of a Core Banking Information System: An Embedded Case Study. 40th Annual Hawaii International Conference on System Sciences, HICSS 2007*. Hawaii: IEEE.

Bergeron, F., L. Raymond, and S. Rivard. 2004. "Ideal Patterns of Strategic Alignment and Business Performance." *Information & Management* 41, no. 8: 1003-1020. http://dx.doi.org/10.1016/j.im.2003.10.004.

Bricknall, Richard, et al. 2007. *Aligning IT Strategy with Business Strategy through the Balanced Scorecard in a Multinational Pharmaceutical Company. 40th Annual Hawaii International Conference on System Sciences, HICSS 2007*. Hawaii: IEEE.

Broadbent, M., and P. Weill. 1997. "Management by Maxim: How Business and IT Managers Can Create IT Infrastructures." *MIT Sloan Management Review* 38, no. 3 (Spring): 77-92.

Bruce, Karin. 1998. "Can You Align IT with Business Strategy?" *Strategy & Leadership* 26, no. 5 (Nov-Dec): 16-21.

Burn, J. M., and C. Szeto. 2000. "A Comparison of the Views of Business and It Management on Success Factors for Strategic Alignment." *Information & Management* 37, no. 4 (Jun): 197-216. http://dx.doi.org/10.1016/s0378-7206(99)00048-8.

Coughlan, J., M. Lycett, and R. D. Macredie. 2005. "Understanding the Business-IT Relationship." *International Journal of Information Management* 25, no. 4 (Aug): 303-319. http://dx.doi.org/10.1016/j.ijinfomgt.2005.04.003.

Croteau, A. M., and F. Bergeron. 2001. "An Information Technology Trilogy: Business Strategy, Technological Deployment and Organizational Performance." *Journal of Strategic Information Systems* 10, no. 2 (Jun): 77-99. http://dx.doi.org/10.1016/s0963-8687(01)00044-0.

Cumps, Bjorn, et al. 2006. *An Empirical Study on Business/ICT Alignment in European Organisations*. Vol. 8. *39th Annual Hawaii International Conference on System Sciences, HICSS 2006*. Hawaii: IEEE.

D'Souza, Derrick, and Debasish Mukherjee. 2004. "Overcoming the Challenges of Aligning IT with Business." *Information Strategy: The Executive's Journal* 20, no. 2 (Winter): 23.

De Haes, Steven, and Wim Van Grembergen. 2005. *IT Governance Structures, Processes and Relational Mechanisms: Achieving IT/Business Alignment in a Major Belgian Financial Group*. *38th Annual Hawaii International Conference on System Sciences, HICSS 2005*. Hawaii: IEEE.

Erickson, T. J., et al. 1990. "Managing Technology as a Business Strategy." *MIT Sloan Management Review* 31, no. 3 (Spring): 73-78.

Gold, Robert S. 2002. "Enabling the Strategy-Focused IT Organization." *Information Systems Control Journal* 4: 21-24.

Henderson, J. C. 1990. "Plugging into Strategic Partnerships - the Critical IS Connection." *MIT Sloan Management Review* 31, no. 3 (Spring): 7-18.

Henderson, J. C., J. F. Rockart, and J. G. Sifonis. 1987. "Integrating Management Support Systems into Strategic Information Systems Planning." *Journal of Management Information Systems* 4, no. 1 (Summer): 5-24.

Henderson, J. C., and J. G. Sifonis. 1988. "The Value of Strategic IS Planning - Understanding Consistency, Validity, and IS Markets." *MIS Quarterly* 12, no. 2 (Jun): 187-200. http://dx.doi.org/10.2307/248843.

Henderson, J. C., and J. B. Thomas. 1992. "Aligning Business and Information Technology Domains - Strategic-Planning in Hospitals." *Hospital & Health Services Administration* 37, no. 1 (Spring): 71-87.

Henderson, J. C., and H. Venkatraman. 1993. "Strategic Alignment: Leveraging Information Technology for Transforming Organizations." *IBM Systems Journal* 32, no. 1: 472-484. http://dx.doi.org/10.1147/sj.382.0472.

Henderson, J. C., and N. Venkatraman. 1991. "Understanding Strategic Alignment." *Business Quarterly* 56, no. 3 (Winter): 72.

---. 1999. "Strategic Alignment: Leveraging Information Technology for Transforming Organizations." *IBM Systems Journal* 38, no. 2-3: 472-484.

Hirschheim, Rudy, and Rajiv Sabherwal. 2001. "Detours in the Path toward Strategic Information Systems Alignment." *California Management Review* 44, no. 1 (Fall): 87-108.

ITGI. 2005. "IT Alignment: Who is in Charge?". Accessed September 16, 2015.

Kearns, G. S., and A. L. Lederer. 2003. "A Resource-Based View of Strategic IT Alignment: How Knowledge Sharing Creates Competitive Advantage." *Decision Sciences* 34, no. 1: 1-29. http://dx.doi.org/10.1111/1540-5915.02289.

Luftman, J. N., P. R. Lewis, and S. H. Oldach. 1993. "Transforming the Enterprise - the Alignment of Business and Information Technology Strategies." *IBM Systems Journal* 32, no. 1: 198-221.

Luftman, Jerry. 2003. "Assessing IT Business Alignment." *Information Systems Management* 20, no. 4 (Fall): 9-15. http://dx.doi.org/10.1201/1078/43647.20.4.20030901/77287.2.

Luftman, Jerry, and Tom Brier. 1999. "Achieving and Sustaining Business-IT Alignment." *California Management Review* 42, no. 1 (Fall): 109-122.

Luftman, Jerry, Raymond Papp, and Tom Brier. 1999. "Enablers and Inhibitors of Business-IT Alignment." *Communications of the AIS* 1, no. 11.

Maes, R. 1999. *A Generic Framework for Information Management*: Universiteit van Amsterdam, Department of Accountancy & Information Management.

Maes, Rik, et al. 2000. *Redefining Business: IT Alignment through a Unified Framework*: Universiteit van Amsterdam, Department of Accountancy & Information Management.

Martin, Nigel, Shirley Gregor, and Dennis Hart. 2005. "The Social Dimension of Business and IS/IT Alignment: Case Studies of Six Public-Sector Organisations." *Australian Accounting Review* 15, no. 3 (Nov): 28-38.

Papp, Raymond. 1999. "Business-IT Alignment: Productivity Paradox Payoff?" *Industrial Management & Data Systems* 99, no. 8: 367-373. http://dx.doi.org/10.1108/02635579910301810.

Peak, D., and C. S. Guynes. 2003. "Improving Information Quality through IT Alignment Planning. A Case Study." *Information Systems Management* 20, no. 4 (Fall): 22-29. http://dx.doi.org/10.1201/1078/43647.20.4.20030901/77289.4.

Reich, Blaize Homer, and Izak Benbasat. 2000. "Factors that Influence the Social Dimension of Alignment between Business and Information Technology Objectives." *MIS Quarterly* 24, no. 1 (Mar): 81-113. http://dx.doi.org/10.2307/3250980.

Silvius, AJ Gilbert. 2007. *Business & IT Alignment in Theory and Practice. 40th Hawaii International Conference on System Sciences, HICSS 2007*. Hawaii: IEEE.

Sledgianowski, Deb, and Jerry Luftman. 2005. "IT-Business Strategic Alignment Maturity: A Case Study." *Journal of Cases on Information Technology (JCIT)* 7, no. 2: 102-120.

Smaczny, Tomasz. 2001. "Is an Alignment between Business and Information Technology the Appropriate Paradigm to Manage IT in Today's Organisations?" *Management Decision* 39, no. 10: 797-802. http://dx.doi.org/10.1108/EUM0000000006521.

Strnadl, C. F. 2006. "Aligning Business and IT: The Process-Driven Architecture Model." *Information Systems Management* 23, no. 4 (Fall): 67-77. http://dx.doi.org/10.1201/1078.10580530/46352.23.4.20060901/95115.9.

van der Zee, J. T. M., and Berend de Jong. 1999. "Alignment Is Not Enough: Integrating Business and Information Technology Management with the Balanced Business Scorecard." *Journal of Management Information Systems* 16, no. 2 (Fall): 137-156.

Van Grembergen, Wim, Steven De Haes, and Hilde Van Brempt. 2007. *Prioritising and Linking Business and IT Goals in the Financial Sector. 40th Annual Hawaii International Conference on System Sciences, HICSS 2007*. Hawaii: IEEE.

van Lier, Joost, and Ton Dohmen. 2007. *Benefits Management and Strategic Alignment in an IT Outsourcing Context. 40th Annual Hawaii International Conference on System Sciences, HICSS 2007*. Hawaii: IEEE.

Wagner, Heinz-Theo, et al. 2006. *IT Business Alignment and It Usage in Operational Processes: A Retail Banking Case*. Vol. 8. *39th Annual Hawaii International Conference on System Sciences, HICSS 2006*. Hawaii: IEEE.

Cragg, P., M. King, and H. Hussin. 2002. "IT Alignment and Firm Performance in Small Manufacturing Firms." *Journal of Strategic Information Systems* 11, no. 2 (Jun): 109-132. http://dx.doi.org/10.1016/s0963-8687(02)00007-0.

Grover, V., and A. H. Segars. 2005. "An Empirical Evaluation of Stages of Strategic Information Systems Planning: Patterns of Process Design and Effectiveness." *Information & Management* 42, no. 5 (Jul): 761-779. http://dx.doi.org/10.1016/j.im.2004.08.002.

Hess, H. M. 2005. "Aligning Technology and Business: Applying Patterns for Legacy Transformation." *IBM Systems Journal* 44, no. 1: 25-45.

Humphreys, J. 2003. "The Dysfunctional Evolution of Goal Setting." *MIT Sloan Management Review* 44, no. 4 (Summer): 96-96.

Kearns, G. S., and A. L. Lederer. 2000. "The Effect of Strategic Alignment on the Use of IS-Based Resources for Competitive Advantage." *Journal of Strategic Information Systems* 9, no. 4 (Dec): 265-293. http://dx.doi.org/10.1016/s0963-8687(00)00049-4.

Kearns, G. S., and R. Sabherwal. 2006. "Strategic Alignment between Business and Information Technology: A Knowledge-Based View of Behaviors, Outcome, and Consequences." *Journal of Management Information Systems* 23, no. 3 (Winter): 129-162. http://dx.doi.org/10.2753/mis0742-1222230306.

Law, C. C. H., and E. W. T. Ngai. 2007. "ERP Systems Adoption: An Exploratory Study of the Organizational Factors and Impacts of ERP Success." *Information & Management* 44, no. 4 (Jun): 418-432. http://dx.doi.org/10.1016/j.im.2007.03.004.

Neirotti, P., and E. Paolucci. 2007. "Assessing the Strategic Value of Information Technology: An Analysis on the Insurance Sector." *Information & Management* 44, no. 6 (Sep): 568-582. http://dx.doi.org/10.1016/j.im.2007.05.005.

Prybutok, V. R., X. N. Zhang, and S. D. Ryan. 2008. "Evaluating Leadership, It Quality, and Net Benefits in an E-Government Environment." *Information & Management* 45, no. 3 (Apr): 143-152. http://dx.doi.org/10.1016/j.im.2007.12.004.

Shpilberg, D., et al. 2007. "Avoiding the Alignment Trap in Information Technology." *MIT Sloan Management Review* 49, no. 1 (Fall): 51-58.

Simonsen, J. 2007. "Involving Top Management in IT Projects - Aligning Business Needs and IT Solutions with the Problem-Mapping Technique." *Communications of the ACM* 50, no. 8 (Aug): 53-58.

Strebel, P. 2004. "The Case for Contingent Governance." *MIT Sloan Management Review* 45, no. 2 (Winter): 59-66.

Sull, D. N. 2007. "Closing the Gap between Strategy and Execution." *MIT Sloan Management Review* 48, no. 4 (Summer): 30-38.

Tallon, P. P. 2007. "A Process-Oriented Perspective on the Alignment of Information Technology and Business Strategy." *Journal of Management Information Systems* 24, no. 3 (Winter): 227-268. http://dx.doi.org/10.2753/mis0742-1222240308.

Thomas, R. J., et al. 2009. "How Boards Can Be Better - a Manifesto." *MIT Sloan Management Review* 50, no. 2 (Winter): 69-74.

Wang, E. T. G., and J. C. F. Tai. 2003. "Factors Affecting Information Systems Planning Effectiveness: Organizational Contexts and Planning Systems Dimensions." *Information & Management* 40, no. 4 (Mar): 287-303. http://dx.doi.org/10.1016/s0378-7206(02)00011-3.

Willcocks, Leslie, and R. Sykes. 2000. "The Role of the CIO and IT Function in ERP." *Communications of the ACM* 43, no. 4 (Apr): 32-38. http://dx.doi.org/10.1145/332051.332065.

Value Delivery

Buckby et al.

Chan, Y. E. 2000. "It Value: The Great Divide between Qualitative and Quantitative and Individual and Organizational Measures." *Journal of Management Information Systems* 16, no. 4 (Spring): 225-261.

Davern, M. J., and R. J. Kauffman. 2000. "Discovering Potential and Realizing Value from Information Technology Investments." *Journal of Management Information Systems* 16, no. 4 (Spring): 121-143.

Dedrick, J., V. Gurbaxani, and K. L. Kraemer. 2003. "Information Technology and Economic Performance: A Critical Review of the Empirical Evidence." *ACM Computing Surveys* 35, no. 1 (Mar): 1-28. http://dx.doi.org/10.1145/641865.641866.

Gregor, S., et al. 2004. "Achieving Value from ICT: Key Management Strategies." *Department of Communications, Information Technology and the Arts, ICT Research Study, Canberra*.

Heier, Hauke, Hans P Borgman, and Mervyn G Maistry. 2007. *Examining the Relationship between IT Governance Software and Business Value of IT: Evidence from Four Case Studies*. *40th Annual Hawaii International Conference on System Sciences, HICSS 2007*. Hawaii: IEEE.

ITGI. 2008a. "Enterprise Value: Governance of IT Investments. The Val IT Framework 2.0." *IT Governance Institute*. Accessed September 18, 2015.

---. 2008b. "Measuring and Demonstrating the Value of IT." *IT Governance Institute*. Accessed September 18, 2015.

---. 2008c. "Optimising Value Creation from IT Investments." *IT Governance Institute*. Accessed September 18, 2015.

Kohli, Rajiv, and Sarv Devaraj. 2004. "Realizing the Business Value of Information Technology Investments: An Organizational Process." *MIS Quarterly Executive* 3, no. 1: 53-68.

Kwon, D., and S. Watts. 2006. "IT Valuation in Turbulent Times." *Journal of Strategic Information Systems* 15, no. 4 (Dec): 327-354. http://dx.doi.org/10.1016/j.jsis.2006.07.003.

Lee, B., and N. M. Menon. 2000. "Information Technology Value through Different Normative Lenses." *Journal of Management Information Systems* 16, no. 4 (Spring): 99-119.

McKay, Judy, Peter Marshall, and Lisa Smith. 2003. *Steps Towards Effective IT Governance: Strategic IS Planning, Evaluation and Benefits Management. 7th Pacific Asia Conference on Informatino Systems, PACIS 2003*. Adelaide, South Australia.

Melville, Nigel, Kenneth Kraemer, and Vijay Gurbaxani. 2004. "Information Technology and Organizational Performance: An Integrative Model of IT Business Value." *MIS Quarterly* 28, no. 2: 283-322.

Rau, Kenneth G. 2004. "The CIO Dashboard Performance Management Program: Measuring and Managing the Value of IT." *Information Strategy: The Executive's Journal* 20, no. 2 (Winter): 6.

Ryan, S. D., and D. A. Harrison. 2000. "Considering Social Subsystem Costs and Benefits in Information Technology Investment Decisions: A View from the Field on Anticipated Payoffs." *Journal of Management Information Systems* 16, no. 4 (Spring): 11-40.

Sircar, Sumit, Joe L. Turnbow, and Bijoy Bordoloi. 2000. "A Framework for Assessing the Relationship between Information Technology Investments and Firm Performance." *Journal of Management Information Systems* 16, no. 4 (Spring): 69-97.

Tallon, P. P. 2007. "Does It Pay to Focus? An Analysis of IT Business Value under Single and Multi-Focused Business Strategies." *Journal of Strategic Information Systems* 16, no. 3 (Sep): 278-300. http://dx.doi.org/10.1016/j.jsis.2007.04.001.

Tallon, P. P., Kenneth L. Kraemer, and Vijay Gurbaxani. 2000. "Executives' Perceptions of the Business Value of Information Technology: A Process-Oriented Approach." *Journal of Management Information Systems* 16, no. 4 (Spring): 145-173.

Thatcher, M. E., and D. E. Pingry. 2007. "Modeling the Value Paradox." *Communications of the ACM* 50, no. 8 (Aug): 41-45. http://dx.doi.org/10.1145/1278201.1278204.

Thorp, John. 2006. "IT Value: Value Management-Responding to the Challenge of Value." *Information Systems Control Journal* 5: 21.

Ward, John, Steven De Hertogh, and Stijn Viaene. 2007. *Managing Benefits from IS/IT Investments: An Empirical Investigation into Current Practice*. *40th Annual Hawaii International Conference on System Sciences, HICSS 2007*. Hawaii: IEEE.

Weill, Peter. 2004. "Don't Just Lead, Govern: How Top-Performing Firms Govern IT." *MIS Quarterly Executive* 3, no. 1: 1-17.

Weill, Peter, and Jeanne W Ross. 2004. *IT Governance: How Top Performers Manage IT Decision Rights for Superior Results*. Boston, Massachusetts: Harvard Business Press.

Demirhan, D., V. S. Jacob, and S. Raghunathan. 2005. "Information Technology Investment Strategies under Declining Technology Cost." *Journal of Management Information Systems* 22, no. 3 (Winter): 321-350.

Gregor, S., et al. 2006. "The Transformational Dimension in the Tealization of Business Value from Information Technology." *Journal of Strategic Information Systems* 15, no. 3 (Sep): 249-270. http://dx.doi.org/10.1016/j.jsis.2006.04.001.

Jeffery, M., and I. Leliveld. 2004. "Best Practices in IT Portfolio Management." *MIT Sloan Management Review* 45, no. 3 (Spring): 41-49.

Kobelsky, Kevin, Starling Hunter, and Vernon J. Richardson. 2008. "Information Technology, Contextual Factors and the Volatility of Firm Performance." *International Journal of Accounting Information Systems* 9, no. 3 (Sep): 154-174. http://dx.doi.org/10.1016/j.accinf.2008.02.002.

Rivard, Suzanne, Louis Raymond, and David Verreault. 2006. "Resource-Based View and Competitive Strategy: An Integrated Model of the Contribution of Information Technology to Firm Performance." *The Journal of Strategic Information Systems* 15, no. 1 (Mar): 29-50. http://dx.doi.org/10.1016/j.jsis.2005.06.003.

Stratopoulos, T., and B. Dehning. 2000. "Does Successful Investment in Information Technology Solve the Productivity Paradox?" *Information & Management* 38, no. 2 (Dec): 103-117. http://dx.doi.org/10.1016/s0378-7206(00)00058-6.

Weill, Peter, M. Subramani, and M. Broadbent. 2002. "Building IT Infrastructure for Strategic Agility." *MIT Sloan Management Review* 44, no. 1 (Fall): 57-65.

Wilson, Melanie, and Debra Howcroft. 2005. "Power, Politics and Persuasion in Is Evaluation: A Focus on 'Relevant Social Groups'." *The Journal of Strategic Information Systems* 14, no. 1 (Mar): 17-43. http://dx.doi.org/10.1016/j.jsis.2004.11.007.

Appendix A - INTERVIEW GUIDELINES

Interview Guidelines

INTERVIEW APPROACH

The interviews use a semi-structured approach that resembles a conversation in which the interviewer discusses themes with the interviewee. In this way, the interviewee can introduce data that she believes is relevant to the themes. Further, the interviewer introduces this data into subsequent interviews.

Interview Protocol

An interview will occur in the interviewee's office or other private location

1. Interviewee is provided the study information form
2. Interviewee is asked if they agree to participate in the study
3. Interviewee is asked for permission to record the interview
4. Interviewer solicits information about the interviewee, e.g. position, tenure in position, tenure in organization, tenure in IT, etc.
5. Interviewer facilitates interview
6. Interviewer requests interviewee to suggest other people to be interviewed
7. Interview is concluded

INTERVIEW THEMES

Organization governance

- Understanding of governance
- Strengths of governance
- Weaknesses of governance

IT governance

- What is governed
- Is IT governance part of the organization governance
- Areas to improve IT governance

Governance processes

- IT governance mechanisms/processes
- Common governance mechanisms/processes
- Processes needing improvement

SAMPLE QUESTIONS

Theme	Sample Question
Governance	▪ I am interested in understanding how governance works within this agency; what do you think governance means? ▪ Unlike a corporation where there is a Board of Directors, how do you see the Agency being governed? ▪ What do you think XXX is concerned with? ▪ Do you think that XXX is concerned with IT? How?
IT Governance	▪ How does the agency choose its IT projects? ▪ How does the agency oversee its IT systems? ▪ Do you think the agency makes good use of technology?
Governance Process	▪ What systems do you work with? ▪ How long have you been working with that system? ▪ What controls are in place for system XXX? ▪ Are these the same controls for the other systems? ▪ Explain how control XXX works? ▪ What would you change?

Appendix B - Research Subject Information Form

This Box for IRB Office Use Only –
Do Not Delete or Revise
Template Rev Date: 3-11-15

RESEARCH SUBJECT INFORMATION FORM

TITLE: From IT Governance to IS Governance: Building a Systems Theory for IS Governance and IT Governance

VCU IRB NO.: HM20006626

If any information contained in this consent form is not clear, please ask the study staff to explain any information that you do not fully understand. You may take home an unsigned copy of this consent form to think about or discuss with family or friends before making your decision.

PURPOSE OF THE STUDY

This study is investigating the appropriateness of considering Information Systems and Information Technology governance as a system that exists within an organization. You are being asked to participate because of your knowledge of your organization's governance and IT governance.

DESCRIPTION OF THE STUDY AND YOUR INVOLVEMENT

In this study, you will meet once with the researcher. This meeting will last approximately one-hour. During the meeting, you will be asked to talk about your ideas regarding governance and IT governance. Examples of what you may be asked to talk about include:

- your understanding of your organization's approach to governance;
- your understanding of IT governance; and
- your knowledge of how your organization uses IT governance.

You may be asked to participate in other meetings to discuss the ideas of the other study participants. Finally, you may be asked to review the study report and suggest corrections to it. During these meetings, you may be asked for permission for the researcher to make an audio recording of the meeting. Should you agree, this recording will be treated as identifiable information (see Confidentiality below for how this information will be handled).

RISKS AND DISCOMFORTS

Sometimes talking about these subjects causes people to be uncomfortable or discuss matters they consider private. You do not have to talk about any subject you do not want to talk about, and you may end a meeting at any time.

BENEFITS TO YOU AND OTHERS

You may not get any direct benefit from this study. The information we learn from people in this study may help us better understand the IT governance and its future.

Page **1** of **3**

COSTS
There are no costs for participating in this study. You are only asked to give your time to speak with the researcher.

ALTERNATIVES
The only alternative is not participating in the study.

CONFIDENTIALITY
Potentially identifiable information about you will be gathered such as your name, age, years' experience, and audio recordings. Other data is being collected only for research purposes, e.g. notes, documents, etc. Data on this information will be identified by an ID letter, not your name or initials. All information will be stored in a secured research area. In addition, your personal identifying information will be encrypted and deleted within thirty-days after the associated dissertation is accepted by the dissertation committee. Access to all data will be limited to the researcher and dissertation chair (the principal investigator).

We will not tell anyone the answers you give us; however, information from the study may be looked at by members of the dissertation committee to verify the research reported in the resulting dissertation. Nevertheless, the dissertation committee members will not be provided access to your personal identifying information.

VOLUNTARY PARTICIPATION AND WITHDRAWAL
You do not have to participate in this study. If you choose to participate, you may stop at any time without any penalty. You may also choose not to answer particular questions that are asked in the study.

Your participation in this study may be stopped at any time by the study without your consent. The reasons might include:

- the principal investigator has stopped the study; or
- administrative reasons require your withdrawal.

QUESTIONS
If you have any questions, complaints, or concerns about your participation in this research, contact:

Principal Investigator:
Dr. Allen S. Lee
aslee@vcu.edu
Phone: 804.827.0366

Researcher:
Bernie Farkas, PhDc, PMP
farkasbw@vcu.edu
Phone: 804.514.2046

The Principal Investigator and researcher named above are the best people to call for questions about your participation in this study.

If you have any general questions about your rights as a participant in this or any other research, you may contact:

Office of Research
Virginia Commonwealth University
800 East Leigh Street, Suite 3000
P.O. Box 980568
Richmond, VA 23298
Telephone: (804) 827-2157

Contact this number to ask general questions, to obtain information or offer input, and to express concerns or complaints about research. You may also call this number if you cannot reach the research team or if you wish to talk with someone else. General information about participation in research studies can also be found at http://www.research.vcu.edu/irb/volunteers.htm.

VITA

Bernard William Farkas was born on October 28, 1954, in Tonawanda, New York and is an American citizen. Bernard graduated from Ossining High School, Ossining, New York in 1972. He received a Bachelor of Science in Management from Dominican College in 1985, and a Master of Science in Management of Technology from Polytechnic University (now the NYU Tandon School of Engineering) in 2002. His professional experience includes being a programmer, designer, and team leader at STC Systems, Inc, and Sony Corporation of America. He worked as an independent consultant, and then worked as a technical project manager at Eaton Navy Controls Division and Micromuse LTD. Moving to Richmond, Virginia, Bernard worked as a consultant with Capital One, Magellan Health Systems, Sun Trust Mortgage, and various Virginia State Agencies (Department of Environmental Quality, Supreme Court of Virginia, Virginia Alcohol and Beverage Control Agency, Virginia Department of Conservation and Recreation, Virginia Department of Transportation, Virginia Information Technologies Agency, and Virginia State Bar). Mr. Farkas earned the rank of Eagle Scout in 1970, and the Project Management Professional certification in 2004.