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Prior research has explored many facets of innovation, provided models of governance maturity, and analyzed the impact of corporate decision-making on innovation. However, there is little research on IT governance maturity in higher education or on IT innovation in organizations outside of the IT industry. Findings from previous research were ambiguous regarding whether a mature IT governance process helps or hinders innovation. This study fills a gap in existing knowledge by reviewing the literature and examining the interaction of IT governance and information technology innovation at five major U.S. universities. It provides insights into the structures and processes necessary for IT governance to facilitate technology innovation and the factors required for effective IT governance in higher education.

Highly effective IT governance processes focused on collaboration and communication were associated with greater integration of radical innovation into institutional processes than effective IT governance processes that focused primarily on the prioritization of large enterprise projects. Incremental technology innovations were pervasive among all schools studied. IT governance was found to be more effective under a delegated model of decision-making authority that empowers IT governance bodies than under a CIO-centric model. The inclusion of a faculty, students and business units in IT governance committees was associated with a stronger innovation culture.

INFORMATION TECHNOLOGY GOVERNANCE MATURITY AND TECHNOLOGY INNOVATION IN HIGHER EDUCATION: FACTORS IN EFFECTIVENESS

by

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To my dear mother, Jill, and
my amazing spouse, Kara

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CHAPTER I

INTRODUCTION

Higher education institutions have long been leaders in information technology (IT), contributing to technology innovations ranging from the development of the first general purpose computer, ENIAC (University of Pennsylvania n.d.), to the development of the Internet and World Wide Web (Spencer and Aardsma 2001). Innovation is pervasive in higher education, a perspective summarized by John Lovelace from The University of Texas at Austin who commented, "Prior to joining the university, I worked in corporate America. The level of innovation at the university compared to the work I've done in the past is kind of astonishing. Innovation comes from everywhere, pushes the envelope." (Lovelace interview 12/10/2014) Innovation continues to be important in higher education. In a survey of its over 1,800 member colleges and universities, the EDUCAUSE organization found that innovation issues were consistently cited as a top-ten issue in higher education IT between 2009 and 2014 (EDUCAUSE 2014c). Higher education institutions are looking for ways to support and increase innovation.

At the same time, IT governance has been a top issue for higher education. In the same surveys between 2004 and 2012, IT governance, organization, and leadership were cited as top concerns. IT governance continues to be an important issue, with sixteen speakers at EDUCAUSE's 2014 annual conference discussing the topic (Educause 2014a). Universities and colleges are developing and improving these decision-making, accountability, and collaboration structures and are learning through experience about what structures work best in their institutions.

The maturation of IT governance processes in higher education is a recent phenomenon, and its impact on information technology innovation, referred to as technology innovation in the remainder of this paper, has not been explored. As institutions seek to implement processes that support innovation, the development of IT governance is an important consideration. Institutions must consider how they will select and fund innovative projects and how they will generate the idea sharing and collaboration necessary to identify and support these projects.

The literature on innovation struggles to define and measure innovation, with some researchers choosing to view innovation from a subjective point of view (Johannessen 2001, Slappendel 1996, Huda and Hussin 2013, Zaltman and Dubois 1971), others attempting objective measurements of the phenomenon (Rose et al. 2009, Merrill and McGeary 2002, van der Panne 2007), and some using elements of both approaches (Rogers 2003). Questions regarding the definition of incremental and radical innovation are pervasive. This study uses a subjective definition of innovation, based on the perception of newness of a technology change, and explores both incremental and radical innovation.

The impact of corporate and IT governance on innovation has been studied to a lesser extent, with authors drawing conflicting conclusions regarding whether and under what circumstances it is helpful to innovation or a hindrance. There is a dearth of literature regarding this question as it relates to IT governance in higher education, and there is little that relates it specifically to technology innovation. This gap led to the current study.

This study is intended to help higher education institutions understand how IT governance impacts technology innovation and to identify the key factors that can lead to an IT governance process that supports innovation. To do so, this study addresses two research questions: *How does IT governance maturity impact technology innovation in higher education? Under what circumstances does IT governance help, or hinder, technology innovation in higher education?*

This study addresses these questions through a literature review covering definitions of innovation, the relationship of governance to innovation, and models of IT governance maturity and effectiveness. A qualitative multiple case study approach is used that includes the development of rubrics for measuring IT governance maturity, IT governance effectiveness, and innovation. Universities participating as case study subjects are investigated to learn the perspectives of chief information officers (CIOs) and key staff responsible for technology innovations. Secondary sources of data are used to corroborate the perspectives they express. The results of this research provide an improved understanding of how IT governance can facilitate technology innovation in higher education and suggestions for improving the effectiveness of IT governance in higher education. This study contributes to the research in IT governance and technology innovation by addressing its impact in higher education and further

illuminates findings in the literature about the circumstances in which IT governance can facilitate innovation.

This paper contains the following chapters. Chapter I: *Introduction* gives an overview of the issues, explains the impetus for this study, and describes the study's process and findings. Chapter II: *Literature Review* investigates the definitions and kinds of innovation, provides a brief review of technology innovation in higher education, reviews research on governance and innovation, and explores models of IT governance maturity and effectiveness. Chapter III: *Methodology and Data Collection* describes the study's design and research questions and explains the methods used for data collection. Chapter IV: *Case Studies* outlines the perspectives of CIOs and key staff responsible for technology innovations and includes assessments of each institution's IT governance maturity, effectiveness, and innovation. Chapter V: *Cross Case Results and Discussion* outlines the findings from a comparative analysis of the individual case studies and includes a discussion of the implications of these findings. Chapter VI: *Conclusion and Future Directions* provides a summary of this study, discusses its limitations, and suggests directions for future research.

CHAPTER II

LITERATURE REVIEW

This literature review examines research surrounding the many facets of innovation and IT governance maturity, particularly as it relates to technology innovation in higher education. The chapter begins with an exploration of the definition and nature of innovation. It is followed by a brief history of technology innovation in higher education. A discussion of the relationship between IT governance and innovation follows. The next section identifies models of governance maturity. The chapter concludes with a review of key characteristics important to effective IT governance, including factors unique to higher education.

Innovation

There is no single definition of innovation. While newness is widely recognized as its essential characteristic, there are questions about its precise definition. Does innovation represent an incremental change in a technology or process within an organization, or must innovation contain an element that is radical, or new to the world (Johannessen et al. 2001; Smith 2005)? Is it important to define innovation using objective criteria or is the perception of newness sufficient (Slappendel 1996)? How quickly must one adopt a new technology in order to be considered innovative (Rogers 2003)? Understanding innovation requires answering these questions.

Not all changes are innovations. Innovation literature broadly conceptualizes two types of innovation: radical or revolutionary change and incremental change (Garcia 2010; Johannessen et al. 2001; Popadiuk and Choo 2006). Competing definitions of innovation differ in the extent of change that is required for an idea, process or product to be considered innovative, rather than merely a change. In his discussion on the impact of innovations on an organization, Damanpour (1996) describes innovation in terms of the extent of change it creates, noting that an innovation changes both the structures and processes of an organization. Radical innovations "produce fundamental changes in the activity of the organization

and represent a large departure from existing practices" (Gopalakrishnan and Bierly 2001). Incremental innovations, by contrast, produce smaller departures from current practices. The extent of required change is often discussed in terms of a unit of adoption. For example, an innovation may be adopted by an individual, organization, industry or region. Huda and Hussin (2013) define technology innovation to be "the introduction of new IT initiatives to the organization." Van de Ven (1986) also supports the idea that an innovation may be new to a group, even if it exists elsewhere. The distinction between newness to the firm and newness to the industry is a useful one. It is conceptually possible to argue that radical change can be defined within the context of an organization. When taken in a broader context, a change that is radical to an organization may be old news to the rest of the world.

Johannessen et al. (2001) draw the line between incremental and radical innovation at the boundary between an organization and its industry. In their view, radical innovation is something new to the industry, whereas incremental innovation is something new to the firm. In a study of 200 CEOs of knowledge-sector Norwegian firms, respondents were asked for their perceptions about whether their firm had made any changes within the past three years by introducing new products, services, methods of production, new sources of supply, new ways of organizing, or by opening new markets. The respondents distinguished between whether the innovations were incremental, new to the firm, or radical, new to the industry. Johannessen et al. (2001) validated a unidimensional construct for measuring innovation, distinguished by the degree to which an innovation is radical, based on perceptions of newness.

Many researchers use a definition of innovation that is based on subjective assessment of newness. Rogers (2003) defines an innovation as "an idea, practice, or object that is perceived as new by an individual or other unit of adoption" (p. 12) and argues that it does not matter whether an idea is objectively new. Johannessen et al. (2001) agree that the perception of newness is the salient factor in defining innovation. Huda and Hussin (2013) also endorse the use of perception as an appropriate way to operationalize innovation and use a definition that asserts that an idea, practice or object is an innovation if it is perceived as new. Slappendel (1996) emphasizes the perception of newness as the defining characteristic of innovation, building on work by Zaltman et al. (1973) who assert that the perception of newness distinguishes innovation from change. Zaltman and Dubois (1971) make the corresponding

observation that some adopters of a change may perceive it as innovative, while other adopters of the same change may not, and assert that the change in question is in fact innovative in the former case and is not an innovation in the latter.

While researchers like Johannessen et al. use a subjective definition of innovation, others emphasize objective characteristics. Rose et al. (2009) define innovation in terms of a measurable national economic impact. Van der Panne (2007) measures innovation based on outputs through the Literature-Based Innovation Output method, which quantifies innovation through searching trade journals for new product announcements. Merrill and McGeary (2002) take a broader view and note that it is possible to make measurements of innovation based on inputs that influence innovative activities, such as research and development investments and human resource activity; outputs of those activities, including new products and processes; and outcomes from those activities, notably the effects on workers, firms, regions, and the economy as a whole (Merrill and McGeary 2002). As reflected by the variety of proposed measurements, defining innovation in objective terms is a challenge.

Rogers' (2003) diffusion theory defines innovation in terms of both perception and objective measurement. In addition to defining innovation as the perception of newness by an individual or other unit of adoption, Rogers describes innovation in objective terms by quantifying the degree to which something new has diffused into the market. He puts forth the idea of a normal distribution of the adoption of innovations in which the term “innovator” is reserved for the first 2.5% of those who adopted a new technology. “Early adopters” comprise the next 13.5% of adopters of an innovation. Rogers argues that there are fundamental differences between innovators and early adopters, describing the former as venturesome with a desire for rash and risky choices and the latter as respected members of a local social system who influence later adopters. The practical application of the definitions is limited by the difficulty with measuring adoption rates, particularly for innovations that are specific to an organization rather than the market at large.

While many attempts have been made to measure innovation objectively, the use of a definition that emphasizes the perception of newness as the defining characteristic makes it possible to consider that innovation may occur within the context of an organization as well as within the context of the

organization's industry or larger environment. Rogers' concept of early adoption is useful because early adopters are implementing new technologies and processes within their organizations. For this reason, the perception of early adoption of an innovation by an organization constitutes a measure of the organization's degree of innovation. The notion of incremental versus radical change further helps explain the degree to which a change is innovative. Using a definition of incremental innovation as new to the organization and radical innovation as new to outside industry as Johannessen et al. suggest is a useful way to describe the degree of change that an innovation brings. Thus, the perception of newness to an organization or industry can be used to estimate an organization's innovativeness.

Technology Innovation in Higher Education

Ideas are essential to innovation. Van de Ven (1986) defines innovation as "the development and implementation of new ideas by people who over time engage in transactions with others within an institutional context." Popadiuk and Choo (2006) agree, distinguishing between knowledge creation and innovation. Knowledge creation is a prerequisite for innovation. Universities and colleges are centers of knowledge development by their very nature, and innovations are the natural result. Stefik and Stefik (2004) argue that universities provide the knowledge base for innovation, but that new technologies are largely created by corporations in their research centers. Yet, higher education has brought forth revolutionary IT innovations that have quite literally changed the world. Schools including Duke University, Cornell University, the University of Minnesota, the University of Essex, Yale University and the City University of New York played significant roles in the creation of the Internet and World Wide Web (Spencer and Aardsma 2001). Higher education continues to play a leadership role in the further development of the Internet: for example, Indiana University runs the Global Research Network Operations Center for Internet2 (Indiana University 2013), an advanced technology consortium founded by universities which supports innovative research and provides very high-speed networking among member institutions world-wide (Internet2 n.d.).

Universities and colleges have a history of radical innovation in information technology and make contributions that are used outside of higher education. Besides the Internet and World Wide Web, there is

the introduction of Kerberos, a secure authentication protocol developed by the Massachusetts Institute of Technology in the 1980s (MIT KIT Internet Trust n.d.). Kerberos was later adopted by Microsoft as the authentication foundation for Windows 2000 (Barr 2000) and continues to be used by Microsoft today in its Windows Server and Active Directory products (Microsoft 2012). The Kermit protocol, developed at Columbia University in 1981 by Bill Catchings and Frank da Cruz, and later developed by Joe Doupnik of the University of Utah (da Cruz 2013), was used to support operations on the International Space Station in 1997 (Hall 2003).

Within the higher education industry, universities and colleges have developed radical innovations in support of teaching and learning. For example, the Virtual Computing Laboratory (VCL), developed by North Carolina State University in 2004, provided a new method of high-speed, dedicated remote access to computing environments and software applications to support off-campus technology use (North Carolina State University 2014). VCL software was contributed to the open source community and is available to the world as a top-level project through the Apache Software Foundation (North Carolina State University 2014).

Incremental innovations are common within higher education. For instance, Wake Forest University implemented a student laptop program in 1995, in which students were given IBM ThinkPad laptops every 2 years (Smith et al. 1999). At the time, only half of the student body owned computers. This program was accompanied by changes in teaching and computing infrastructure to take advantage of the technology, resulting in process innovations. The Sakai learning and collaboration platform was developed by the University of Michigan, Indiana University, the Massachusetts Institute of Technology and Stanford University, University of California at Berkley and Foothill Community College (Sakai n.d.). Sakai can be viewed as an incremental innovation because the technology was not a new idea as there were existing proprietary course management systems that it intended to replace. The introduction of a multi-platform, free, open source learning management system that could be modified by anyone was arguably a process innovation. Notably, Sakai was built on top of University of Michigan's "CHEF" course management system, which itself was innovative relative to the organization.

Innovation is an important issue in higher education IT. The EDUCAUSE Center for Analysis and Research found that the need for funding models supporting innovation is one of the top-ten concerns for higher education IT in 2014 for universities and colleges at all Carnegie levels (EDUCAUSE 2014b). Universities and colleges value the development of new ideas and technologies that support the mission and operations of the institutions. Organizational processes that support innovation are key to their continuing contributions.

IT Governance and Innovation

What is the relationship between IT governance and innovation? Is it a bureaucracy, creating a culture that impedes innovative ideas and projects? Or is it a facilitator that allows an institution to integrate innovation into its strategic processes?

Van de Ven (1986) asserts that it is natural for people and organizations to protect existing processes and practices, rather than embracing new ideas, and argues that more successful organizations have particular problems in getting people to pay attention to novel ideas and opportunities. He finds that getting commitment from interested groups can be challenging and coordinating across multiple groups is difficult. Further, the tendency of groups to maximize consensus while avoiding controversial topics leads to an environment in which innovative ideas may be rejected precisely because of their newness. Stefik and Stefik (2004) describe resistance to innovation at Xerox, where they observed that people were in a "comfortable rut" (p. 186), which made them less open to taking chances on radical changes, such as the development of a personal computer business. Van de Ven (1986) suggests that established organizations are likely to have ingrained systems and structures that encourage making incremental changes to existing technologies and processes, while discouraging innovation. Verloop (2004) agrees that incremental changes encounter less emotional resistance, and Huda and Hussin (2013) concur that organizational norms and practices support the status quo. So, while governance may help achieve commitment and encourage knowledge sharing across the groups of participants, mature structures can create difficulties with bringing innovative ideas and projects forward.

Horne and Foster (2013) describe several problems with the impact of governance on innovation. Capital allocation processes are designed to support business partners' priorities, although these priorities are usually based on existing ideas and projects. When projects have a value that is difficult to measure, it is challenging for companies that use return on investment as a measure of value to support such projects. Also, funding that is distributed "fairly" across business units may not provide enough to invest in promising innovative projects.

By contrast, Van de Ven (1986) believes that it is possible for an organization to create structures that support innovation with good institutional leadership and effort to create a culture of innovation by engaging in strategic recognition rather than planning. Similarly, Deschamps (n.d.) believes that governance is necessary in order for an organization to successfully innovate and discusses models for IT innovation governance. In these models, innovation must be explicitly addressed. Deschamps' view is that there should be a structure for allocating the responsibility for innovation, which may be inside or outside of the organization's other governance structures. The size and composition of the management team responsible for innovation may vary, resulting in nine models, ranging from the CEO or other executive leadership, to steering teams, middle management or a group of innovation champions. The important feature is that the governing body is charged with supporting innovation.

Huda and Hussin (2013) suggest that good IT governance structure is an important factor in IT innovation implementation effectiveness. One key component is top management support for using IT to support the higher education mission of the institution. Hoonsopon and Ruenrom (2012) did not find empirical support for the value of top management support in product innovation or product innovation performance. They did find that formalization of an organization's rules and procedures has a positive impact on incremental innovation but not radical innovation. These conflicting findings raise a question regarding how an organization's executive leadership's engagement impacts innovation.

Governance Maturity Models

Many governance maturity models have roots in the Capability Maturity Model. The original Capability Maturity Model is a process improvement framework developed at the Carnegie-Mellon

Software Engineering Institute that was originally designed to describe the level of maturity of a software development process (Bowen and Schneid 2013). The Capability Maturity Model was developed further into the Capability Maturity Model Integration project (CMMI), which provides a generalized framework and models for process improvement, including methods of assessing the maturity of services (CMMI Product Team 2010). It has become commonplace to use variations of this model to describe the maturity of non-software processes and to extend it for use outside of the process improvement areas defined in the CMMI for Services framework.

The concept of maturity in the CMMI refers to the structure and organization of a set of processes. Processes are categorized into five maturity levels. At the first level, "initial," processes are ad hoc and chaotic. At the second level, "managed," there is some project management at the work group level and stakeholders are included in decision-making. In the third level, "defined," processes to manage work are identified, documented, and understood throughout the organization, and project management best practices are institutionalized. The fourth level is "quantitatively managed," where quantitative objectives are set for performance, and the objectives are based on the needs of stakeholders, implementers, and the organization. Finally, at the fifth level, "optimizing," processes are continuously improved based on business and performance needs, and there is a focus on improving the performance of the overall organization (CMMI Product Team 2010).

The CMMI for Services model is directed toward the measurement of work products, and does not explicitly apply to IT governance. However, elements of the CMMI are repurposed and used in the Control Objectives for Information Technology (COBIT) maturity model for IT governance. COBIT is an industry standard framework and body of knowledge used in the assessment and management of enterprise IT governance (ISACA 2012b).

COBIT version 4.1 adapted CMMI terminology in its six levels of governance maturity, adding Level 0: Non-existent to Levels 1-5: Ad Hoc, Repeatable, Defined Processes, Managed and Measurable, Optimising (ISACA 2012b). It assesses thirty-four processes in four process domains in determining governance maturity (Administrator 2008; ISACA 2012c)**.** The process domains are Plan and Organize, Acquire and Implement, Design and Support, and Monitor and Evaluate. The Monitor and Evaluate domain

includes process *ME4: Provide IT Governance*, which provides a maturity model for IT governance (ISACA n.d.). Governance processes progress from non-existent, when the organization is not aware that the issue needs to be addressed, to optimized, in which the organization's processes are strategically aligned, highly performing, monitored, and measured according to industry best practices. The advantage of the COBIT 4.1 model is that it provides a view of governance processes from a high vantage point, enabling organizations to identify weaknesses and map progress toward the next level. Table 1 summarizes the maturity model from COBIT 4.1 (ISACA n.d.).

Table 1. Summary of COBIT 4.1 Governance Maturity Model

Level	Essential Characteristics
0 - Non-existent	No recognizable governance process exists, and the organization does not recognize a need for one.
1 - Initial/Ad hoc	Ad hoc approaches are applied reactively case-by-case. Communication on issues is sporadic and inconsistent. There is only an approximate indication of IT's value to the business.
2 - Repeatable but intuitive	IT governance processes are under development. Basic IT governance measurement and assessment is adopted in some areas of the organization. Individuals drive the governance process.
3 - Defined	The importance and need for IT governance is communicated throughout the organization. Procedures are standardized and documented. IT governance is integrated into strategic and operational processes.
4 - Managed and measurable	There is a full understanding of IT governance issues at all levels. IT governance is aligned with business and IT strategy. Stakeholders are aware of risk and the value of IT. Performance indicators are recorded and tracked. Accountability for key processes' performance is clear.
5 - Optimised	Best practices are followed and applied to continuous improvement. Risks and returns of IT processes are defined and communicated. Monitoring, self-assessment and communication about governance expectations are pervasive. Enterprise governance and IT governance are strategically linked and the processes are integrated.

The latest revision of COBIT, version 5, has moved from a maturity model to a process capability model, which maps to the COBIT 4.1 maturity model but with a greater emphasis on individual processes. It draws from the ISO/IEC 15504 Software Engineering—Process Assessment international standard on IT governance which provides guidelines for measuring process capability, using a scale based on the

Capability Maturity Model (ISACA 2012b). While COBIT 4.1 is intended to provide a maturity profile of an organization, COBIT 5 is intended to make assessments for capabilities in each of nine process areas (ISACA 2012c). The advantage of this more detailed approach is that an organization can view its capabilities with much more granularity. However, the complexity can be daunting. In assessing higher education IT governance maturity, both approaches have value, but available research on IT governance maturity has been done using COBIT 4.1 as the basis.

COBIT 5 divides 37 processes for IT governance into five groups: Evaluate, Direct and Monitor; Align, Plan and Organise; Build, Acquire and Implement; Deliver, Service and Support; and Monitor, Evaluate and Assess. The capability of each process is assessed on a scale with six levels, ranging from "0 Incomplete process" to "5 Optimising process", summarized in Table 2. Each level is defined in terms of the effectiveness of the process in achieving its purpose. Unlike COBIT 4.1, COBIT 5 requires that the processes associated with a lower level be fully implemented before a process can be rated at the next level. There is no overall enterprise score for governance maturity or capability. Instead the organization's processes are scored individually.

Table 2. Summary of Process Capability Levels in COBIT 5.

Level	Essential Characteristics
0 - Incomplete process	The process is not implemented or fails to achieve its process purpose. At this level, there is little or no evidence of any systematic achievement of the process purpose.
1 - Performed process	The implemented process achieves its process purpose.
2 - Managed process	The previously described performed process is now implemented in a managed fashion (planned, monitored and adjusted) and its work products are appropriately established, controlled, and maintained.
3 - Established process	The previously described managed process is now implemented using a defined process that is capable of achieving its process outcomes.
4 - Predictable process	The previously described established process now operates within defined limits to achieve its process outcomes.
5 - Optimising process	The previously described predictable process is continuously improved to meet relevant current and projected business goals.

Adapted from ISACA (2012b)

The EDUCAUSE Center for Analysis and Research (ECAR) studied IT governance maturity among 438 member higher education institutions (Yanosky and McCredie 2008). The study used a simplification of the COBIT 4.1 maturity model to assess the IT governance maturity perceptions of higher education CIOs, reproduced in Table 3. Of the institutions surveyed, 58.5% of CIOs described their IT governance maturity as Initial or Repeatable. Another 23.7% described their processes as Defined, while 10.5% categorized themselves as Managed and 5.7% claimed to have Optimized governance. Only 1.6% reported non-existent governance.

Table 3. ECAR IT Governance Maturity Levels.

Level	Definition
Nonexistent	IT governance processes are not applied, and the institution has not recognized a need for them.
Initial	IT governance processes are informal and uncoordinated.
Repeatable	IT governance processes follow a regular pattern.
Defined	IT governance processes are documented and communicated.
Managed	IT governance processes are monitored and measured.
Optimized	IT governance best practices are followed, and there are provisions for amending processes.

From Yanosky and McCredie (2008)

The maturity levels defined by derivatives of the Capability Maturity Model including CMMI, COBIT 4, COBIT 5, and ECAR are similar, tracing the development of an organization's processes from completely disorganized to well-organized and continuously improved. A combination of the COBIT 4.1 approach of assessing the organization overall and COBIT 5's assessment of outcomes for individual processes provides a good way to assess an organization’s maturity and capabilities. The ECAR scale allows CIOs to make an assessment of their IT governance process maturity using a scale that incorporates the essential elements of the COBIT 4.1 standard without requiring the CIOs to have an in-depth understanding of the COBIT, and it is a useful starting point for assessing an organization's IT governance maturity.

Factors in IT Governance Effectiveness

Maturity implies effectiveness. A mature IT governance process includes both a structure and the implementation of practices that facilitate effective decision-making. In addition to the characteristics that are assessed in derivatives of the Capability Maturity Model, there are factors that further illustrate the maturity of an IT governance process. Moreover, there are factors that are unique to higher education, notably the roles that faculty and students play in the organization.

The degree to which IT governance is embedded in the organization is one factor in the effectiveness of the process. Weill and Ross (2004) note that IT governance functions best in organizations in which at least 50% of managers can describe the governance process. In the COBIT 5 framework, the *Ensure Governance Framework Setting and Maintenance* process similarly puts forward a goal that "The governance system for IT is embedded in the enterprise," with suggested metrics including well-defined roles, responsibilities, and authority, and the degree to which IT governance principles are demonstrated in processes and practices (ISACA 2012a). In other words, people in the organization need to both understand and apply a well-defined set of IT governance practices.

The active management of the IT governance process contributes to its success. When the organization devotes staff effort specifically to maintaining the IT governance process, IT governance is more effective (van Grembergen and de Haes 2009). Continuous assessment of the IT governance process is part of this maintenance. One of the COBIT 5 framework's key governance practices is the evaluation of IT governance processes. One of the framework's processes, *EDM01: Ensure Governance Framework Setting and Maintenance,* suggests the frequency of independent evaluations of IT governance as a metric (ISACA 2012a). Van Grembergen and de Haes (2009) identify regular self-assessment or independent assessment as important to effective IT governance. The stability of the IT governance process is important as well. Weill and Ross (2004) observed that effective IT governance structures have one or fewer major changes to the IT governance process per year.

The role executive leadership plays in IT governance is a critical factor in its effectiveness. Van Grembergen and de Haes (2009) found that in the most effective structures, the CIO is a member of the executive board, reporting to the chief executive officer or the chief operating office. Also, there is a

committee at the executive level that regularly includes IT on the agenda. Weill and Ross (2004) found that in the most effective IT governance, decisions are made by an IT duopoly that includes IT executives and another group, such as executive management. They assert that executive management should have input on all decisions. Thus, the relationship of the CIO to executive leadership and their engagement in IT decision-making reflects the effectiveness and maturity of an organization's IT governance process. In a related finding, Weill and Ross note that the thoughtful participation of senior management is important as well. The engagement of executive leadership and senior management with IT results in decisions about IT investments and policies that are aligned with the organization's strategy.

In their influential work, "IT Governance: How Top Performers Manage IT Decision Rights for Superior Results," Weill and Ross (2004) define IT governance to be "specifying the decision rights and accountability framework to encourage desirable behavior in the use of IT" (p. 8). Defining who will make which decisions is central to an effective IT governance structure. Weill and Ross consider five governance archetypes and assess when it is best for each one to provide input or make decisions. They found that the federal archetype, which consists of a group of IT executives and business unit leaders, should provide input on all IT decisions. Decision-making itself works best for the IT duopoly archetype, which consists of a group of IT executives and a group of business leaders, such as an executive leadership team or business process owners. The business monarchy archetype, in which the business's executive leadership makes IT decisions for the enterprise, and the IT monarchy archetype, in which IT leadership makes all of the IT decisions, were less effective. The feudal model, in which business units optimize decisions for local needs, was found to be ineffective for enterprise decision-making.

When considering decision-making in higher education, the right structure depends on the institution. Weill and Ross (2004) recommend limiting decision-making structures in order to avoid problems with contradictions or disconnects between IT and business objectives. Effective IT governance requires the institution to design, define, and document decision-making powers throughout the IT governance structure. It is unclear to what extent effective IT governance requires decision-making to be delegated or distributed. However, it is clear that it is necessary for the organization to clearly understand where the authority to make decisions lies.

Among the decisions to be made are project prioritization, and to some extent portfolio management. These decisions require the input of both IT and non-IT stakeholders (van Grembergen and de Haes 2009). The involvement of IT governance with project review is associated with higher levels of IT governance maturity (Yanosky and McCredie 2008). IT governance participants need to be able to represent both their own interests and the interests of the institution as a whole when prioritizing (Weill and Ross 2004). In the resource-constrained environment that much of higher education operates in, project prioritization can be particularly challenging. Effective IT governance enables the organization to make decisions about competing priorities that best align with the institution's strategic goals (Weill and Ross 2004).

In order for IT governance to be most effective for an institution, Weill and Ross (2004) argue that the number of "renegade" projects, those that do not go through the IT governance process, should be minimized. Instead, there should be a formal exception process (Ross and Weill 2004). When projects avoid the IT governance process, it is difficult for decision-makers to have enough information to balance priorities, and projects that are not aligned with the organization's mission may consume resources that might otherwise have been directed toward more strategic work.

Stakeholder inclusion is an essential characteristic of IT governance maturity. Higher education is complex, because the stakeholder groups include not only administrative business units, which are responsible for business functions such as admissions, grant administration, payroll, human resources or facilities, but also include the faculty and students of the university. The inclusion of administrative business units is necessary for effective IT governance (Ross and Weill 2004; van Grembergen and de Haes 2009). Faculty and students occupy unique roles in higher education institutions, and their inclusion is also critical.

While faculty are employees, their connection to the institution differs from the usual employee-employer relationship in some important ways. Higher education's mission requires it to develop and retain the best faculty possible and to support faculty research. A well-respected faculty is critical to its viability and reputation (Adams 2014). With respect to IT, faculty members are both creators of innovative technologies and consumers of IT resources. Faculty are as much products of the institution as employees

of the institution (Christensen 2011), and as such their voices and priorities often carry more weight than those of other staff.

Students occupy a unique place, fulfilling roles both as customers of the institution and as contributors to its mission (Christensen 2011). Like faculty, the development and retention of the best students is important to the institution's mission and reputation, but unlike faculty, student satisfaction directly impacts the institution's bottom line. Student priorities differ from those of traditional business units and faculty. Students consume IT resources not only for education and research, but also for recreation. In fact, some university libraries have invested in computer gaming technologies in order to draw students to the libraries. For example, Hunt Library at North Carolina State University offers a Game Lab that serves both to allow instruction in the development of gaming technologies and as a drop-in recreational facility for students (North Carolina State University n.d.-c). In order to adequately represent stakeholder perspectives and priorities, students should be included.

Faculty and students have unique perspectives on institutional priorities. For this reason, an assessment of IT governance in higher education must include an evaluation of faculty and student involvement in the process. Higher levels of faculty engagement and student participation are characteristics of a more effective and mature IT governance process.

CHAPTER III

METHODOLOGY AND DATA COLLECTION

The research questions that this paper investigates are:

1. How does IT governance maturity impact technology innovation in higher education?
2. Under what circumstances does IT governance help, or hinder, technology innovation in higher education?

These are questions of an exploratory, qualitative nature. Such questions are well suited for a case study design (Yin 2014). A case study approach allows the development of practical, contextual knowledge (Flyvbjerg 2006) and the interpretation of the complex, human interactions in information systems (Walsham 1995) that one finds in an organization's IT governance process. The use of multiple case studies in this paper allows theoretical replication (Yin 2014), such that it is possible to assess the conceptual framework of the impact of IT governance maturity on innovation across multiple subjects. This provides insights not otherwise possible with a single case study design.

Data Collection

Both primary and secondary sources of data were used in this research. Primary sources included a survey sent to CIOs at a set of higher education institutions, unstructured interviews with CIOs who responded, as well as semi-structured interviews with key staff responsible for the innovations that the CIO identified. Secondary data sources from the universities studied included publicly available documentation on IT governance and innovative technology projects from the universities' web sites; if available, annual reports or newsletters from central IT; documentation provided by interviewees; and commercialized product listings from each university's office of technology transfer.

Additional secondary sources included articles in *EDUCAUSE Quarterly* and *EDUCAUSE Review* and presentations at EDUCAUSE conferences. EDUCAUSE is an international organization devoted to the advancement of higher education through the use of information technology (EDUCAUSE n.d.-b) with

over 1,800 member universities and colleges (EDUCAUSE n.d.-a). Searches were performed for articles on information technology innovations in selected peer-reviewed journals relevant to higher education or technology innovation that were published by authors from each institution between 2009 and 2014. Journals included were *American Journal of Distance Education, The Internet and Higher Education, Journal of Online Teaching and Learning, Journal of Computing in Higher Education, Journal of Computing and Information Technology,* and all *IEEE* journals.

Case Selection and Participation

Universities and colleges were recruited for this study via an email request through personal contacts. Dr. Marc Hoit, CIO at North Carolina State University[1], forwarded the request to participate to an email list that includes CIOs from research universities. Additional CIOs at non-research universities were recruited through personal contacts. The CIOs were asked to complete a survey and to potentially allow the researcher to interview their key staff who are responsible for the innovations identified by the CIO.

Of the sixteen CIOs that completed the survey, eleven responded to follow-up contact before February 1, 2015. Five permitted the researcher to complete interviews with key staff and with the CIO: North Carolina State University, The University of Texas at Austin, University of Nebraska-Lincoln, Virginia Polytechnic Institute and State University, and "Zed University," a pseudonym used at the request of the CIO. An additional five CIOs allowed the researcher to interview them. These universities included Colorado State University, Excelsior College, The University of Arizona, The University of North Carolina at Chapel Hill, and University of California at Los Angeles. The CIO at another research university responded to questions via email. Universities at which the CIO agreed to allow interviews with key staff were selected for in-depth case studies.

Profile of Universities Studied

The five universities that were selected for in-depth case studies were all four-year, doctoral institutions and have a Carnegie classification as research universities with very high research activity

[1] The researcher is employed in the central IT unit at North Carolina State University.

(Carnegie Foundation for the Advancement of Teaching 2014). Four are public institutions. These include North Carolina State University, located in Raleigh, North Carolina; The University of Texas at Austin, located in Austin, Texas; University of Nebraska-Lincoln, located in Lincoln, Nebraska; and Virginia Polytechnic Institute and State University, located in Blacksburg, Virginia. Zed University is a private institution located in the northeastern United States.

These universities organize their IT function using a federated model: there is a central IT unit and independent, distributed IT units in the universities' constituent colleges and departments. North Carolina State University has a separate division in the Provost's Office for Distance Education and Learning Technology Application, whose mission is to support the integration of learning technologies into online and on-campus classrooms (North Carolina State University n.d.-a).

Control variables. The size of the universities is measured by several variables, which are used a control variables in this study. Variables considered include the population size of the faculty, non-faculty staff, undergraduate students, and graduate students, along with the proportion of faculty, staff and all students, as reported in Table 4. The IT budgets and staff sizes for each university are considered and are reported in Table 5. These figures are presented for the central IT unit and the university as a whole.

Table 4. Faculty, Staff, Undergraduate and Graduate Student Population[2].

University	Faculty	Staff (non-faculty)	Under-graduate Students	Graduate Students	Faculty to staff to student ratio
North Carolina State University	2,320	6,223[3]	24,536	9,473	1:3:15
The University of Texas at Austin	3,065	21,102[4]	39,079	12,080	1:7:17
University of Nebraska-Lincoln	1,829	4,098[5]	19,376	5,069	1:2:13
Virginia Polytechnic Institute and State University	2,978	3,519[6]	24,034	7,171	1:1:10
Zed University[7]	6,000	6,000	18,000	14,000	1:1:5

Table 5. IT Budget and Staff Size for Central IT and Overall University

University	Central IT Staff Size, headcount	Central IT Budget, in millions	University IT Staff Size, headcount	University IT Budget, in millions
North Carolina State University	200 to 299	$20 to $50	more than 500	more than $100
The University of Texas at Austin	200 to 299	$20 to $50	400 to 499	$50 to $100
University of Nebraska-Lincoln	100 to 199	$20 to $50	300 to 399	$20 to $50
Virginia Polytechnic Institute and State University	300 to 399	$50 to $100	more than 500	more than $100
Zed University	300 to 399	$20 to $50	400 to 499	more than $100

[2] Faculty, undergraduate and graduate student population figures are taken from IPEDS data from Fall, 2013[2].
[3] Headcount as of September 30, 2014 (North Carolina State University 2014)
[4] Headcount from Fall, 2012 (The University of Texas at Austin 2012)
[5] Headcount from 2014 (University of Nebraska-Lincoln 2014)
[6] Headcount for 2013-14 academic year (Virginia Polytechnic Institute and State University 2014)
[7] Figures for Zed University are rounded to the nearest thousand to protect the university's identity.

Survey Development

The CIO survey was developed based on instruments from two sources, with the addition of original questions. Dr. Ronald Yanosky, Senior Research Fellow at the EDUCAUSE Center for Analysis and Research (ECAR), created an original survey design and questions for a study, "Process and Politics: IT Governance in Higher Education" in 2008. This survey instrument, for which ECAR generously granted permission for use in this study, is valuable for its approach in facilitating the assessment of IT governance maturity by CIOs. A question was drawn verbatim from this instrument, and it was used as a guide for the survey format. Johannessen et al.'s (2001) survey questions were modified to focus only on new products, services and processes. The questions were further modified to require a yes or no answer rather than a Likert scale rating when asking whether new products, services or processes had been introduced to the organization. Original questions were added to the survey. The survey was then submitted for review to the CIO at North Carolina State University, the CIO at College of Charleston, and a faculty member at the University of North Carolina at Greensboro. Based on feedback received, the survey was adjusted to ask a question about the phase of adoption of a set of new technologies and to include questions about IT staff size and budget.

The final survey contained questions in six areas: (1) institutional demographics; (2) IT governance maturity; (3) IT governance and innovation; (4) adoption of new technologies, (5) innovations; and (6) permission to follow up. The survey questions and answer choices may be found in Table 6.

Table 6. CIO Survey Questions.

Question	Answer Choices	Source of Question
IT budget for entire institution	In millions of dollars: less than 1, 1-5, 5-10, 10-20, 20-50, 50-100, more than 100, or cannot estimate	Original question
IT budget for central IT		
IT staff size for entire institution	1-49, 50-99, 100-199, 200-299, 300-399, 400-499, 500 or more	Original question
IT staff size for central IT organization		
How long has your IT governance structure been in place in its current form?	• 0-1 years • 2-3 years • 4-5 years or more	Original question
Which of the following best describes IT governance at your institution?	• Non-existent: IT governance processes are not applied, and the institution has not recognized the need for them. • Initial: IT governance processes are informal and uncoordinated. • Repeatable: IT governance processes follow a regular pattern. • Defined: IT governance processes are documented and communicated. • Managed: IT governance processes are monitored and measured. • Optimized: IT governance best practices are followed, and there are provisions for amending processes.	This question was taken verbatim from a survey instrument used in a 2008 survey of EDUCAUSE member institutions (Yanosky and McCredie 2008), with permission from the EDUCAUSE Center for Analysis and Research.
IT governance facilitates and supports technology innovation.	• Strongly Disagree • Disagree • Neither Agree nor Disagree • Agree • Strongly Agree • Don't Know	Original question
Technology innovation is a part of our mission.		
IT governance processes apply only to central IT.		
Significant technology innovations often come from groups outside of central IT.		
Successful technology innovations often bypass our formal governance processes.		
Cloud computing	• Participated in development of the technology • Early Adopter	Original question
Mobile computing		
Social computing		

Data analytics/business intelligence Enterprise identity and access management	• Mainstream Adopter • Late Adopter • Plan to adopt • No plans	
Has your institution made technology changes during the last five years that were perceived to be new for the institution, but which have previously been used by other institutions, within the following areas?	Yes, No or Don't Know for each of the following: • New services • New products • New processes	Adapted from Johannessen et al. (2001)
Has your institution made technology changes during the last five years that were perceived to be new to higher education, within the following areas?	Yes, No or Don't Know for each of the following: • New services • New products • New processes	Adapted from Johannessen et al. (2001)
Has your institution made technology changes during the last five years that were perceived to be new to industries other than higher education?	Yes, No or Don't Know for each of the following: • New services • New products • New processes	Adapted from Johannessen et al. (2001)
If any, list one to five of these changes that have had the most impact (1) at this institution. (2) in higher education. (3) in industries other than higher education.	• Free form answers for each	Original questions
Would you be willing for the researcher to conduct a 30-minute interview with staff responsible for these innovations?	• Yes or No	Original question
Would you be willing to be contacted with follow-up questions?	• Yes or No	Original question

Interviews

The CIOs gave twenty- to thirty-minute unstructured interviews regarding the functioning and design of their IT governance structure, the interaction of IT governance and technology innovation, and role of technology innovation at their institutions. Additional questions were based on their survey responses. Key staff gave thirty-minute, semi-structured interviews regarding the role of IT governance in their innovative product, process or service, and the impact of IT governance on technology innovation at the institution. Interviews were conducted by telephone, with the exception of North Carolina State University, where the interviews were conducted in person in Raleigh, North Carolina. Questions used in the interviews with key staff are in Table 7.

The number of key staff interviewed varied by university, depending on the number of innovations identified by the CIO on the survey. In some cases the CIO identified a single individual as responsible for multiple innovations. All key staff who were identified by the CIO were contacted for interviews.

Table 7. Interview Questions for Key Staff.

Area of Inquiry	Questions
IT governance processes	Could you start by describing the process by which this innovation came to be -- who had the idea? When did it start? How did you get buy-in for moving it forward?
	Was there a formal approval process? If so, please describe it, including the names of any people or committees involved.
	Was the innovation funded? If so, what process was used to acquire funding for it? Please include the names of any people or committees involved.
Impact of IT governance on innovation	Would you say that IT governance helped, or hindered, progress on this innovation? Why?
	Would you say that IT governance helps, or hinders, innovation in general at this institution? Why?
Technology innovations at the institution	Thinking over the last 5 years, are there any other technology innovations at this institution that you could identify? (Technology changes that are new to the institution, new to higher education, or new to outside industry?)

Additional Contacts and Exceptions

At The University of Texas at Austin, an additional source was recommended through an interview with a key staff member. That source was unavailable for an interview but answered some questions through email. In one case at University of Nebraska-Lincoln, the key staff member responsible

for an innovation did not respond to requests for an interview or to questions asked via email. However, through a web search another staff member involved in the project was identified, who did reply to emailed questions regarding the project. At Virginia Polytechnic Institute and State University, the key staff member identified by the CIO for two innovations reported that he was not employed at the institution when they were selected and implemented, and he named another staff member who was then interviewed. In four cases, key staff brought an additional person to their interview. Additional information was obtained via email from a source at Zed University after an interviewed staff member recommended the contact.

Measuring IT Governance Maturity and Effectiveness

IT governance maturity and effectiveness were assessed using two methods: an assessment of maturity based on the Capability Maturity Model and an analysis of key effectiveness characteristics derived from the literature. First, the COBIT 4.1, COBIT 5, and ECAR variations on the Capability Maturity Model were combined to determine a maturity level. In order for the organization's IT governance process to be rated at a given level, it must demonstrate or exceed the characteristics of that level and the preceding levels. This rubric is identified in Table 8. Second, the IT governance process was rated on characteristics of effective governance as identified in the works of Ross and Weill (2004), Weill and Ross (2004), van Grembergen et al. (2004) and Yanosky and McCredie (2008) to provide further insight into its maturity. These characteristics are identified in Table 9. Each institution's IT governance process was assessed for these qualities and received a rating on each characteristic. The ratings are: Not Present if the characteristic was missing, Developing if there was partial support for the characteristic or Mature if there was clear and complete support for the characteristic. The resulting profile was used to describe the effectiveness of the institution's IT governance process.

Table 8. IT Governance Maturity Rubric - Capability Maturity Model Derivative

Level of IT Governance Maturity	Characteristics of Maturity Level	Adapted From
Non-existent	IT governance processes are absent, and a need for them is not recognized.	COBIT 4.1 (ISACA n.d.)
Initial	IT governance processes are formed on a case-by-case or per project basis. Formal groups may dissolve after a project is complete.	COBIT 4.1 (ISACA n.d.)
	Processes are informal and uncoordinated.	ECAR (Yanosky and McCredie 2008)
	Processes achieve their purpose.	COBIT 5 (ISACA 2012b)
Repeatable	IT governance processes are under development.	COBIT 4.1 (ISACA n.d.)
	Basic IT governance measurement and assessment is adopted in some areas of the organization.	
	Processes are planned, monitored, and adjusted in some areas, but not universally.	COBIT 5 (ISACA 2012b)
	Processes follow a regular pattern. The same process may be used to form governance processes in multiple cases.	ECAR (Yanosky and McCredie 2008)
	There is no overall IT governance process that would allow coordination of priorities, decisions or resource allocation across all IT domains.	COBIT 4.1 (ISACA n.d.)
Defined	IT governance is a part of the organization's operational and strategic processes. The organization's IT strategic planning includes IT governance.	COBIT 4.1 (ISACA n.d.)
	Processes are defined and documented.	COBIT 5 (ISACA 2012b), ECAR (Yanosky and McCredie 2008)
	The distinction between decisions that may be made operationally and those that should be brought before IT governance is clearly communicated throughout the organization.	COBIT 4.1 (ISACA n.d.)
Managed	Processes are consistently followed.	COBIT 5 (ISACA 2012b)
	Processes are monitored and measured.	ECAR (Yanosky and McCredie 2008)
	IT governance is well-understood at all levels of the organization.	COBIT 4.1 (ISACA n.d.)
	IT governance participants act in accordance with the organization's strategic and business needs, rather than optimizing only for their constituency.	
Optimized	IT governance and university governance are strategically linked and well-integrated.	COBIT 4.1 (ISACA n.d.)
	IT governance best practices are followed, and there are provisions for amending processes in order to achieve continuous improvement.	COBIT 4.1 (ISACA n.d.), ECAR (Yanosky and McCredie 2008), COBIT 5 (ISACA 2012b)

Table 9. Characteristics of Effective IT Governance.

Factor	Characteristics of Effectiveness	Adapted From
Executive leadership engagement	● CIO is a member of the executive board. ● IT matters are regularly on the agenda of the executive board.	Ross and Weill (2004), van Grembergen and de Haes (2009)
Business unit engagement	● Business units and business process owners have input into IT priorities and decision-making.	Ross and Weill (2004), van Grembergen and de Haes (2009)
Faculty engagement	● Faculty have input into IT priorities and decision-making.	Derived from business unit engagement
Student engagement	● Students have input into IT priorities and decision-making.	Derived from business unit engagement
Utilization of IT governance process	● IT governance process is applied to all projects, and "renegade" projects are minimized. ● Distributed IT units' projects are included in the IT governance process.	Weill and Ross (2004)
Decision-making	● Decision-making roles are clearly defined. ● A broad set of stakeholders have input into the decision-making process. ● Executive leaders have input into all IT decisions. ● People involved in IT governance are at the right level to make decisions and recommendations.	Ross and Weill (2004), van Grembergen and de Haes (2009)
Project prioritization and portfolio management	● IT governance fulfills a role of project prioritization. ● IT governance has input into the IT project portfolio and may manage the portfolio. ● Prioritization aligns with the institution's strategic priorities. ● IT governance participants advocate for the interests of the institution as a whole rather than for only their own agendas.	Ross and Weill (2004), van Grembergen and de Haes (2009) and Yanosky and McCredie (2008)

IT governance adoption by the institution	● Managers understand the IT governance process. ● IT governance principles are reflected in decision-making. ● Roles, responsibilities, and authority are well-defined.	Weill and Ross (2004)
IT governance management	● Staff effort is specifically devoted to managing the IT governance process. ● IT governance process is regularly reviewed and assessed for effectiveness. ● IT governance process is stable with one or fewer major changes per year.	Weill and Ross (2004)

Measuring Innovation

Four dimensions of innovation are assessed in order to develop a picture of an institution's innovativeness: (1) innovative activity, (2) innovation culture, (3) incremental innovation, and (4) radical innovation. Innovative activity refers to the introduction of new IT initiatives and to the development and implementation of new ideas and technology innovations. An innovation culture is a set of organizational practices that create an environment that is conducive to the development and implementation of new ideas. As previously discussed, the distinction between incremental innovation and radical innovation centers around whether a product, service or process is new to the institution, or whether it is new to higher education or outside industry. Note that an innovation can be a new application or combination of existing technologies (Verloop 2004). Thus, these products, services, and processes may consist of the combination of technologies, the new application of an existing technology or may be a new technology entirely. Additionally, a distinction can be drawn between whether innovative projects are focused on what is possible, which constitutes radical innovation, or what is immediately needed to meet business goals, which is incremental innovation (Stefik and Stefik 2004). Characteristics of these four dimensions are drawn from the literature and are identified in Table 10. One original item was added for the assessment of innovation culture that examines the inclusion of innovation in the organization’s mission. These characteristics are rated for each institution as Not Present if the characteristic is missing, Emerging if there is partial support for the characteristic, or Integrated if the characteristic is clearly and fully present. The resulting profile is used to discuss the level of innovativeness at the university.

Table 10. Characteristics of Innovation.

Dimension	Characteristics of Innovation	Adapted From
Innovative Activity	New IT initiatives are introduced to the organization.	Huda and Hussin (2013)
	New ideas are developed and implemented by people who are engaged with others in context of the institution.	van de Ven (1986)
	Sources identify multiple technology innovations that have been developed or implemented at the institution within the past five years.	Johannessen (2001)
Innovation Culture	Mechanisms exist for identifying and developing new ideas. Input from external groups or people is regularly sought out.	Verloop (2004)
	CIO agrees technology innovation is part of the mission. IT mission and strategy emphasize new initiatives and new ideas.	Original
	Innovation is explicitly funded.	Deschamps (n.d.)
Incremental Innovation	New products, services or processes are implemented that are new to the organization.	Johannessen et al. (2001)
	Innovative projects are focused on meeting near-term business needs.	Stefik and Stefik (2004)
Radical Innovation	New products, services or processes are implemented that are new to higher education or to outside industry and represent a large departure from existing practices.	Johannessen et al. (2001), Damanpour (1996)
	Organization makes presentations or publishes articles on technology innovations developed or implemented within the institution at EDUCAUSE or publishes articles on such innovations in peer-reviewed journals.	van der Panne (2007)
	Institution sells information technology products, services or processes that were developed in-house.	Merrill and McGeary (2002)
	Institution is an early adopter or contributor to the development of new technologies.	Rogers (2003)

	Leadership sponsors projects but does not closely manage them. The focus of innovative projects is on exploring what is possible.	Stefik and Stefik (2004)

CHAPTER IV

CASE STUDIES

Case studies of five universities are presented: North Carolina State University, The University of Texas at Austin, University of Nebraska at Lincoln, Virginia Polytechnic Institute and State University, and Zed University. Each case study includes a description and diagram of the university's IT governance structure. Assessments for each institution's level of IT governance maturity and effectiveness and for technology innovation are provided using the rubrics developed for this study. The case concludes with an analysis of the role that IT governance plays in technology innovation at the institution.

North Carolina State University

The CIO and nine key staff were interviewed at North Carolina State University, which refers to itself as NC State. Two additional sources provided email responses to questions.

Interviewed Sources

- Dr. Marc Hoit, Vice Chancellor for Information Technology and Chief Information Officer, 1/16/2015
- Billy Beaudoin, ITECS Systems Manager, Information Technology and Engineering Computing Services, College of Engineering (unified Active Directory), 1/6/2015
- Susan West, Director, Technology Support Services, Office of Information Technology (Bring Your Own Device), 1/6/2015
- Mardecia Bell, Director, Security and Compliance, Office of Information Technology (IT governance), 1/8/2015
- Harry Nicholos, Manager, Identity and Web Services, Office of Information Technology (Shibboleth and single sign-on), 1/9/201

- Greg James, Assistant Director, Communication Technologies, Office of Information Technology and James Nesbitt Communication Technologies, Office of Information Technology (Eduroam), 1/12/2015
- Stan North Martin, Director, Outreach, Consulting and Communications, Office of Information Technology (Google Apps for Education, mobile computing), 1/13/2015
- Gwen Hazlehurst, Director, Enterprise Application Systems, Office of Information Technology (data analytics/business intelligence and enterprise identity and access management), 1/14/2015
- Danny Davis, Assistant Director, Technology Support Services, Office of Information Technology (managed desktop), 1/13/2015

Additional Sources

- Dr. Donna Petherbridge, Associate Vice Provost, Instructional Technology Support and Development Services, Distance Education and Learning Technology Applications, email, 2/5/15
- David Howard, Director, Instructional Innovation Services, Distance Education and Learning Technology Applications, email, 2/6/15

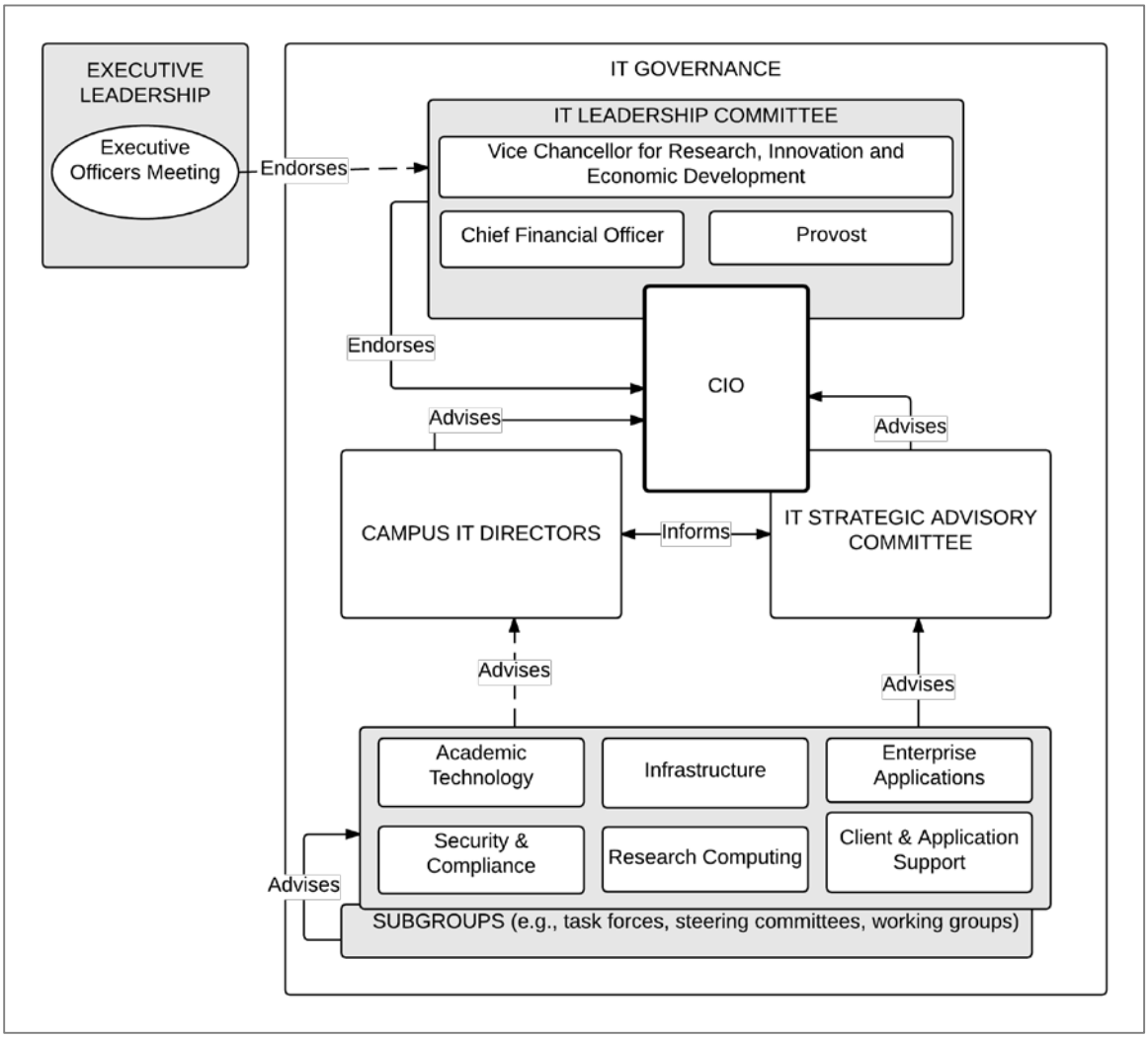
IT Governance Structure

NC State's IT governance structure is multi-level, consisting of standing committees, subcommittees, and subgroups, as seen in Figure 1. The top-level IT Leadership Committee consists of the Provost, Chief Financial Officer, Vice Chancellor for Research, Innovation and Economic Development, and the CIO. Outside of IT governance, the Executive Officer's Meeting group includes all of the university's executive leadership. This group endorses decisions made by the IT Leadership Committee when that committee seeks funding or input.

The CIO receives recommendations from IT governance bodies at the next level down: the Campus IT Directors committee and the Strategic IT Advisory Committee. The Campus IT Directors committee is charged with making technology recommendations to the CIO and advises the IT Strategic Advisory Committee on policy issues. Its members are the leaders of major IT units from the colleges, the Distance Education and Learning Technology Applications division, the Libraries, and central IT. The IT Strategic Advisory Committee is charged with advising the CIO on enterprise IT policy, investments and

matters pertaining to enterprise business applications. Members are drawn from the leadership of major functional areas of the university, such as Human Resources, Dean's Council, Research and Graduate Libraries, Extension and Engagement, Academic Affairs and Business Operations. The committee is chaired by the CIO and includes the chair of the Campus IT Directors committee.

Figure 1. IT Governance Structure at North Carolina State University.



The IT Strategic Advisory Committee has six subcommittees representing various IT functions: the Academic Technology, Client and Application Support, Enterprise Applications, Infrastructure, Research Computing, and Security and Compliance subcommittees. These subcommittees advise both the

IT Strategic Advisory Committee and the Campus IT Directors committee. There are no student members. Faculty are represented on the academic technologies and research computing subcommittees. Membership in the subcommittees' subgroups varies widely. Some are composed almost entirely of technical support staff while others include a wider set of campus stakeholders.

IT Governance Maturity and Effectiveness

On the survey, the CIO selected "Defined: IT governance processes are documented and communicated" to describe NC State's IT governance maturity. This assessment has support. The IT governance structure and charters for the committees and six subcommittees are well documented on the university's IT governance website (North Carolina State University n.d.-e). There is an overall process that allows the university to coordinate priorities institution-wide. The organization's IT strategic planning process includes IT governance, and it is part of the university's operational and strategic processes for information technology. However, the distinction between operational decisions and those which should be brought to governance is not well-defined or communicated. NC State is implementing a university-wide IT strategic plan and one of its six goals is to "Optimize IT Resources through Governance" (North Carolina State University n.d.-f). The current IT governance process is under review to identify possible improvements. Processes are not yet consistently followed and no monitoring or measurement of governance processes are in place, so a rating above a Defined level is not supported.

The process for decision-making through IT governance is not clearly defined. The IT Leadership Committee makes decisions on matters that require substantial additional funding or that have an enterprise-wide strategy implication. In these cases, the committee endorses recommendations that were received through the IT governance process and seeks funding for their implementation. The IT governance committees outside of the IT Leadership Committee are not formally charged with decision-making but rather are chartered to provide input, communication, and recommendations which ultimately reach the CIO for a decision. The CIO stated that IT governance both recommends and decides, but that not all groups are empowered to make decisions because some are not sufficiently open or do not provide sufficient research to back up decisions. This is an issue that he hopes to address as the IT governance process is revisited through the strategic planning process. Several key staff indicated that there is

confusion about when and under what circumstances the lower level bodies should make decisions. The CIO and key staff agreed that it is often unclear whether a decision should be considered operational and made by management or whether it needs to go through IT governance for approval.

NC State's processes do not fully conform to the known characteristics of effective IT governance, as summarized in Table 11. Dr. Hoit reported that IT governance has a project prioritization role and further noted that some groups have a resource allocation role. For instance, the Enterprise Applications subcommittee has a set of criteria that are used to determine which governance body must approve the allocation of resources based on the hours of staff effort required by a project. IT governance does not manage the university's nor central IT's portfolio of IT projects. Executive leadership is engaged in IT decision-making on a case-by-case basis through formal and informal channels. The IT Leadership Committee, which includes the CIO and other executive leaders, meets approximately four times per year as needed but not on a regular schedule (Hoit, personal communication, 2/6/2015). Dr. Hoit indicated that he is in regular contact with all of the members of this group through his participation in the Executive Officer's Meeting and discusses IT issues with them through informal meetings.

Although there is some confusion around decision-making, collaboration is enhanced by the inclusion of a broad set of campus stakeholders on the committees and subcommittees. However, faculty representation in IT governance is limited. There are two faculty representatives on the Academic Technology subcommittee. The Research Computing subcommittee is composed of faculty but does not meet. Dr. Eric Sills reports that the group sometimes discusses issues through email, although it is infrequent. Faculty are not represented on other subcommittees or on the top-level committees. There is no student representation on any IT governance body. Subcommittee representation consists of a mix of those who are at an appropriate organizational level to make campus-wide decisions or recommendations and those who are not. While some managers may not have a full grasp of the IT governance process, key staff find that the communication and collaboration that results from involving a broad cross-section of campus enhances effectiveness. Yet Billy Beaudoin, a staff member in the College of Engineering, noted that many distributed units view IT governance as an "opt-in" and do not bring their projects through it if they would

prefer to go in their own direction, Overall, NC State has a Defined level of IT governance maturity and is developing effective processes in many areas.

Table 11. Key Factors in IT Governance Effectiveness at North Carolina State University.

Factor	Characteristics of Effectiveness	Rating
Executive leadership engagement	● CIO is a member of the Executive Officer's Meeting. ● IT Leadership Committee includes executive leaders but does not meet regularly. ● IT matters are presented ad hoc to the IT Leadership Committee or informally to its members.	Developing
Business unit engagement	● Business units and business process owners are represented on IT governance committees and have input into IT priorities and decision-making.	Mature
Faculty engagement	● Faculty have limited input into IT decision-making and priorities. ● There are some faculty on the Academic Technology committee, and the Research Computing committee does not meet.	Developing
Student engagement	● Students do not have representation or input into IT priorities and decision-making through IT governance.	Not Present
Utilization of IT governance process	● IT governance process is applied only to selected projects, and it is unclear which should go to governance for review. ● IT governance applies to distributed units as well as central IT. ● For distributed units, governance is viewed as "opt-in."	Developing
Decision-making	● Decision-making roles are not clearly defined. ● A broad set of campus stakeholders have input into the decision-making process. ● Executive leaders do not have a process for providing input into all IT decisions. ● In some committees, people involved in IT governance are at the right level to make decisions and recommendations. In others some of the representatives are not at the appropriate level to make campus-wide decisions.	Developing
Project prioritization and portfolio management	● IT governance fulfills a role of project prioritization. ● IT governance does not manage the project portfolio. Portfolio management is not part of IT governance's role. ● The alignment of decisions with the institution's strategic priorities is being improved through IT strategic planning.	Developing

IT governance adoption by the institution	• Managers do not have a complete understanding of the IT governance process. • IT governance principles are defined but not fully integrated into the process. • Roles, responsibilities, and authority are defined, but there is ambiguity in practice.	Developing
IT governance management	• No staff effort is specifically devoted to managing the IT governance process. • IT governance process is being reviewed and assessed for effectiveness. • IT governance process is stable with one or fewer major changes per year.	Developing

Innovation

In the survey, the CIO strongly agreed that "technology innovation is part of our mission." The mission statement for central IT does not include innovation. Dr. Hoit commented, "But our mission is not necessarily to be innovative; our mission is to support the campus and to support its mission and goals. In order to do that, we have goals of being innovative in order to support that mission." Innovation is clearly important: the NC State IT Strategic Plan identifies "Lead IT Innovation" as the first of its strategic goals (North Carolina State University n.d.-d). NC State has a program to provide seed grants to faculty who explore the use of new technologies in the delivery of online and classroom learning (North Carolina State University n.d.-b).

The CIO identified NC State as an early adopter of several of the core technologies in the survey, including cloud, social, and mobile computing and enterprise identity and access management. He noted several technology changes that were new to the institution including the implementations of Google Apps for Education, the managed desktop environment for campus, a unified Active Directory, virtualization of processing and storage resources, and the introduction of IT governance. He further listed the Virtual Computing Laboratory as an innovation that is new to higher education and mentioned cloud use and single sign-on through Shibboleth and InCommon as innovations that are new to outside industry. He also indicated that NC State's early adoption of Bring Your Own Device was new to outside industry when adopted more than five years ago. Some key staff were able to identify additional incremental technology innovations at NC State, such as a wireless network mashup, an imaging system for managing medical records at the College of Veterinary Medicine, Microsoft Systems Center for managing Windows desktops, Mediasite lecture capture, sourcing JAMF/Casper for managing Macintosh computers to the cloud as a shared solution with other UNC system schools, CrashPlan for cloud-based desktop backup, the adoption of the Moodle learning management system, and movement of the wireless network to the 802.11n standard.

Other innovations are more radical. Greg James mentioned the technology in the Hunt Library, which includes large-scale visualization and interactive computing that are arguably new to higher education and outside industry. The central IT unit's IT Accessibility office has developed a "gamification"

system that includes incentives and tools for making web pages accessible to people with disabilities. One faculty member who is on staff in central IT is developing a student success application that may become patented. NC State staff have made presentations on technology innovations at EDUCAUSE conferences. Presentation topics include the Hunt Library learning space design (Boyer et al. 2014; Duckett et al. 2012) and mobile technology tools developed at the university libraries (Woodbury 2014). Articles about the NC State Virtual Computing Library have appeared in *EDUCAUSE Review* (Stein and Schaffer 2010), IEEE conference proceedings (Bouterse and Perros 2012) and the *IBM Journal of Research and Development* (Vouk et al. 2009). An innovative project that involved a combination of technologies used to provide a remote physics lab was described in *IEEE Transactions on Education* (Jernigan et al. 2009).

NC State has integrated innovative activity into its operational processes, particularly incremental innovations which are new to the institution, as summarized in Table 12. Campus service teams and governance subcommittees and subgroups have worked in an institutional context to select and develop many innovations, including Google Apps for Education, Microsoft Systems Center, unified Active Directory, and Moodle. NC State is developing a culture that supports technology innovation, an effort that is expected to move forward through the implementation of its IT strategic plan.

IT Governance and Innovation

Many of the innovative projects identified by the CIO did not go through IT governance for prioritization or approval. There was no IT governance involvement with the development of the managed desktop, Virtual Computing Laboratory or the development of the NC State mobile application. The decision to move forward with the Eduroam wireless network was made within central IT although a subgroup of the Infrastructure subcommittee had an opportunity to provide feedback on its implementation. The creation of a shared Active Directory infrastructure pre-dated IT governance, although there are now IT governance structures in place to manage it. On the other hand, the selection of Google Apps for Education went through a rigorous governance process. The project to replace the existing email and calendaring systems was mandated by the CIO. The project pre-dated the current iteration of IT governance on campus, but a cross-campus task force was formed to evaluate and select a product. This process was

useful in generating campus buy-in for a major transition. The data analytics project went through a prioritization and resource allocation process through IT governance.

Table 12. Characteristics of Innovation at NC State

Dimension	Characteristics of Innovation	Rating
Innovative Activity	● New IT initiatives are introduced to the organization. ● New ideas are developed by people in the context of the institution through campus service teams or governance groups. ● Sources identified multiple technology innovations that have been implemented at NC State within the past five years.	Integrated
Innovation Culture	● IT governance is used for communication and idea sharing among campus units. ● CIO agrees technology innovation is part of the mission. IT strategic plan emphasizes innovation. ● Technology innovation is funded for teaching and learning.	Integrated
Incremental Innovation	● New products, services and processes are implemented that are new to the organization that meet near-term business needs.	Integrated
Radical Innovation	● Articles on the Hunt Library and mobile technologies developed at NC State were presented at EDUCAUSE conferences, and articles on the Virtual Computing Laboratory were published in peer-reviewed journals. ● The Office of Technology Transfer does not list any information technology innovations for sale. ● NC State is an early adopter of many new technologies and contributes to the current development of the Virtual Computing Laboratory. ● A faculty member working in central IT is developing a potentially patentable student success application. ● The focus of innovative projects is typically on exploring near-term business needs. The exception is the Hunt Library, where the focus was on what is possible.	Emerging

IT governance is sometimes seen as a hindrance to innovation because of the time it takes to move a proposal through IT governance and the degree of consensus that is required for acceptance. Stan North Martin observed that IT governance can stifle innovative grassroots projects. He commented,

> There are often projects that spring up without going through governance channels. If they don't align with current priorities sometimes you'll hear someone say, 'Well, let's open up a can of governance on it,' assuming that will squash the potential innovation. There is sometimes a mentality that governance is always a bad thing. We need to get over that; we need to move past that.

Martin added that as IT governance processes continue to mature he does not expect to hear this attitude as frequently. Dr. Sills noted that IT governance is intended to ensure that things keep working well. However, he pointed out that this can be an impediment to innovation because as he says, "...there's some element of aversion to change that gets baked into that. You have to overcome that to be able to do innovative things."

By contrast, other key staff found that IT governance helps innovation. Susan West attributed this to having access to a group of people who can be relied on to provide input. She did not find the IT governance groups' meeting schedules to be an obstacle, as input can be obtained via email between meetings. Gwen Hazlehurst found that governance has been helpful in prioritizing projects, including innovative ones, in the Enterprise Applications subcommittee, which has a well-defined process for decision-making.

Summary

NC State's IT governance process is evolving. There are some areas of governance in which the process is thriving and innovative projects are supported. In other cases, the lack of clarity about the kinds of projects and decisions that need to go through the IT governance process provides an avenue for innovators who are accustomed to being agile and quick to avoid going through the process. In its current state, the level of IT governance maturity and effectiveness of the IT governance process at NC State does not strongly facilitate innovation.

The University of Texas at Austin

The CIO at The University of Texas at Austin (UT) and four key staff were interviewed. An additional source responded to emailed questions.

Interviewed Sources

- Brad Englert, Associate Vice President, University Chief Information Officer (CIO) and Information Technology Services Chief Operating Officer, 12/10/2014
- William Green, Director of Networking and Telecommunications, Information Technology Services (network standards), 12/8/2014
- Mario Guerra, Project Manager, Center for Teaching and Learning (Canvas LMS), 12/9/2014
- Dr. Angela Newell, Faculty, McCombs School of Business and LBJ School of Public Affairs and IT Governance Lead, Office of the CIO (mobile strategy, IT governance), 12/9/2014
- John Lovelace, Program Coordinator, Information Technology Services (Voice over IP, UT Mail/Google Apps for Education), 12/10/2014
- David Moss, Project Manager, Information Technology Services (mobile/web infrastructure upgrade, Canvas LMS, UT Mail/Google Apps for Education), 12/11/2014

Additional Source

- Cam Beasley, Chief Information Security Officer, Information Technology Services (commercialized cyber security applications), email, 12/30/2014

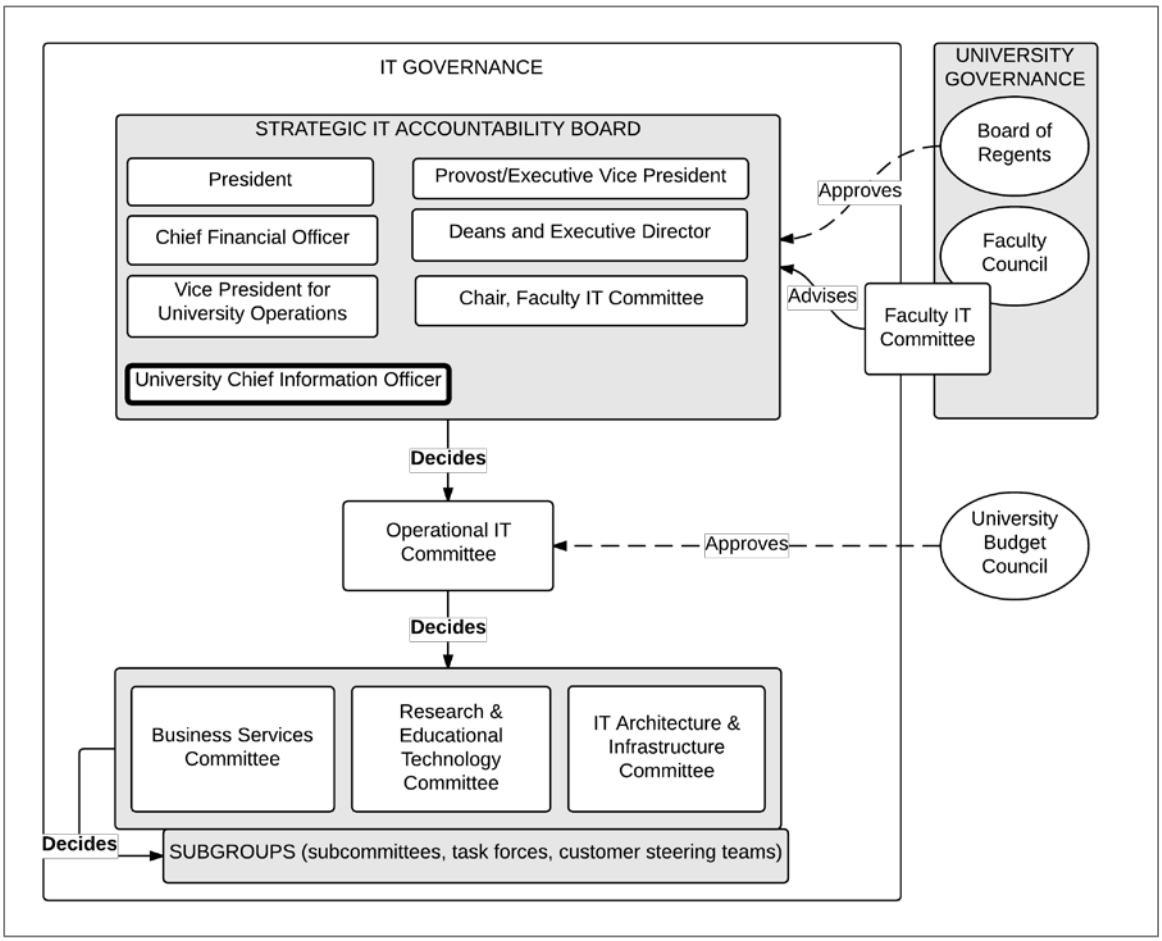
IT Governance Structure

IT governance at UT is a three-level structure, as shown in Figure 2. The Strategic IT Accountability Board at the top includes the university's executive leadership and is responsible for overseeing governance and for strategic decisions. At the next layer, the Operational IT Committee is responsible for budget and funding decisions and consists of those at the assistant/associate dean level. The three committees at the bottom are responsible for decisions in particular domains and include a broad array of stakeholders with 19 to 21 members on each committee.

IT governance is integrated into the university's operational and strategic processes. University governance interacts with IT governance through the Faculty Council's Faculty IT Committee and the

Board of Regents. The Chair of the Faculty IT Committee has a seat on the Strategic IT Accountability Board. This committee advises the board on strategic decisions and policies in which faculty have an interest, such as the selection of Canvas, a new learning management system for online course delivery and management. The Board of Regents provides oversight and approval for projects requiring very large expenditures. Furthermore, the University Budget Council advises the Operational IT Committee on budget priorities and approves funding when expenditures require significant additional funding beyond what was allocated in the IT budget.

Figure 2. IT Governance Structure at The University of Texas at Austin.



The Strategic IT Accountability Board is the final decision-making authority for IT on campus. It is responsible for enterprise IT vision and IT budget structure, sets overall priorities and strategies, and establishes the accountability for decision-making. IT policies are vetted by all parts of the IT governance structure, with final decision-making by the board. The board's membership includes the CIO and the university's executive leadership. The CIO is also an ex officio member of the Operational IT Committee and its three subgroups.

The Operational IT Committee's charge states that it "defines and recommends approaches to key IT issues requiring decisions" (The University of Texas at Austin n.d.-c). Funding decisions require its endorsement. In practice, the Operational IT Committee makes a range of operational and technical IT decisions having broad campus impact, but which do not rise to the level of strategic decision-making. The Strategic IT Accountability Board reviews and endorses the decisions the Operational IT Committee makes. The committee may establish task forces and working groups to support particular projects. For example, it created an executive committee to advise the Voice Over IP project team on business and cost issues.

Three committees report to the Operational IT Committee: the Architecture & Infrastructure Committee, the Research & Educational Technology Committee, and the Business Services Committee. These committees make decisions in their domains, which they may bring forward to the Operational IT Committee for endorsement depending on the scale and impact of the decision. They establish customer steering teams for particular projects and have the ability to create task forces or create subcommittees.

Committee membership is deliberately designed to include a broad cross-section of the campus community. Membership consists of people with sufficient authority to make decisions. The Operational IT Committee is composed of members at the assistant and associate dean levels. Faculty, senior researchers and students are part of Research and Educational Technology Committee. Students have notable engagement in the committee's work; for example, they were involved in the selection of a replacement email system and were responsible for checking vendors' references. The Business Services Committee consists of staff at the assistant or associate vice president level. The Architecture and Infrastructure

Committee includes senior-level IT staff representatives from several schools and colleges, the library, internal audit, and central IT.

IT Governance Maturity and Effectiveness

On the survey, the CIO selected "Managed: IT governance processes are monitored and measured" to describe UT's level of IT governance maturity. This is substantiated by several sources. Information about IT governance can be easily located from the CIO's website, including its purpose, composition, and decision-making structure. All five of the staff responsible for the identified key innovations who were interviewed described IT governance processes in a manner consistent with the documented processes. Governance processes are monitored and measured: the CIO's office produces an annual "IT Governance Accountability Report" in which measures of IT governance effectiveness and accomplishments are published. UT distinguishes between operational issues and those that should be brought to governance (The University of Texas at Austin n.d.-b). IT governance is integrated with the university's operational processes. It is also a central part of IT strategic decision-making. The CIO reported that he does not view IT governance as functioning at an Optimized level of maturity, because there are processes that need to be standardized across committees. There is no evidence of a continuous improvement process for IT governance that would sustain rating at an Optimized level; thus, the assessment that UT is at the Managed level of maturity is appropriate.

UT's IT governance demonstrates mature qualities through practices which are congruent with known characteristics of effectiveness, as summarized in Table 13. The current IT governance structure is well-established and has been in place since 2009. IT governance processes are applied to IT throughout the university, including groups outside of central IT. The people involved in the governance hierarchy have sufficient decision-making authority to fulfill the responsibilities of their committees' charges. The executive leadership of the university is engaged at the highest level of governance, and the majority of committee members are drawn from the stakeholder communities rather than from the IT organization. Faculty engagement is high, and UT successfully involves students in IT governance. Further, resource allocation is handled within the IT governance structure rather than solely by central IT, with appropriate involvement of university governance. The IT governance process itself is not regularly reviewed.

Table 13. Key Factors in IT Governance Effectiveness at The University of Texas at Austin.

Factor	Characteristics of Effectiveness	Rating
Executive leadership engagement	● CIO is a member of the executive board as an associate vice president. ● The President and other executive officers actively participate on the Strategic IT Accountability Board.	Mature
Business unit engagement	● Business units and business process owners are well-represented on IT governance committees.	Mature
Faculty engagement	● Faculty have input into IT priorities and decision-making through membership at all levels of IT governance.	Mature
Student engagement	● Students have input into IT priorities and decision-making through participation in the Research and Educational Technologies Committee. ● Students were involved in the selection and contacted references for the transition to Google Apps, a new email system.	Mature
Utilization of IT governance process	● The IT governance process is applied to all projects other than those of a strictly operational nature. ● IT governance applies to both central and distributed units. Distributed units projects are part of the governance process.	Mature
Decision-making	● Decision-making roles are clearly defined. ● A broad set of campus stakeholders have input into the decision-making process through membership on committees and task forces. ● Executive leaders have input into all strategic IT decisions. ● People involved in IT governance are at the right level to make decisions and recommendations.	Mature

Project prioritization and portfolio management	• IT governance fulfills a role of project prioritization. • IT governance has input into and manages the IT project portfolio. • The inclusion of executive leadership ensures that prioritization aligns with the institution's strategic priorities. • IT governance participants advocate for the interests of the institution as a whole rather than for only their own agendas.	Mature
IT governance adoption by the institution	• The IT governance process is well-documented and well-understood. • IT governance principles are documented explicitly and are reflected in decision-making. • Roles, responsibilities, and authority are documented and well-defined.	Mature
IT governance management	• Dr. Angela Newell is identified as the IT Governance Lead and is responsible for facilitating IT governance processes. • The IT governance process is stable and has not been altered since 2009. • The IT governance process itself is not regularly reviewed and assessed for effectiveness.	Developing

However, the process is highly functional, at least in part because there is a staff member who is assigned responsibility for facilitating IT governance overall. These characteristics demonstrate a high level of IT governance effectiveness.

Innovation

Technology innovation is important to UT. The CIO indicated on the survey that he agreed that "technology innovation is part of our mission". In his interview, he asserted that technology innovation is "one of our priorities." The published values of the central IT organization explicitly include innovation: "Make Data Driven, Innovative, Customer Focused Decisions" (The University of Texas at Austin n.d.-e)

Innovation is pervasive at UT. John Lovelace described the locus of innovation at the university as "everywhere". Interviewed sources were each able to name several innovative projects and processes at UT, with some overlap. Innovative initiatives are regularly introduced through IT governance that are both incremental and radical in nature (The University of Texas at Austin n.d.-d). As a strategy, UT seeks to acquire the most innovative products in the marketplace, preferring to buy rather than build. Among the incremental innovations are a two-factor authentication system, web upgrades to support mobile computing, the use of edX for online course delivery, and the implementation of Voice Over IP. UT developed a comprehensive set of network standards which was new to the institution and had a significant impact on the processes for managing and funding the campus network. One example of a radical innovation at UT is the implementation of a cloud-based enterprise resource planning system, Workday, which the CIO perceived to be new to both higher education and outside industry. Other examples of innovations new to higher education that the CIO identified include implementation of the Canvas learning management system, Google Apps for Education, and Box for cloud-based file storage. Dr. Angela Newell named the university's broadband process, UT's technology strategies for mobile computing, and digital asset management strategy as new to higher education. In addition to the adoption of commercial technologies, UT has generated new technologies, including several cyber security software applications that have been commercialized by the university such as ISORA, a web-based enterprise risk assessment application and Stache, a secure escrow service for storing sensitive credentials.

The university deliberately fosters technology innovation and the innovative applications of technology through the Longhorn Innovation Fund for Technology, which is administered through IT governance via the Research and Educational Technology Committee. The committee allocates $500,000 in seed grants annually to support innovative projects involving information technology. In some cases, the innovative technology itself is developed; in others, technology is applied in an innovative way to address pedagogical or research goals. For example, the design and creation of a 3-D printing vending machine was funded, as well as a project to develop Peer Instruction, a research-based pedagogy in online teaching (The University of Texas at Austin n.d.-a).

UT actively innovates and has a culture that supports innovation. Both incremental and radical innovation are incorporated into it operations, as summarized in Table 14. Overall, technology innovation is highly integrated into institutional processes at UT.

IT Governance and Innovation

The key innovations identified by the CIO all went through the IT governance process with involvement from the lowest level committees. Most of these innovations also went through the Operational IT Committee and the Strategic IT Accountability Board. All interviewed sources cited the stakeholder buy-in that resulted from communication and transparent decision-making, as well as a broad and diverse committee membership, as essential to the success of project implementation. The stakeholder buy-in function is critically important in university cultures that are based on consensus because, as Brad Englert put it, "in higher education, 1 to 99 is a tie." Mario Guerra praised the requirement of accountability from the project team as one of the benefits of IT governance. The authority that governance lends to decision-making is another benefit which helped Guerra inform faculty about the decision to change learning management system platforms from Blackboard to Canvas, and aided William Green with enforcement of the new network standards.

IT governance does have a downside for innovation at UT, in that it slows progress on the implementation of innovative ideas. As David Moss stated, "Basically IT governance can be exhausting… continually reporting up almost becomes the job." However, he further explained that IT governance does not adversely impact innovation itself, saying,

> I wouldn't say it hinders innovation, it hinders progress on a project. I don't think it hinders innovation, it provides an opportunity to be able to identify gaps between requirements and what we were looking to deliver. It takes innovative solutions to be able to resolve those gaps.

IT governance at UT facilitates innovation through the collaborative generation of good ideas, according to Englert, who describes IT governance as a method to get "the best thinking on campus." Green noted that through the resolution of contentious issues, the governance process results in decisions that are good for the university as a whole, as higher-level committees have a broader perspective. Dr. Newell noted that IT governance provided the "possibility to share innovation and talk among ourselves."

Table 14. Characteristics of Innovation at The University of Texas at Austin.

Dimension	Characteristics of Innovation	Rating
Innovative Activity	● New IT initiatives are regularly introduced to the organization through IT governance. ● The involvement of a broad set of stakeholders provides an environment supporting innovation through opportunities to share "the best thinking on campus." ● Sources identified a substantial number of innovations developed and implemented at UT; innovation is said to be "everywhere."	Integrated
Innovation Culture	● Mechanisms exist for identifying and developing new ideas including the Longhorn Innovation Fund for Technology grant program. Input from a broad range of people at all levels in the organization is regularly sought out. ● CIO agrees technology innovation is part of the mission. IT values include innovation explicitly. ● Innovation is explicitly funded through the Longhorn Innovation Fund for Technology grant program.	Integrated
Incremental Innovation	● New products, services, and processes are implemented that are new to the organization. ● Many innovative projects are focused on meeting near-term business needs.	Integrated
Radical Innovation	● Several key innovations were identified as new to higher education, and the Workday ERP is identified as new to industry. ● Several cyber security applications were commercialized through the university's Office of Technology Commercialization. ● Leadership sponsors projects through the Longhorn Innovation Technology Fund, which has a focus on exploring what is possible.	Integrated

Cam Beasley offered a contrary point of view. IT governance was not formed when his group developed the innovative cyber security applications that were later commercialized. However, when questioned about whether IT governance helps or hinders innovation at the university, he said, "[I] would say it would have hampered our agility." He did go on to explain that IT governance is helpful "when you have a good product or policy that needs to be baked into the business."

Summary

IT governance at UT supports innovation because of its mature characteristics. Because its processes are well-defined, documented, and communicated throughout the organization, innovative ideas have a clear path from idea to implementation, including funding, prioritization, and approval. People at the right level in the organization are involved, thus decisions made in IT governance have authority, which was cited as important to the adoption of new technologies and processes. Broad and diverse participation, including that of faculty, students, and staff from across the university, contributes both to stakeholder buy-in and the generation of new ideas. IT governance at UT may slow the process of adoption of an innovation, because of the extensive communication process and meeting schedule of governance committees, but the process of pursuing an innovative idea appears to be supported by IT governance. Innovation is pervasive at UT and is highly integrated into its strategy and operations. The high level of IT governance maturity facilitates technology innovation at UT.

University of Nebraska-Lincoln

The CIO at University of Nebraska-Lincoln (UNL) and four key staff were interviewed. An additional source responded to emailed questions.

Interviewed Sources

- Mark Askren, Chief Information Officer, 12/22/2014
- Amy Metzger, Data Center & Operations Manager, Office of Information Technology Services and Corrie Svehla, Manager, Special Events & Projects, Office of Information Technology Services (Microsoft Office 365), 1/23/2015

- Neil Wineman, Director of Client Services, Office of Information Technology Services and Eric Haffey, Client Services Help Center Manager, Office of Information Technology Services (Box), 12/17/2014

Additional Source

- Dr. Amy Goodburn, Associate Vice Chancellor for Academic Affairs (Starfish), email, 2/6/15

IT Governance Structure

UNL's IT campus governance process is minimal, as documented in Figure 3. The CIO recognizes the need for a formal IT governance process and has begun to develop a formal structure for UNL. He noted that he had started IT governance within the past year by meeting quarterly with executive leadership to discuss high-level issues. The CIO reports to the Chancellor but is not a vice chancellor; his peers are at the director level (University of Nebraska-Lincoln n.d.-b). IT governance applies only to central IT although there are substantial numbers of IT staff and organizations outside of central IT.

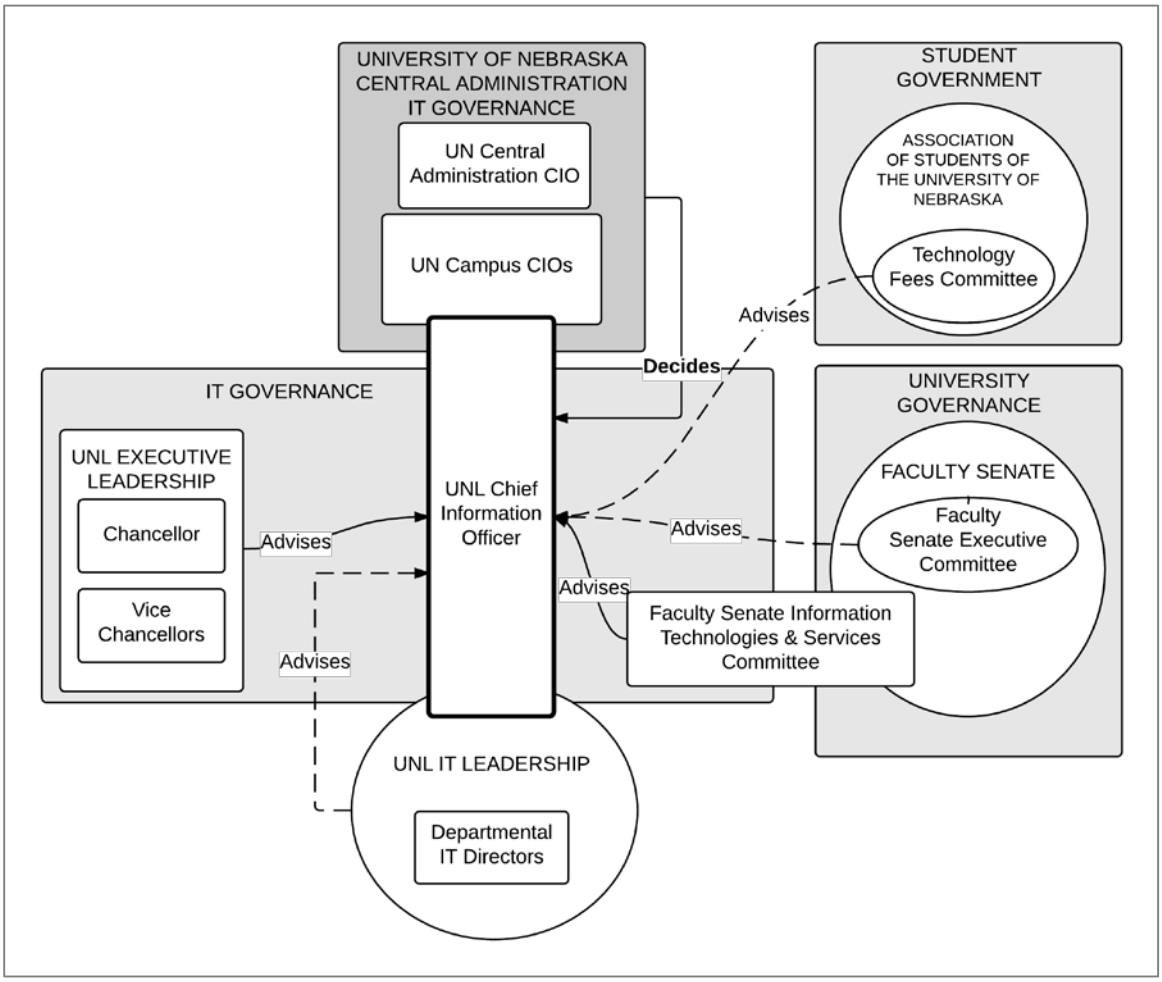
Several stakeholder groups fulfill an advisory role to the CIO, including executive leadership, the Faculty Information Technology and Services Committee, and the student government's Technology Fees Committee. The IT Leadership group, chaired by the CIO, consists of the IT directors in more than twenty-five campus IT units. This group is not formally a part of the IT governance process but is used for communication and feedback. IT governance often takes the form of task forces formed for particular projects that dissolve upon completion of the projects.

The CIO makes IT decisions that have a campus-wide impact and is responsible for implementing decisions which are made by the University of Nebraska's Central Administration. Many large IT projects that UNL participates in are shared services within the University of Nebraska system. These projects are managed by Central Administration and include a shared enterprise resource planning system (ERP) and the implementation of cloud services for email and file sharing. Central Administration manages these shared services using an IT governance process that includes a group of the CIOs from the four campuses of the University of Nebraska system. This system-wide IT governance has decision-making authority for shared services such as ERP and email that are used by all of the University of Nebraska campuses. The system has some formal IT governance processes. For example, the CIO reports that there is an executive

committee for the shared ERP service. However, IT governance processes are not documented on the Central Administration public web site.

Task forces are created when required by particular projects. Amy Metzger and Corrie Svehla described the task forces as "standalone", in that they are not standing committees, but rather are specific to the project and are dissolved at the end of the project. The task forces may include non-IT representation. For example, when the University of Nebraska system decided to evaluate a potential replacement to its on-premises email solution, a task force was formed to make a recommendation. The task force consisted of faculty and business unit leaders from the University of Nebraska campuses.

Figure 3. IT Governance Structure at University of Nebraska-Lincoln.



IT Governance Maturity and Effectiveness

In the survey, the CIO selected "Repeatable: IT governance processes follow a regular pattern" to describe IT governance maturity at UNL. There is no documentation of the IT governance process (Askren, personal communication, 11/24/14), thus a rating beyond Repeatable is not supported. IT governance at UNL has some characteristics that correspond to the Initial maturity classification. For example, when projects require stakeholder participation, task forces are formed that are dissolved when the project is complete. However, the formal inclusion of executive leadership in regular meetings reflects a repeatable pattern for university-level IT decision-making. While not officially part of IT governance, the Faculty Senate's Information Technology and Services committee meets regularly with the CIO, as does the IT Leadership group. Central IT regularly brings IT issues to these groups for feedback. Metzger commented that faculty have "a lot of input" at UNL. While these groups weigh in on IT proposals and policies, there is no overall IT governance process for coordinating IT priorities, decisions or resource allocations across all domains. The CIO explained that prioritization is limited in scope to particular units or technology areas, and there is no mechanism for balancing competing priorities among them, pointing out, "...we have uncoordinated priority-setting mechanisms in silos of technology services."

The CIO recognizes that IT governance is important and is in the process of developing a strategic roadmap. He has begun a process to formalize the IT governance process, starting with the recent establishment of quarterly meetings with executive leadership to discuss high level IT issues. He sees it as a way to increase innovation by strategically aligning project priorities with institutional goals, saying, "If we can find some resources and choose wisely among innovation and transparency, that can help us be a strategic differentiator for campus." Overall, a rating of Repeatable is supported.

UNL's current "governance light" approach, as Mark Askren described it, reflects a less mature governance process. Neil Wineman described the campus culture at UNL as "anti-governance," particularly among faculty. Because of this aversion to formal governance, individual units often have their own decision-making processes. For example, the Academic Affairs unit has an informal process for making decisions about classroom technology. Decision-making for enterprise IT projects, policies, and processes is the province of the CIO, and there are no mechanisms to distribute decision-making. Distributed units are

independent and make decisions about the projects they implement in their areas. Various university business unit stakeholders are consulted for input on projects on a case-by-case basis.

UNL's IT governance processes are not currently well-integrated into the campus culture. There are some repeatable patterns of IT governance, although they are not documented or defined. While engagement with the Faculty Senate's Faculty Information Technology and Services committee reflects an element of maturity, many of UNL's IT governance effectiveness characteristics vary from known success factors, as indicated in Table 15. However, in some key areas UNL's processes are developing, notably with executive and stakeholder engagement, decision-making, and utilization of IT governance processes. IT governance is not yet to the point of prioritizing the university's overall portfolio of IT projects. The CIO is working to further develop the IT governance process, but does not have staff resources devoted to managing the process. Overall, UNL's IT governance process is at a Repeatable level of maturity and is developing effectiveness in many areas.

Innovation

In the survey, the CIO strongly agreed that "technology innovation is part of our mission." No corroborating or contradicting documentation is available at this time. The CIO does not publish an annual report, and the central IT organization does not have a publicly published mission statement. UNL does not have a specific program for funding technology innovations. There is evidence that technology innovation is valued through the leadership that UNL provides the University of Nebraska system in the selection and deployment of shared cloud services. However, the CIO later noted that UNL's focus is more on using proven practices and less on technology innovation. He described UNL's approach to innovation saying, "Most of our work has been to move to best practices rather than being on the leading edge" (Askren, personal communication, 2/2/2015).

Table 15. Key Factors in IT Governance Effectiveness at University of Nebraska-Lincoln.

IT Governance Effectiveness Factor	Characteristics of Institution	Rating
Executive leadership engagement	● CIO reports to the Chancellor, but is not a vice chancellor; peers are at the director level. ● CIO has quarterly meetings with executive leadership to get input on some high-level IT issues.	Developing
Business unit engagement	● Business units are included on task forces on a case-by-case basis.	Developing
Faculty engagement	● Faculty have input into IT priorities through the Faculty Senate's monthly IT committee meetings with the CIO. ● Faculty are included ad hoc in project committees.	Mature
Student engagement	● Students have limited input into IT priorities, only on expenditures of the technology fee.	Developing
Utilization of IT governance process	● IT governance process is not applied to all projects, but ad hoc groups are formed for specific projects. ● IT governance applies only to central IT.	Developing
Decision-making	● Decision-making roles are clearly defined for projects with broad, institutional impact, but distributed units have their own decision-making processes. ● Business units are not included in IT governance. ● Executive leaders have input into high level issues. ● The people involved in IT governance are at the right level to make decisions and recommendations, but stakeholder representation is limited.	Developing
Project prioritization and portfolio management	● IT governance does not fulfill a role of project prioritization. ● The IT governance process does not fulfill a portfolio management role. ● IT governance participants represent departmental agendas.	Not Present
IT governance adoption by the institution	● The campus IT governance process is not well-understood or well-defined. ● IT governance principles are not established.	Not Present

IT governance management	● No staff effort is specifically devoted to managing the IT governance process. ● The IT governance process is not regularly reviewed and assessed for effectiveness. ● The IT governance process is not stable as it is currently under development.	Not Present

While UNL is a mainstream adopter of the survey's core set of new technologies, including cloud, mobile, social, enterprise identity and access management, and business intelligence/data analytics, it is implementing some innovative projects. The CIO identified examples of technology innovations that are new to the institution. These include the implementations of Starfish, an application designed to track and improve student success and academic advising, and cloud services such as Microsoft Office 365 for email and collaboration and Box for storage and file sharing. Metzger and Svehla agreed with Askren that the implementation of cloud services on campus is a significant technology innovation new to the institution. UNL recently deployed a cloud-based desktop backup service, and other services such as identity management are being considered. They noted that the UNL content management system and web hosting service were recently changed, and Svehla discussed his work on a new scheduling system for classrooms and conference rooms. The CIO further observed that many times innovation happens at "the edge," with faculty and staff outside of central IT. Those innovations come to the attention of the CIO when they need to become ready to be used across the enterprise.

The CIO did not identify any technology innovations that were perceived to be new to higher education or outside industry. The university's technology transfer program, NUtech Ventures, does not list any information technology innovations for sale (NUtech Ventures n.d.). However, Wineman and Eric Haffey discussed an innovative project in which UNL negotiated a pilot project that allowed the University of Nebraska system to use shared implementations of Box and Microsoft Office 365 through Net+. UNL was the first institution nationally to negotiate with Internet2 to make Net+ services available for an entire university system. At that time, only Internet2 member institutions were eligible to use Net+ services, and UNL is the only member from the University of Nebraska system. Wineman stated that the University of California system was later able to take advantage of the work UNL did to extend Net+ services system-wide.

Overall, UNL has integrated innovative activity into its practices, as summarized in Table 16. It has a culture that is emerging in its support for innovation. Technology innovation occurs both in central IT and at the edge by faculty. These innovations are largely incremental in nature, which is congruent with UNL's strategy of adopting established technologies rather than seeking to be on the leading edge.

However, UNL does have some emerging characteristics of radical innovation as evidenced by examples such as the implementation of a shared cloud-based email system and the publication of a peer-reviewed article in an IEEE conference proceeding by a Computer Science faculty member on an innovative use of networking technology at UNL (Angu and Ramamurthy 2011). UNL's leadership in negotiating with Internet2 for Net+ services and developing a shared pilot of Microsoft Office 365 for the University of Nebraska system demonstrates that the institution at times engages in innovative activity that is important beyond the campus.

IT Governance and Innovation

UNL emphasizes collaboration with other campuses in the University of Nebraska system, according to the CIO and interviewed staff. Several key innovative projects have been implemented in cooperation with the University of Nebraska's Central Administration. These include the deployment of Internet2's Net+ cloud services such as Microsoft Office 365 and Box, a new student information system, and the system's enterprise resource planning solution. When the entire system is involved, system-level IT governance processes are used.

The email replacement evaluation process, which resulted in the selection and implementation of Microsoft Office 365 to replace Lotus Notes, benefitted from IT governance involvement at the University of Nebraska system level. Faculty and business units were directly engaged in the process. A cross-university task force was created that was chaired by a faculty member at UNL and included faculty and administrators from the four campuses and University of Nebraska Central Administration. It was charged with evaluating replacement email products (University of Nebraska-Lincoln n.d.-a). Svehla explained that including well-respected faculty helped build support for the decision, saying "The goal was to get buy-in and respect for the process, and to help communicate."

Box, a Net+ cloud-based storage and file sharing service, was selected by the University of Nebraska CIOs group for implementation system-wide. On the UNL campus, stakeholders from the Faculty Information Technology and Services Committee and the IT Leadership group were consulted for feedback. These groups did not have a role in the selection of the product. The purpose of the discussion

with them was to share information about central IT's plans for the service and to generate stakeholder buy-in for its use.

Table 16. Characteristics of Innovation at University of Nebraska-Lincoln.

Dimension	Characteristics of Innovation	Rating
Innovative Activity	● New IT initiatives are introduced to the organization through participation in Internet2 and the University of Nebraska system, and some originate internally. ● UNL provides leadership to the system in the development of new IT initiatives. ● Major initiatives are developed cooperatively in the context of the institution or the University of Nebraska system. ● Multiple technology innovations were identified. Mentions were made that some innovations originate outside of central IT.	Integrated
Innovation Culture	● Input and new ideas are sought out through the UNL IT Leadership meeting and the Faculty Senate IT committee. ● The CIO agrees that technology innovation is part of the mission. ● There is no formal IT strategy. ● Innovation is not explicitly funded.	Emerging
Incremental Innovation	● New products, services or processes are implemented that are new to the organization. Examples include multiple cloud-based solutions as well as Starfish. ● Innovative projects are focused on meeting near-term business needs, such as the email replacement. ● The CIO reports a focus on adopting best practices rather than being on the leading edge.	Integrated
Radical Innovation	● The CIO did not identify any new products, services or processes that are new to higher education or to outside industry. ● The implementation of a shared cloud-based email service represented a large departure from existing practices. ● UNL has no articles on technology innovations published through EDUCAUSE, nor any relevant EDUCAUSE presentations or forum posts. ● One innovative use of networking technology is published in an *IEEE* conference proceeding by a UNL Computer Science faculty member. ● No information technology innovations have been commercialized through the NUtech Ventures technology transfer program. ● UNL is not an early adopter or contributor to the development of the survey's core set of new technologies.	Emerging

Going through the task force process slowed progress, but Metzger felt that the task force's work was essential to the success of the project, commenting, "It slowed it down, but without the process and the task force, we could still be on Lotus Notes."

While Metzger suggested that IT governance slowed down the process for Microsoft Office 365, Wineman believes that the lack of formal IT governance on the UNL campus is responsible for slowing down the process of implementing innovative ideas. He commented, "...without a formal process there are a lot more grey areas, it increases the timeline to get the services from idea to actual implementation..." He went on to explain that it is difficult to get major projects completed in a timely way because often stakeholders have been overlooked or approvals have not been obtained because there is not a clear process.

The Starfish project was a UNL campus-level initiative that was not adversely impacted by the lack of formal IT governance. Starfish was deployed by UNL in 2012 as part of a campus initiative to improve academic advising and student success (Fedderson 2012). It was the first university-wide central advising system implemented by the UNL campus, replacing eight separate advising systems in different colleges (Starfish Retention Solutions 2014). It was later adopted by another school in the system, the University of Nebraska at Omaha (Askren, personal communication, 2/2/2014). According to Goodburn, the project originated with the Academic Affairs unit, which coordinated an evaluation process to select a product. An advising leader had seen a demonstration of a homegrown solution created by a peer institution, and started discussions within Academic Affairs about student success and advising systems. An ad hoc group of academic advisors, the central IT group, and the University Registrar's office were involved. There was an emphasis on gathering stakeholder input early in the process. Funding was provided by the Chancellor's office for the first three years, after which Academic Affairs began paying for it. The informal nature of the process did not impede the success of the initiative.

Summary

UNL is in the early stages of formalizing its IT governance process. Because its process is not yet well-defined, radically innovative ideas do not have a clear path from idea to implementation. This leads to a focus on incremental innovations that meet near-term business needs. However, when IT governance

processes are utilized that include faculty and business unit stakeholders, positive results are obtained. The process may slow the progress on an innovation, due to the time it takes to achieve consensus, but the resulting stakeholder buy-in has proved valuable. Overall, the low maturity of the IT governance process at UNL may constrain innovation.

Virginia Polytechnic Institute and State University

Interviews were collected from the CIO and five key staff at Virginia Polytechnic Institute and State University, which refers to itself as Virginia Tech. An additional source responded to emailed questions.

Interviewed Sources

- Dr. Scott Midkiff, Vice President for Information Technology and Chief Information Officer, 12/15/2014
- Mary Dunker, Director, Secure Enterprise Technology Initiatives, Information Technology, 12/8/2014
- William Dougherty, Executive Director, Network Infrastructure and Services, Information Technology, 12/9/2014
- Mark DeBonis, Director, Collaborative Computing Solutions, Information Technology, 12/18/2014
- Marc Zalvidar, Director, Electronic Portfolio Initiatives, Information Technology and Brian Broniak, Senior Director, Networked Knowledge Collaboration, Information Technology, 1/14/2014

Additional Source

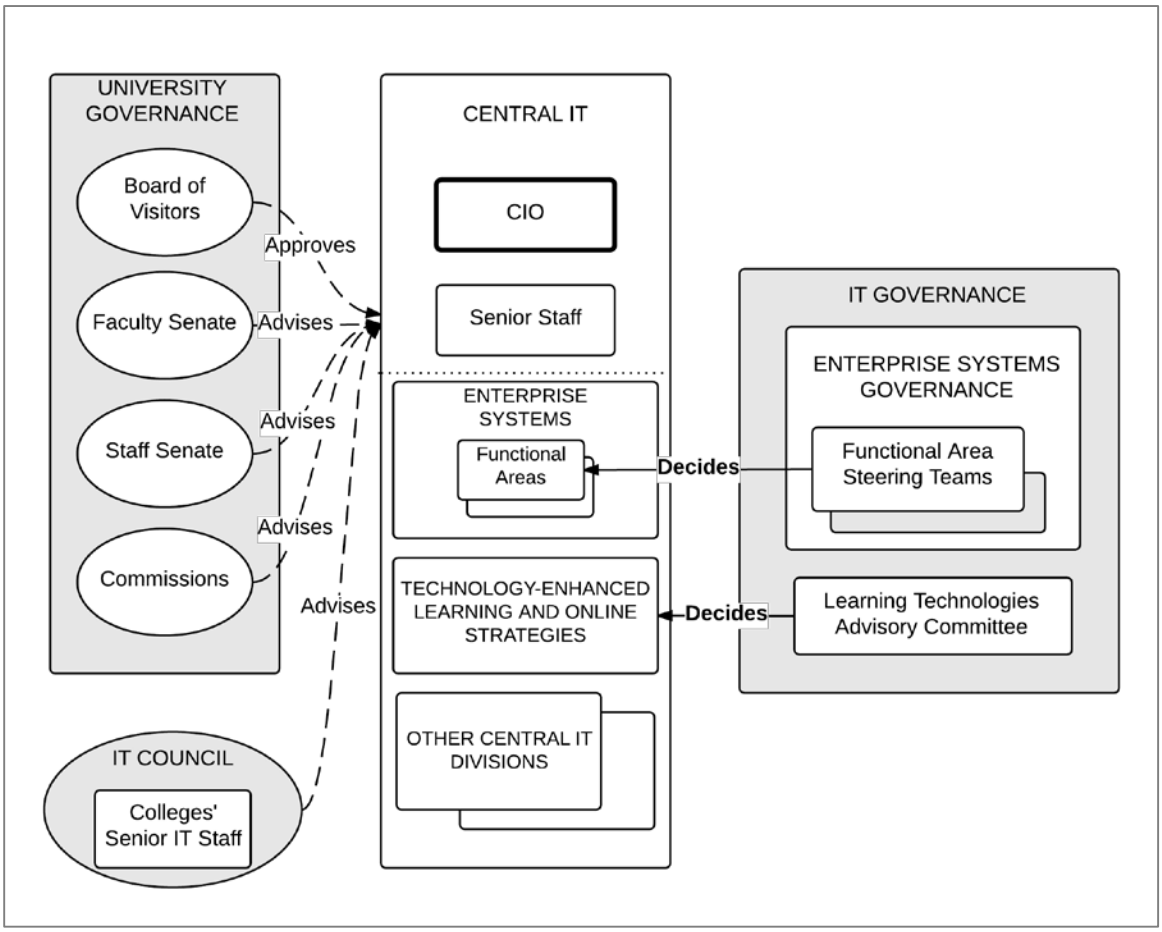
- Dale Pike, Executive Director, Technology-enhanced Learning and Online Strategies, email 12/11/2014

IT Governance Structure

There is no overarching IT governance process at Virginia Tech. Central IT makes IT decisions for campus-level services while distributed units make IT decisions for their constituents. William

Dougherty reported that the senior IT staff in the colleges have independently formed an IT Council and have approached central IT about being included in decision-making. This group is currently being consulted for communication and feedback but does not have a formal role in central IT's decision-making processes. There are a few steering and advisory committees that make decisions which apply to particular functional areas within central IT's operational units. Central IT receives advisory input from university governance bodies and the IT Council. The IT governance structure is described in Figure 4.

Figure 4. IT Governance Structure at Virginia Polytechnic Institute and State University.



Within central IT, two divisions have their own IT governance processes: Enterprise Systems and Technology-enhanced Learning and Online Strategies (TLOS). The Enterprise Systems division is responsible for the enterprise resource planning system, which includes human resources, finance, student information systems, and advancement functional areas. Each of these functional areas has a steering committee made up of members of the Enterprise Systems team and business unit representatives who are stakeholders for that particular function. The steering teams prioritize projects related to their areas. There is no overarching mechanism for balancing priorities among these areas. The TLOS division is advised by the Learning Technologies Advisory Committee which includes vice presidents, deans, directors and faculty from academic and business units, as well as central IT directors from Learning Technologies. Students are not included. This committee is responsible for advising TLOS on issues related to academic technologies (Virginia Polytechnic Institute and State University n.d.-g). Neither the Enterprise Systems steering teams nor the TLOS Learning Technologies Advisory Committee report to any other governance bodies. They serve to advise specific units within central IT and have some level of decision-making responsibility (Midkiff, personal communication, 1/3/2015).

Committees are formed ad hoc for particular projects if needed. When Virginia Tech began its adoption of electronic portfolios, which allow people to collect and share a portfolio of their work online, a committee of faculty was formed to determine how the product would be implemented. Notably this committee was not charged with deciding whether to adopt an electronic portfolio product; that decision was made jointly between the CIO and Provost's offices. Project selection and approvals go through the Information Technology unit's internal chain of command, with funding acquired on a case-by-case basis (Virginia Polytechnic Institute and State University n.d.-j). Project sponsors are responsible for providing project funding. Large funding requests go to the university's budget office for review.

There is some engagement with university governance, although it does not have an active, formal role in guiding IT on campus. The Board of Visitors plays an occasional role when there is a substantial expenditure or the need to take on debt, as with Virginia Tech's Unified Communications project which required $17.5 million. Neither the Faculty Senate nor the Staff Senate have a formal IT committee or working group (Virginia Polytechnic Institute and State University n.d.-e; Virginia Polytechnic Institute

and State University n.d.-i). However, the central IT unit does bring important IT issues forward to the two full senates for discussion from time to time. The university lists a standing committee for IT issues on the University Council's list of commissions, councils, and committees (Virginia Polytechnic Institute and State University n.d.-b). However, this Computing and Communications Resources committee is marked with a "Suspended" status, and all membership and officer positions are listed as "vacant" (Virginia Polytechnic Institute and State University n.d.-c).

IT Governance Maturity and Effectiveness

The CIO's initial assessment in his survey response was that IT governance maturity at Virginia Tech should be categorized as "Defined: IT governance processes are documented and communicated". His assessment may be considered accurate when applied to the particular areas in which IT governance processes are in place. Because there is a lack of an overarching, coordinated, and formal IT governance structure for the university as a whole, a different level of maturity applies when considering the overall institution.

Dr. Scott Midkiff, CIO, acknowledged that the lack of an overarching IT governance structure adversely impacts project prioritization. He noted that there is not a good way to have discussion and prioritization when projects span more than one functional domain. He said it is difficult to prioritize the requests of those he describes as the "have-nots," who have needs but not resources. However, Dr. Midkiff expressed reservations about how realistic it would be to use an IT governance process to prioritize projects across different domains, such as academic technology and enterprise systems, saying:

> I think that they are such different constituents, using different resources within the IT organization, that it's a little hard for me to believe that there is a governance process that would let you make those trade-offs, versus a more strategic realignment that would be driven by the senior leadership of the university.

He stated that dealing with such trade-offs should be handled through the management structure and through discussions with university leadership, including the president and the provost. This is consistent with the current practice at Virginia Tech in which decisions about projects and expenditures are made through the management chain rather than through an IT governance process. While there is not an

acknowledgement of a need for an overarching IT governance process for the university, Dr. Midkiff is engaged in conversations regarding the creation of a group that would balance priorities among the different functional areas in Enterprise Systems.

The current state of IT governance has some characteristics consistent with a Non-existent rating, notably the CIO's thoughts that an overarching IT governance process would not be of benefit when prioritizing projects and managing resource needs. However, there is evidence that would support an Initial rating. IT governance groups are formed on a case-by-case basis when needed for particular projects, although they occupy an advisory rather than a decision-making role. These groups dissolve when the project is completed and they have achieved their purpose. There are smaller instances of a repeatable pattern, as with the steering teams for the Enterprise Systems functional areas, and a case with a Defined level of maturity, the Learning Technologies Advisory Committee whose process is documented and integrated with the organization's operations. Overall, however, the university's processes are uncoordinated, and an Initial rating would apply to the institution as a whole.

Virginia Tech's IT governance processes do not conform to known characteristics of IT governance effectiveness, as summarized in Table 17. There is faculty engagement that is directed toward learning technologies. Executive leadership does not have an engagement channel through IT governance, nor do students. Decision-making for campus-level services is largely the province of central IT, with the exception of IT governance processes in the Enterprise Systems functional units and the Learning Technologies Advisory Committee. Distributed IT units are not subject to IT governance processes. There is no staff effort devoted to IT governance. Overall, the informal nature of the process at Virginia Tech results in low levels of IT governance effectiveness.

Table 17. Key Factors in IT Governance Effectiveness at Virginia Tech

Factor	Characteristics of Effectiveness	Rating
Executive leadership engagement	● CIO is a Vice President and is a member of the executive team. ● Executive leadership does not have a meeting or committee devoted to IT.	Developing
Business unit engagement	● Business units have input into IT priorities and decision-making in the enterprise systems functional areas. ● There is no IT governance process that would allow business units to have input on other IT priorities.	Developing
Faculty engagement	● Faculty have input into IT priorities and decision-making for learning technologies and are included on an ad hoc basis in project-specific task forces or committees.	Developing
Student engagement	● Students do not have input into IT priorities and decision-making.	Not Present
Utilization of IT governance process	● There is no formal overall IT governance process. ● Distributed IT units' projects are not included in the IT governance process.	Not Present
Decision-making	● Decision-making roles are clearly defined; decision-making is in the province of central lT. Some decisions are made by the IT governance bodies for specific areas. ● There is no mechanism for broad stakeholder input into overall IT priorities or in areas outside of Learning Technologies or Enterprise Systems functional areas. ● Executive leaders are not involved in all IT decisions. ● People involved in IT governance are at the right level to make decisions and recommendations; however, the scope of IT governance is limited.	Developing
Project prioritization and portfolio management	● There is no mechanism for balancing project priorities across multiple domains. ● IT governance does not have input into the IT project portfolio, and does not manage the portfolio.	Not Present

IT governance adoption by the institution	● Some managers understand the IT governance process that applies to their functional areas, but there is no overarching IT governance process. ● Roles, responsibilities, and authority are defined in some functional areas, but there is not an overall IT governance process. Central IT has the authority to make decisions for campus services.	Developing
IT governance management	● There is no staff effort specifically devoted to managing the IT governance process. ● IT governance processes are not regularly reviewed and assessed for effectiveness.	Not Present

Innovation

Virginia Tech values technology innovation. The CIO strongly agreed in his survey response that "Technology innovation is part of our mission," although the central IT organization does not refer to innovation in its mission statement. The mission statements for two units within central IT refer to innovation and support for emerging technologies, the Converged Technologies for Security, Safety and Resilience (Virginia Polytechnic Institute and State University n.d.-d) and Network Infrastructure Services (Virginia Polytechnic Institute and State University n.d.-h).

The central IT unit's activity reports reveal that Virginia Tech engages in new IT initiatives (Virginia Polytechnic Institute and State University n.d.-f). New products, services are routinely added to the portfolio. The CIO and key staff cited the adoption of several technologies that were new to the institution, such as Google Apps for Education cloud-based email and Office 365 collaboration tools, electronic portfolios, Echo 360 for lecture capture, WebEx for web conferencing and online course delivery, DyKnow for interactive learning, and unified communications/Voice over IP. Several sources noted that mobile computing is having an impact on campus. Outside of central IT, faculty have published peer-reviewed articles regarding IT innovations such as hybrid cloud (Li et al. 2014), secure encryption on cloud systems (Sun et al. 2014), and verifiable databases (Chen et al. 2014). A faculty member created an information technology application for network security that is available for commercialization through Virginia Tech Intellectual Properties (Virginia Tech Intellectual Properties n.d.).

Virginia Tech is an early adopter of enterprise identity and access management according to Dr. Midkiff and Mary Dunker. Virginia Tech sought and received InCommon Silver certification for its identity services. InCommon is operated by Internet2 and provides a federated identity trust system and an assurance program for U.S. education and research (InCommon n.d.-a). The Virginia Tech InCommon Silver assurance certification project is featured on the InCommon web site as the example of a successful implementation story (InCommon n.d.-b). Dunker co-authored a paper on electronic identities in *EDUCAUSE Review* (West et al.) and presented at the EDUCAUSE Security Professionals Conference 2011 on the InCommon Silver certification project.

Dr. Midkiff indicated that some functional areas' priorities are so focused on operations and compliance that there is not room to focus on longer-term, fundamentally different ways of doing things. An exception is in the area of teaching and learning, where Dr. Midkiff said that Virginia Tech has "gone in with a clear mandate to foster innovation." Virginia Tech was mentioned as a "world leader" in electronic portfolios by the president of The Association for Authentic, Experiential and Evidence-Based Learning (Batson). Virginia Tech's central IT unit offers several grant programs to support innovation in teaching and learning (Virginia Polytechnic Institute and State University). The grants are administered through the Technology-enhanced Learning and Online Strategies unit within central IT and not through an IT governance body. The grants often involve the application of technology to support innovation in pedagogy. For instance, a faculty member received an NLI Innovation in Learning grant for using Google Glass, a new wearable technology, in the classroom (Virginia Polytechnic Institute and State University).

As summarized in Table 18, Virginia Tech's culture is emerging in its support of technology innovation, and innovative activity occurs despite a lack of a defined method for gathering new ideas in an institutional context. Virginia Tech has integrated innovation into its institutional processes, particularly in the learning technologies area. In some areas such as identity management and electronic portfolios, it is radically innovative and provides leadership in the higher education community.

IT Governance and Innovation

The lack of formal IT governance has some impact on innovation. The innovations identified by the CIO and key staff did not go through a formal IT governance process, nor did the innovative works created by faculty. Dunker perceived that the lack of a formal IT governance process may have adversely impacted the enterprise identity management implementation process. There were communication deficits, in that there were groups who were not aware of the project or how it would impact them when it went into production. She felt that a true IT governance process would have led to more stakeholder awareness. Dougherty's positive experience in utilizing university governance for communication about the unified communications project supports the idea that the kinds of stakeholder input available through governance bodies can facilitate progress on an innovative project.

Table 18. Characteristics of Innovation at Virginia Polytechnic Institute and State University.

Dimension	Characteristics of Innovation	Rating
Innovative Activity	• New IT initiatives are introduced to the organization. • New ideas are developed and implemented by people within the context of their units, but there is not a mechanism for developing ideas in the context of the institution. • Some sources identified multiple technology innovations at the institution.	Emerging
Innovation Culture	• Mechanisms exist for identifying and developing new ideas in learning technologies and in some functional areas. Input from external groups or people is not regularly sought out for IT as a whole. • CIO agrees technology innovation is part of the mission. IT mission and strategy emphasize new initiatives and new ideas. • Innovation is explicitly funded for learning technologies.	Emerging
Incremental Innovation	• New products, services or processes are frequently implemented that are new to Virginia Tech. • Many innovative projects are focused on meeting near-term business needs, such as web conferencing, collaboration tools and lecture capture.	Integrated
Radical Innovation	• Staff made a presentation at an EDUCAUSE conference on the InCommon Silver project. • Virginia Tech has publications on technology innovations in E*DUCAUSE Review* and IEEE journals. • There is one information technology innovation that is available for commercialization. • Through the learning technologies innovation grant programs, leadership sponsors some projects whose focus is on exploring what is possible.	Integrated

Summary

While Virginia Tech's low level of IT governance maturity may adversely impact the implementation of technology innovations, it is able to maintain a high level of innovative activity. Virginia Tech does not have processes in place that allow it to manage competing priorities in an overall institutional context, so the integration of innovation into its strategic processes is limited. Low IT governance maturity and effectiveness do not prevent Virginia Tech from innovating, but the selection of innovations to pursue is done without broad stakeholder buy-in and implementation encounters hurdles resulting from the lack of formal mechanisms for communication throughout the organization. There is no clear avenue for innovative projects to be aligned with the university's strategic goals. Overall, Virginia Tech's low IT governance maturity presents an obstacle for the pursuit of innovative projects.

Zed University

At Zed University, the CIO and three key staff were interviewed. An additional source responded to emailed questions.

Interviewed Sources

- Name withheld, CIO, 1/12/2015
- Name withheld, Director of Educational Technologies, central IT, 12/16/2014
- Name withheld, Associate Vice President, Communication and Collaboration Technologies, central IT, 12/16/2014
- Name and title withheld upon request, Senior Administrator, 12/17/2014

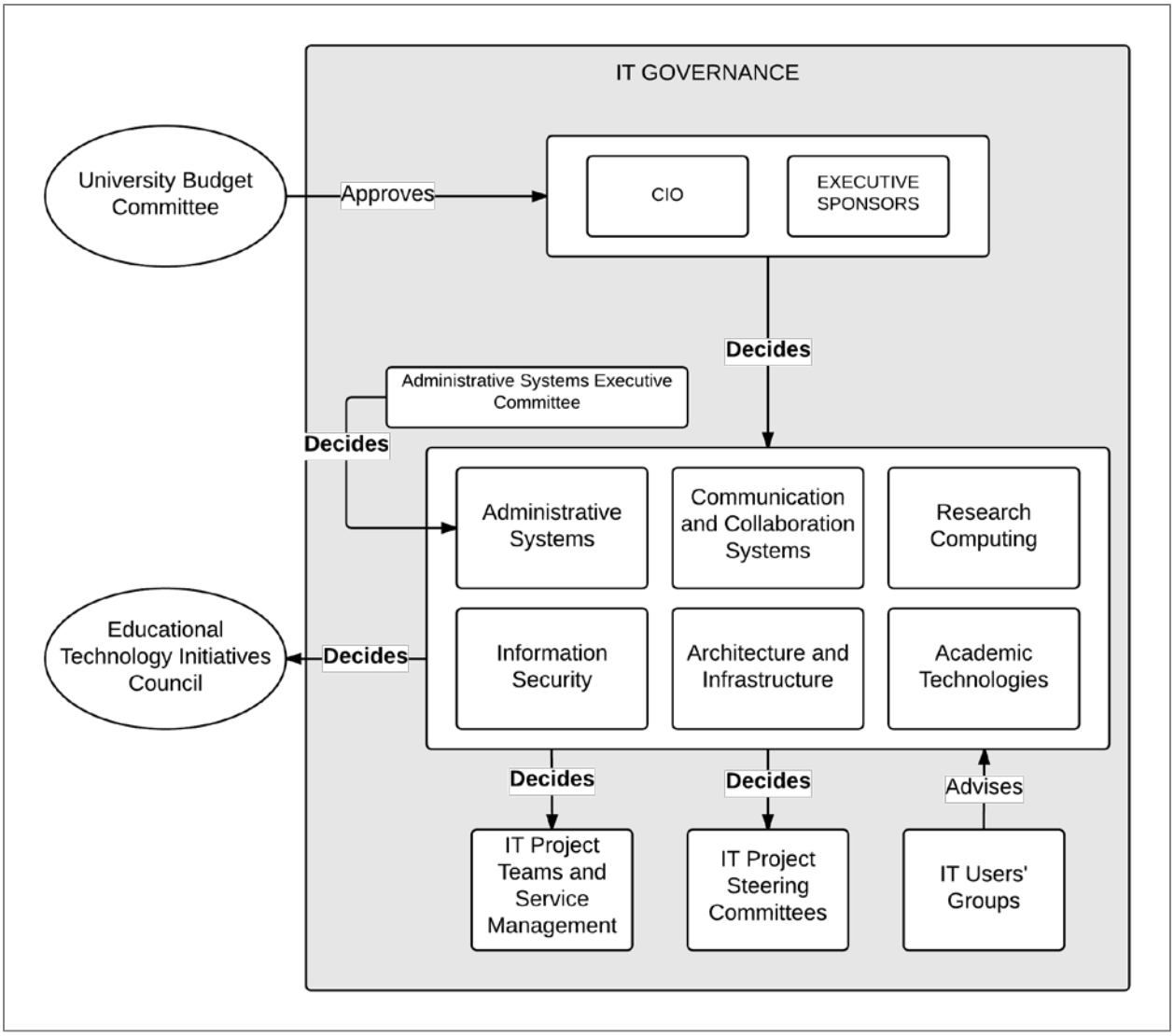
Additional Source

- Name withheld, Associate Vice President, Project Management Office, central IT, email, 2/24/2015

Governance Structure

The IT governance structure consists of six committees that report to the CIO and to the executive sponsors for client areas, as shown in Figure 5. There is not a standing committee consisting of executive leadership for the overall IT function. The CIO reports that this was tried unsuccessfully in an earlier iteration of IT governance. Instead, the executive sponsor for a particular area becomes involved depending on the project's area. For example, when a travel and reimbursement system was proposed, the chief financial officer was included in the decision-making. The Administrative Services committee reports to a standing executive committee made up of the Provost, chief financial officer, CIO and the Vice President for Research. The executive committee reviews, prioritizes and scores projects whose expenditures exceed the thresholds that would trigger the CIO to seek funding from the University Budget Committee. In 2015, these thresholds are $200,000 in one-time costs, $100,000 in annual continuing costs, or the addition of an incremental full-time equivalent staff.

Figure 5. IT Governance Structure at Zed University



The six committees are responsible for different IT functions, such as Administrative Systems, Communication and Collaboration Systems, Research Computing, Information Security, Architecture and Infrastructure, and Academic Technologies. Names of the committees have been altered to protect the identity of the university. Membership on the committees consists of faculty, students, and staff outside of central IT. There is one central IT staff member assigned to each committee for support. The CIO

commented on the constitution of the committees, stating, "To create a committee of IT staff is redundant. The purpose of governance is alignment; therefore it should be populated by clients."

Committee size ranges from fourteen for Architecture and Infrastructure to twenty-five for Administrative Systems. Members are deliberately drawn from a broad spectrum of campus units and departments. The Administrative Systems committee consists of executive leadership from university business units. The Architecture and Infrastructure Committee includes business unit representatives at the associate director and associate professor levels and through associate vice president and provost levels. The Research Computing committee is structured to be composed almost completely of faculty, and the Academic Technologies committee is sixty percent faculty. The Communication and Collaboration, Information Security, Research Computing, and Academic Technologies committees each have a membership charter that deliberately includes students. IT governance committees are charged to review and prioritize projects whose costs exceed the thresholds that require the CIO to request funding from the University Budget Committee. A scorecard method is used for ranking projects and deciding which ones to take forward to the University Budget Committee for funding prioritization relative to other university projects. The IT governance committees are also responsible for IT policy decisions which flow into the university's policy process.

The central IT Project Management Office provides reports to the IT governance bodies with information about all of the projects in their service areas. The administrative systems domain has the largest number of new project requests, and they are all reviewed monthly with the Administrative Systems committee, even if they do not otherwise reach the threshold for governance involvement. IT project and service management teams bring proposals forward to IT governance for approval if they exceed those thresholds. Projects with resource requirements below those thresholds are managed by central IT's Project Management Office through established project prioritization and funding processes.

IT Governance Maturity and Effectiveness

The CIO rated the university's IT governance maturity level as "Optimized: IT governance best practices are followed and there are provisions for amending processes." This observation is supported by the information available. The IT governance process is well-defined and documented. It is integrated into

operational and strategic processes both of the central IT organization and the university. There are clear guidelines about what kinds of projects are brought forward to governance. The process is followed and is well-understood throughout the organization. The broad sets of stakeholders that participate in IT governance bodies make decisions in the interests of the institution. This is facilitated by the use of a scorecard method for prioritizing and ranking IT projects. IT governance is integrated with the university's business practices for budget and policy decisions. Although it does not have explicit ties into university governance, there is broad faculty representation on the research and academic technologies committees. Student government does not appear to be engaged, although there is a student representative on some committees. The university does not have a governance body for non-faculty staff. IT governance practices are monitored and measured through an assessment performed as part of an annual planning process. IT governance processes are continuously improved through that planning process. There is an annual review of committee membership in which member attendance and participation is reviewed and decisions are made about whether to ask the member to continue. Over the last five years, the CIO has made two adjustments to the thresholds required to trigger governance engagement based on a review of the success of the existing thresholds. Given all of these factors, a maturity rating of Optimized is supported.

The university's IT governance process demonstrates many characteristics of effectiveness, as seen in Table 19. The CIO is a member of the executive leadership team, reporting to the university President. Executive leaders are directly engaged in IT governance when issues pertain to their functional areas, rather than through an executive board. This approach was found to be most effective for Zed University. Committee members represent many constituencies and are at appropriate organizational level to make the necessary decisions about project

Table 19. Key Factors in IT Governance Effectiveness at Zed University

Factor	Characteristics of Effectiveness	Rating
Executive leadership engagement	● CIO is a member of the executive board. ● Executive sponsors are engaged in their domains.	Mature
Business unit engagement	● Business units and business process owners are represented in IT governance and have input into IT priorities and decision-making.	Mature
Faculty engagement	● Faculty have substantial representation and input into IT priorities and decision-making.	Mature
Student engagement	● Students have one to two seats on some committees but not broad engagement. ● Student government is not engaged.	Developing
Utilization of IT governance process	● IT governance process is applied to all central IT projects. ● Distributed IT units' projects are not included in the IT governance process.	Developing
Decision-making	● Decision-making roles are clearly defined. ● A broad set of stakeholders have input into the decision-making process. ● Executive leaders have input into all IT decisions in their domains. ● People involved in IT governance are at the right level to make decisions and recommendations.	Mature
Project prioritization and portfolio management	● IT governance fulfills a role of project prioritization and has input into the IT project portfolio. ● Prioritization aligns with the institution's strategic priorities through the budget process. ● IT governance participants advocate for the interests of the institution as a whole rather than for only their own agendas, aided by the scorecard methodology.	Mature
IT governance adoption by the institution	● Staff are able to accurately describe the IT governance process. ● IT governance principles are not explicitly documented, but best practices are followed. ● Roles, responsibilities, and authority are well-defined.	Mature

IT governance management	• Staff effort is specifically devoted to managing the IT governance process. • IT governance process is regularly reviewed and assessed for effectiveness. • IT governance process is stable with less than one major change per year on average.	Mature

prioritization and portfolio management. Priorities are aligned with the university's goals through the budget process. Regular review and adjustments to IT governance have resulted in a continuously improving process.

The areas that are less mature are student engagement and utilization of the IT governance process. While faculty and business units are engaged in the IT governance process, student representation is nominal and student government is not engaged. IT governance applies only to central IT, according to the CIO. Given the relatively large threshold of expenditure required to trigger IT governance involvement on a project, this is not surprising. The result is that distributed IT units' projects are not prioritized in the context of the institution as a whole, which may lead to an inefficient use of resources in some cases. Overall, however, the university's process conforms to the characteristics of effective IT governance.

Innovation

Technology innovation is not a central part of Zed University's mission. The CIO, who indicated that she strongly disagreed with the statement "Technology innovation is part of our mission" on the survey, explained that the university tries to incorporate innovative approaches to current problems but finds that it is challenging to "get into core innovation" and entirely new services. She commented, "People don't look to us to for innovation as much to provide services; they expect those innovations to come from elsewhere." The CIO indicated that there are resource constraints affecting innovation and observed that the credibility of the central IT organization is dependent on operational quality and efficiency rather than innovation.

New IT initiatives are part of Zed University's strategic technology plan, which lists twenty-six initiatives for the 2015-2020 fiscal year period. In the prior five years, the university focused on IT service improvement, added a new project management office, and implemented ITIL, a framework for IT service management. The CIO identified several new products and services that are new to the institution, including implementation of an ERP suite, a development and alumni relations system, an academic data warehouse, and campus-wide wireless. In addition, she listed the use of the edX platform to deliver massive open online classes, known as MOOCs. The CIO made a presentation at an EDUCAUSE conference on identity and access management solutions related to this initiative. A senior administrator outside of the IT

unit co-authored an *EDUCAUSE Review* article on MOOCs. The CIO reported that the university had implemented a research administration system as new to higher education. She noted that Zed University was the first in the country to deploy a major module in that system. The director of the educational technologies group reported that there is a council on educational technologies which is outside of the university's IT governance that provides seed grants for innovative projects. Another administrator observed that there are regularly a "myriad" of significant technology changes and described two innovations including a wiring upgrade project bringing gigabit speeds to offices across the campus and the transition from analog to digital phone services.

Some information technology innovations have originated outside of central IT, including the development of a cloud-based security application and a data analytics application which were created by faculty and commercialized. Another important innovation that was initiated by faculty was the creation of a next generation open source cloud hosting infrastructure, a project which received staff resources from central IT with the approval of the university's provost. This project was recognized as innovative by industry and was supported by the governor of the state.

The university demonstrates a high level of functioning in many characteristics of innovation, as summarized in Table 20. The culture of innovation is at an emerging state, but innovative activity, both radical and incremental, is integrated into the operational and strategic processes of the university. The majority of the university's focus is on incremental innovation, although the university at times is on the leading edge of adoption of some new technologies. The educational technologies area has the most developed innovative culture and processes. Innovation is well-integrated at Zed University.

Table 20. Characteristics of Innovation at Zed University

Dimension	Characteristics of Innovation	Rating
Innovative Activity	• New IT initiatives are introduced to the organization in the context of a strategic plan. • New ideas are developed in the context of the institution in the educational technologies area through a council and through the strategic planning process. • Sources identified multiple technology innovations, including ERP, MOOCs, data warehouse, development and alumni relations, wireless, wiring upgrades and digital phone services.	Integrated
Innovation Culture	• Within educational technologies, mechanisms exist for identifying and developing new ideas and input from external groups or people is regularly sought out. • In other areas, no formal mechanisms were identified. • While the CIO does not agree that technology innovation is part of the mission, the IT mission and strategy emphasize new initiatives and new ideas. • Innovation is explicitly funded through a grant program in the educational technologies area.	Emerging
Incremental Innovation	• New products and services are frequently introduced that are focused on meeting near-term business needs.	Integrated
Radical Innovation	• The introduction of edX/MOOCs and the research administration system were identified as new to higher education. • The CIO made a presentation at EDUCAUSE related to MOOCs, and a senior administrator co-authored an *EDUCAUSE Review* article on the topic. • Faculty created information technology innovations that have been commercialized. • An open source cloud hosting infrastructure was developed that was recognized by industry as innovative. • Zed University is an early adopter of a module in the research administration system software. The university was not listed as an early adopter of the core set of new technologies investigated in the survey. • The focus of innovative projects in the educational technologies area is on exploring what is possible.	Integrated

IT Governance and Innovation

Key staff regard the IT governance process as hindering innovation. They all agreed that IT governance is essential, and that it supports the university's ability to accomplish IT projects, but it can be burdensome. The director of the Educational Technologies unit explained that the Educational Technology

Initiatives Council was created to avoid being burdened by requiring innovative projects to go through governance. A senior administrator concurs with the viewpoint that IT governance is burdensome for innovation at the university, saying, “At a high level there needs to be a way for innovation to... exist in this type of governance structure, but we’re not there.” The CIO identified the problem and explained that because a high level of inclusion and engagement is required in higher education environments, time and complexity are added to the decision-making process which slows innovation, a perspective shared by all interviewed staff. She further observed that the consensus-driven nature of higher education can stop innovation. Another challenge is that resources for innovative projects must be prioritized against other important needs. The CIO found that innovation is often left out because IT governance is oriented towards managing risk and ensuring that current operations are sustained. A senior manager agreed and stated that the university struggles to keep current and maintain operations and does not devote resources to innovation. The CIO summarized, "So, I think there’s no doing without it, but it generally does not prompt innovation; it generally manages or throttles innovation." It is interesting that innovation is nevertheless well-integrated into the university’s institutional processes. However, much of the radical innovation happens outside the IT governance process.

Summary

The IT governance structure at the university, while mature and effective, does not facilitate innovation at Zed University. It is limited by its focus on the prioritization of large, enterprise projects and the tendency of its IT governance groups to prioritize projects that incrementally enhance existing operational services rather than riskier initiatives. While Zed University has integrated technology innovation into its activities, it has chosen a different objective for its IT governance process such that it is focused on operations rather than innovation. The organization’s IT governance process does not support technology innovation and may inhibit it.

CHAPTER V

CROSS CASE RESULTS AND DISCUSSION

A comparative analysis of the five universities' IT governance maturity, effectiveness, and innovation characteristics resulted in findings that suggest certain IT governance structures and processes facilitate technology innovation. These include the purpose of the IT governance process and the presence of innovation seed grant programs. The identification of models of decision-making authority in effective IT governance structures emerged from the study.

Cross Case Results

Control Variables

The demographic attributes of the universities do not correlate with their IT governance maturity level or the degree to which technology innovation is integrated into the culture; neither are they are associated with the degree to which innovative activity and incremental innovation are integrated into their operations. The central and university IT budget and staff sizes are not correlated with any of these factors, nor with radical innovation. The degree to which radical innovation is integrated into operations may be related to faculty size, but there is not enough data in this study to draw a conclusion. NC State and UNL have the smallest faculty sizes, and they are at the lower Emerging level for radical innovation, whereas the other universities are at an Integrated level for radical innovation.

Decision-Making Structures, Maturity and Effectiveness

Two models of decision-making authority emerged from an examination of the IT governance structures at these five universities. In the first, the CIO is at the center of the decision-making process. IT governance bodies serve in an advisory role and are primarily used for communication. Decision-making authority is not delegated to IT governance bodies. This is the model in use at Virginia Tech, NC State, and UNL. The other is a committee-centric model, in which the CIO is a member of an executive committee at the top of the governance hierarchy. While the CIO is responsible for the IT function, decision-making

authority is distributed throughout the governance hierarchy, depending on the kind or scope of the decision. The committee-centric model of decision-making authority is associated with higher maturity and effectiveness ratings found at UT and Zed University, as summarized in Table 21. There is a substantial difference in the number of characteristics of effectiveness rated at the Mature level between universities using a CIO-centric model and a committee-centric model. The CIO-centric schools have no more than one out of the nine effectiveness characteristics rated at the Mature level, while the committee-centric schools have no less than seven characteristics rated at the Mature level.

IT Governance Maturity and Effectiveness and University Budget Processes

The two universities with the highest levels of IT governance maturity and effectiveness have a defined relationship between the university's budget process and IT governance. At UT, IT proposals that require funding allocations beyond what is already available in operational budgets are taken to the university budget council for approval, and the projects are then taken to IT governance bodies for endorsement and prioritization. At Zed University, IT governance bodies prioritize projects requiring large expenditures and take those with the highest priority to the university's budget committee for funding and approval during the university's budget cycle. In both cases, IT initiatives are aligned with the institution's strategic priorities and are prioritized among the university's portfolio of projects. At schools with lower levels of IT maturity, the university budget process is not directly linked to the operations of IT governance.

IT Governance, Incremental Innovation and Innovative Activity

Incremental innovation is integrated into the operational processes of each university's IT function. New initiatives aimed at meeting the near-term business needs are frequently brought forward. Innovative activity is similarly well integrated at most schools; at Virginia Tech this dimension is rated at an Emerging level because of the lack of a governance process or other mechanism that would facilitate idea-sharing at the institutional level. No conclusions about IT governance maturity's impact on incremental innovation or innovative activity can be drawn based on examination of these five universities.

Table 21. Decision-Making Authority Model, IT Governance, and Innovation

	DECISION MAKING MODEL	**IT GOVERNANCE MATURITY**	**IT GOVERNANCE EFFECTIVENESS** Number of Characteristics Per Level			**INNOVATION** NP = Not Present E = Emerging I = Integrated			
University	**Authority**	**Maturity Level**	**Mature**	**Developing**	**Not Present**	**Activity**	**Culture**	**Incremental**	**Radical**
Virginia Tech	CIO	Initial	0	5	4	E	E	I	I
UNL	CIO	Repeatable	1	5	3	I	E	I	E
NC State	CIO	Defined	1	7	1	I	E	I	E
UT	Committee	Managed	8	1	0	I	I	I	I
Zed University	Committee	Optimized	7	2	0	I	E	I	I

Stakeholder Engagement and Innovation

IT governance maturity level, stakeholder engagement, and the levels of radical innovation and innovation culture are summarized in Table 22. Faculty engagement in IT governance is not clearly associated with increased levels of radical innovation or in the integration of an innovation culture. Faculty at some schools have created IT innovations outside of the IT governance process and without the involvement of central IT. Faculty research is independent of the universities' IT operations, although collaboration can occur. The higher level of student engagement in IT governance at UT is associated with an increased level of innovation culture. Student involvement may or may not directly impact innovation, but it is indicative of a culture that provides opportunities for idea-sharing and collaboration. Business unit engagement is a key characteristic of IT governance effectiveness, and in this study it is seen in the organizations with more mature processes. However, it is not directly associated with radical innovation or innovation culture.

Table 22. IT Governance Maturity, Stakeholder Engagement and Innovation

	IT GOVERNANCE MATURITY	**STAKEHOLDER ENGAGEMENT** NP=Not Present DEV=Developing MAT=Mature			**INNOVATION** NP=Not Present E=Emerging I=Integrated	
University	**Maturity Level**	**Faculty**	**Student**	**Business**	**Radical Innovation**	**Innovation Culture**
Virginia Tech	Initial	DEV	NP	DEV	I	E
UNL	Repeatable	MAT	DEV	DEV	E	E
NC State	Defined	DEV	NP	MAT	E	E
UTA	Managed	MAT	MAT	MAT	I	I
Zed	Optimized	MAT	DEV	MAT	I	E

Governance and Funding Innovation

At UT, Virginia Tech, NC State, and Zed, the universities explicitly fund technology innovation related to teaching and learning through internal innovation seed grant programs. UNL does not have such a program. This may be related to its budget; UNL has the smallest overall university budget for IT among the five institutions studied. UT is the only institution that administers its innovation grant program through IT governance, and it is unique in that its program is also targeted at attracting sponsored research. At Zed, the program was deliberately constructed to avoid the overhead of IT governance, while at Virginia Tech and NC State, the programs are administered by IT units that are focused on technology in teaching and learning. Many of the radically innovative technologies found at these universities emerged from these seed grant programs.

Impact of Governance Purpose on Innovation

The purpose and use of IT governance on a campus affects its impact on innovation. The consensus among the universities is that IT governance slows progress on innovations or even stops it. However, there were differences among campuses regarding the desirability and impact of this result. UT was unique among the universities studied because while interviewees universally asserted that IT governance slows progress on innovations, they viewed this as positive for the university because it allows time to develop stakeholder buy-in and to analyze proposals, which allows the university to make strategic decisions about which of many innovative projects to pursue. At the other end of the spectrum, interviewees at Zed universally felt that IT governance has a negative impact on innovation because the focus of IT governance on risk management and the optimization of operational services does not leave room for riskier, more innovative projects. Both UT and Zed have mature and effective IT governance processes. However, the purpose of governance at these institutions is different. At UT, interviewees reported that communication and developing stakeholder buy-in for project prioritization are among the most important functions of IT governance. While IT governance focuses on projects that have a broad campus impact, a diverse set of initiatives flows through the IT governance process. By contrast, at Zed, the primary purpose of IT governance is the prioritization of large expenditures for enterprise projects.

At NC State, IT governance is used for communication and to some extent for project prioritization, though it does not make decisions about project prioritization as is done at UT or Zed. Sources at NC State were not unanimous on whether IT governance facilitates innovation. For those involved with the strongest parts of IT governance at NC State, they found that the process simultaneously slows and facilitates innovation, a result similar to UT. In other areas, where IT governance is less effective and decision-making is more ambiguous, NC State staff found that IT governance is an impediment to be worked around. At Virginia Tech, when university governance was used for communication and feedback it was seen to facilitate innovation, and the lack of a formal IT governance process was perceived to impede it. UNL uses IT governance for communication and to prioritize high-level projects. While its process is developing, UNL staff perceive that improved IT governance processes will facilitate innovation by providing a clear pathway and method to move projects forward.

When IT governance is effectively used to develop stakeholder buy-in and provide communication, it is perceived to facilitate innovation. This holds true regardless of the maturity level of the university's IT governance process. Universities with more mature IT governance processes tend to have more effective methods for engaging stakeholders, and thus innovation may be better facilitated.

Discussion

This study explores the characteristics of IT governance that are associated with incremental and radical innovation in higher education. It seeks to answer the following questions: *How does IT governance maturity impact technology innovation in higher education? Under what circumstances does IT governance help, or hinder, technology innovation in higher education?* Analysis of case studies identifies key factors impacting the effectiveness of IT governance in facilitating technology innovation. The following discussion includes IT governance characteristics universities need to develop to facilitate technology innovation and factors to be considered in developing effective IT governance.

Challenges

IT governance adds overhead. A common theme among all universities studied is that IT governance slows things down. The degree to which progress on projects is hindered by slowdowns

resulting from committee meeting timelines, risk aversion or paralysis-by-consensus affects the acceptance of IT governance by the organization. When it slows things down excessively, renegade projects are the result, in which case the university loses the opportunity to thoughtfully plan its resource investments and project priorities. Organizations need to plan for the level of agility they need when they design their IT governance structures and processes.

Implementing IT governance can be met with resistance, as UNL and NC State have experienced. Perceived bureaucracy or a feeling of being excluded from decision-making can stymie efforts to develop support in the organization. UNL's approach to building IT governance incrementally can be a successful strategy in an organization that lacks experience with an effective process. NC State has adopted a similar strategy and is reviewing its IT governance process to identify potential improvements. Continuous refinement is important to success.

Facilitating Innovation Through IT Governance

Effective IT governance can facilitate innovation, but effectiveness alone is not sufficient as demonstrated by Zed University's experience. Innovation can be integrated into an institution's processes without it, as seen at Virginia Tech. However, an effective governance process can ensure that the university selects and supports innovative projects in a manner that aligns them with the university's strategic goals as is the case at UT. The difference between an effective process that supports innovation and one that impedes it is the focus and inclusiveness of the IT governance process. Zed University, whose process primarily focuses on resource allocation and project prioritization for large projects run by central IT, has encountered the obstacles identified by Van de Ven (1986), Stefik and Stefik (2004), and Huda and Hussin (2013). These include the tendencies of IT governance groups to avoid risky projects and to select projects that incrementally improve existing services rather than those that make innovative changes. UT's IT governance focus includes formal project prioritization but emphasizes communication and collaboration as primary goals of the process. It includes projects of varying sizes from distributed units as well as central IT. This inclusiveness facilitates a culture of idea-sharing. Universities should seek to include voices from a large cross-section of their campuses. Engaging faculty and students adds to the diversity of thought and promotes buy-in for moving innovative projects forward. There is a tendency to

seat members according to their presumed subject matter knowledge, particularly on infrastructure committees. However, because the decisions that should be made by IT governance are those with strategic impact, deep technical knowledge is not necessary, as evidenced by the success of UT's Architecture and Infrastructure Committee.

In order to develop radical innovation, universities need processes that encourage it. The deliberate approach to funding IT innovation in support of the academic, and in UT's case, research missions of the university results in extensive innovation. IT governance provides a mechanism for selecting innovations for further development that are most viable and that mesh best with the voiced priorities of the university community.

Developing Effective Governance

Making the IT governance process effective requires attention to four elements: engagement, usage, decision-making, and management. It is essential for the university's non-IT stakeholders to be included and engaged in IT governance in order to develop buy-in, to communicate, and to facilitate collaboration. It is not sufficient to have a defined IT governance process; it must actually be used, which means that it must be well-understood and supported throughout the organization, including executive leadership.

Decision-making is by definition at the heart of IT governance. As institutions develop their IT governance structure, consideration should be paid to whether to adopt a CIO-centric or committee-centric model. As NC State noted, there can be difficulties with committee-driven decision making when the committees are not mature. However, an environment with a well-designed committee structure, members at appropriate organizational levels, defined charges, and clear guidelines around decision-making results in effective IT governance.

Effective governance does not happen by accident. It must be deliberately planned and maintained. Weill and Ross (2004) provide an excellent resource for conceptualizing IT governance and developing a structure. Devoting staff effort to managing IT governance is essential to a highly functioning process. Brad Englert, CIO at UT, advises that universities establish a formal governance facilitation position, saying, "Having a constant governance contact solidifies the governance bodies and ensures work

and progress toward established goals," (Englert, personal communication, 2/25/2015). Zed University similarly found benefit in having staff assigned to regularly review IT governance and to facilitate its operation. The effort involved in tasks such as seeking out and assigning members of governance bodies, reviewing their attendance and participation, facilitating the development and assessment of short- and long-term strategic goals for IT governance, creating an agenda roadmap and meeting schedule, ensuring that reporting and communication among governance bodies is occurring appropriately, and regularly assessing the effectiveness of IT governance should not be underestimated. As Susan West at NC State succinctly put it, "It takes a great deal of effort to sustain good governance practice." Successful IT governance requires that the organization provide the staff resources needed to maintain it.

CHAPTER VI

FUTURE RESEARCH AND CONCLUSION

This research explores new ground in the study of IT governance maturity and technology innovation. Findings from this qualitative study suggest new directions in research that can extend the applicability of the results to a variety of higher education institutions. This study provides guidelines that will help institutions position themselves to align technology innovation with their strategic objectives.

Limitations and Directions for Future Research

This research is limited by its subjects, which consist of large, non-profit doctoral research universities with very high research activity. It is possible that IT governance processes at smaller institutions or those with a different academic mission may differ. Future research focusing on four-year colleges, master's institutions, for-profit institutions, and community colleges could provide additional insight as the relationship between IT governance and the institution may differ.

All of the universities in the study operate their IT functions in a federated model. Most do not include distributed units in their IT governance process. Further study at institutions with a centralized IT function may reveal differences in IT governance effectiveness and patterns of stakeholder engagement.

The key staff interviewed were nominated by the CIOs at each institution and were mostly from central IT units reporting to the CIO. Although many offered critiques of their university's processes, staff may have been biased towards presenting the organization in a positive light. Other research methods, such as anonymous surveys, may be better able to obtain an unbiased perspective.

CIOs and key staff frequently noted that much innovation happens in distributed units. The perspectives of staff in distributed units regarding the benefits and impact of IT governance may be different, particularly at institutions in which IT governance is applied only to central IT. Further research

in this area could reveal additional insights into factors impacting IT governance effectiveness and its impact on technology innovation.

This study employs limited objective measurements of innovation through secondary sources. The analysis of journals for corroboration of radical innovation is limited by two factors: the limited set of journals reviewed, and the method, which relied on the researcher to accurately recognize that an article might pertain to an information technology innovation through its title. While finding such an article provides corroborating evidence, the lack of such an article cannot be construed to represent an absence of it. Future research might adapt the more rigorous "Literature-Based Innovation Output" methodology described by van der Panne (2007) to search a broader set of journals or publications for evidence of innovation. More quantitative measures may allow additional comparisons among higher education institutions.

This research yielded an observation that IT governance effectiveness and maturity appear related to whether the IT governance decision-making structure is CIO-centric or committee-centric. Further research in this area could provide organizations with guidance in the design of decision-making structures.

Conclusion

The development and maturation of formal IT governance processes may be a recent phenomenon in higher education, but the need to support innovation is a perennial issue for universities and colleges. Higher education has a long tradition of leadership in information technology. Ensuring that IT governance structures support rather than impede the development of technology innovations will help universities and colleges continue to move forward.

This study addresses the questions: *How does IT governance maturity impact technology innovation in higher education? Under what circumstances does IT governance help, or hinder, technology innovation in higher education?* Findings from previous research were ambiguous regarding whether a mature IT governance process helps or hinders innovation. These results show that it can do both. A mature and effective IT governance process can facilitate technology innovation if it is inclusive and emphasizes communication and collaboration while performing project prioritization across the university's IT project

portfolio. Radical innovation can be integrated into institutional processes even when the IT governance process is very limited, but alignment with other priorities and institutional strategy is optimized when a robust IT governance process is employed. An effective IT governance process requires management, and dedicated staff effort is part of processes with higher levels of maturity. The IT governance structure should be thoughtfully designed to appropriately delegate decision-making. It should include a broad set of campus stakeholders from business units, faculty, and students in order to ensure that the culture supports the idea-sharing and collaboration necessary for innovation.

As higher education institutions grapple with the dual needs for the strategic alignment of IT resources with the organization's mission and a vibrant culture of innovation, they will find that these two goals can be simultaneously met through a well-designed IT governance process. Careful attention to engagement, usage, decision-making structures, and management of the process will result in the facilitation of technology innovation and positions the institution to achieve its strategic mission.

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