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# Comparing Public and Private Institutions that Have and Have Not Implemented Enterprise Resource Planning (ERP) Systems: A Resource Dependence Perspective

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COMPARING PUBLIC AND PRIVATE INSTITUTIONS THAT HAVE AND  
HAVE NOT IMPLEMENTED ENTERPRISE RESOURCE PLANNING (ERP)  
SYSTEMS: A RESOURCE DEPENDENCE PERSPECTIVE

By

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A dissertation submitted in partial fulfillment  
of the requirements for the

Doctor of Philosophy in Educational Leadership

Department of Educational Leadership  
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University of Nevada, Las Vegas  
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## THE GRADUATE COLLEGE

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## **ABSTRACT**

### **COMPARING PUBLIC AND PRIVATE INSTITUTIONS THAT HAVE AND HAVE NOT IMPLEMENTED ENTERPRISE RESOURCE PLANNING (ERP) SYSTEMS: A RESOURCE DEPENDENCE PERSPECTIVE**

by

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The purpose of this national study was to utilize quantitative methods to examine institutional characteristics, financial resource variables, personnel variables, and customer variables of public and private institutions that have and have not implemented enterprise resource planning (ERP) systems, from a resource dependence perspective. Resources were examined within the context of resource dependency theory as it relates to organizations seeking to manage their environments by: using strategies to enhance their autonomy and pursue their organizational interests; acquiring, maintaining and controlling critical resources from the environment, and understanding that social context matters in the relationship between organizations and their external environment.

There were several findings of this study. Two institutional characteristics and eight resource variables predict institutions of higher education that have implemented ERP systems: size 20,000 and above, Carnegie 2000 – Doctoral/ Research Universities, total core revenues, investment return, total core expenses, research expenses, total FTE staff, instruction-research-public service FTE staff, executive-admin-managerial FTE staff, and other professional FTE staff. In addition, four institutional characteristics and three resource variables predict IHEs that have not implemented ERP systems: age group

between 51 and 100; size between 1,000 and 4,999; Carnegie 2000 – Masters Colleges and Universities; Carnegie 2000 – Associates Colleges; revenues of tuition and fees; student service expenses, and institutional support expenses.

Lastly, there were similarities and differences for IHEs that have and have not implemented ERP systems. When compared between FY 06 and FY 10, five resource variables are consistent among IHEs that have and have not implemented ERP systems. These are: total core expenses, instruction expenses, other core expenses, instruction-research-public service FTE staff and reported FTE undergraduate enrollment. For institutions that have implemented ERP systems, the following eight resource variables are significant, in addition to the five mentioned previously: tuition and fees, state appropriations, research expenses, student service expenses, academic support expenses, total FTE staff, other professional FTE staff, and reported FTE graduate enrollment. Further, for institutions that have not implemented ERP systems, the following two resource variables are significant, in addition to the five previously mentioned: total core revenue and reported FTE graduate enrollment. Overall, there was a significant decrease in institutional support per student FTE for IHEs that have implemented ERP systems.

This research provides a baseline regarding IHEs that have and have not implemented ERP systems in higher education, and raises additional questions for further research.

*Keywords:* resource dependency; enterprise resource planning; information technology; resource allocation; higher education.

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My friends, classmates, and colleagues have supported me as I worked to accomplish yet another goal I set for myself. For the sake of brevity, I will not name everyone individually, but you know who you are at UNLV and UCLA. However, there is one person that encompasses all three of these categories, Mike Wilde. Mike and I started out as colleagues at UNLV, became classmates in the educational leadership doctoral program, and then became fast friends going through the trials and tribulations of every class together for three solid years. Mike has read every paper I have ever written in the doctoral program, and I appreciate his candor and encouragement. Thank you, Mike, for starting the marathon with me and continuing on, so we both cross the finish line!

Last, but not least, I owe a debt of gratitude to my family, who continue to believe in me, support me, and have joined me on this quest. Again, for the sake of brevity, I will

not name all my family members who have played an integral part in my life over the past several years, but you know who you are. It has been tough to add the role of doctoral student to the many challenging roles I already have, namely wife and mother. My husband, Sendhil, has been with me through the good, the bad, and the crazy times for almost two decades. We have a 15 year-old son, Selvam, and a nine year-old daughter, Aasha, that inspire me above and beyond my expectations. They are smart, funny, well-adjusted, and supportive, and it is their resilience that has encouraged me to keep running the marathon without worrying too much that they may be adversely impacted by the many commitments a career and pursuing higher education brings. If nothing else, we continue to learn what flexibility and forgiveness is. Although this dissertation ends at “Chapter 5,” I am looking forward to writing many more chapters together with my inner circle over the years to come. I dedicate this dissertation to Sendhil, Selvam, and Aasha, with all my love and gratitude.



## TABLE OF CONTENTS

ABSTRACT .....	iii
ACKNOWLEDGMENTS .....	v
LIST OF TABLES .....	ix
CHAPTER 1: INTRODUCTION .....	1
Overview .....	1
Literature Overview .....	3
Theoretical Framework .....	6
Purpose .....	8
Research Questions .....	8
Methods .....	9
Definitions .....	10
Limitations .....	13
Significance of the Study .....	15
Summary .....	16
CHAPTER 2: LITERATURE REVIEW .....	18
Overview .....	18
IT in Higher Education .....	20
Funding in Higher Education .....	28
ERP Systems Implementation .....	35
Costs of ERP Systems Implementation .....	43
Theoretical Framework .....	53
Summary .....	68
CHAPTER 3: RESEARCH METHODS .....	70
Introduction .....	70
Research Design .....	70
Data Sources .....	71
Sample Institutions .....	73
Data Collection Procedures .....	74
Independent Variables .....	77
Data Analyses .....	83
Research Questions .....	86
Summary .....	88
CHAPTER 4: RESULTS .....	89
Overview .....	89
Discriminant Function Analysis Model .....	90
Institutional Characteristics .....	90
Resource and Customer Variables .....	96
Paired Samples t-test Model .....	106

Summary .....	128
CHAPTER 5: INTERPRETATIONS AND RECOMMENDATIONS.....	131
Introduction.....	131
Overview of the Study .....	131
Discussion of the Findings.....	133
Implications for Theory .....	145
Implications for Practice.....	148
Suggestions for Future Research .....	150
Conclusion .....	151
APPENDIX 1: Institutions with ERP Systems.....	154
APPENDIX 2: Institutions without ERP Systems.....	158
APPENDIX 3: Definitions of Financial Input Variables from IPEDS.....	161
APPENDIX 4: Definitions of Financial Output Variables from IPEDS .....	166
APPENDIX 5: Definitions of Personnel Variables from IPEDS .....	170
APPENDIX 6: Definitions of Customer Variables from IPEDS.....	174
REFERENCES .....	176
VITA.....	189

## LIST OF TABLES

Table 1. Relationship between Resource Dependency Theory and Literature Review Topics.....	7
Table 2. Overview of Resource Dependency Theory.....	59
Table 3. Details about Variables.....	75
Table 4. Predicted Group Membership Based on Institutional Characteristic.....	94
Table 5. Discriminating Institutional Characteristics for Public and Private IHEs that Have Implemented ERP Systems .....	97
Table 6. Discriminating Institutional Characteristics for Public and Private IHEs that Have Not Implemented ERP Systems .....	98
Table 7. Descriptive Statistics of FY 10 Revenue Variables.....	101
Table 8. Descriptive Statistics of FY 10 Expense Variables .....	102
Table 9. Descriptive Statistics of FY 10 Personnel Variables .....	103
Table 10. Descriptive Statistics of FY 10 Customer Variables .....	103
Table 11. Predicted Group Membership Based on Resource Variable .....	105
Table 12. Descriptive Statistics of FY 06 Revenue Variables.....	108
Table 13. Descriptive Statistics of FY 06 Expense Variables .....	109
Table 14. Descriptive Statistics of FY 06 Personnel Variables.....	110
Table 15. Descriptive Statistics of FY 06 Customer Variables .....	110
Table 16. Paired Samples t-test – Institutions with ERP Systems – Revenues .....	112
Table 17. Paired Samples t-test – Institutions with ERP Systems – Expenses.....	113
Table 18. Paired Samples t-test – Institutions with ERP Systems – Personnel .....	114
Table 19. Paired Samples t-test – Institutions with ERP Systems – Customers.....	114
Table 20. Paired Samples t-test – Institutions without ERP Systems – Revenues .....	116
Table 21. Paired Samples t-test – Institutions without ERP Systems – Expenses.....	117
Table 22. Paired Samples t-test – Institutions without ERP Systems – Personnel.....	118

Table 23. Paired Samples t-test – Institutions without ERP Systems – Customers.....	119
Table 24. Cohen’s Thresholds for Interpreting Effect Size .....	120
Table 25. Noteworthy Effect Size for Paired t-tests – IHEs with ERP Systems .....	121
Table 26. Noteworthy Effect Size for Paired t-tests – IHEs without ERP Systems .....	123
Table 27. Variance of Revenues between FY 06 and FY 10.....	125
Table 28. Variance of Expenses between FY 06 and FY 10 .....	126
Table 29. Variance of Personnel between FY 06 and FY 10.....	127
Table 30. Variance of Customers between FY 06 and FY 10 .....	128

## CHAPTER 1: INTRODUCTION

### Overview

While industries such as engineering, finance, and manufacturing became the first adopters of information technology (IT) in the early 1950s to operate more efficiently, institutions of higher education (IHEs) utilized IT more for instruction and research than for institutional operation during the early stages of this technological revolution.

“Mainframe computers in the 1960s became the mainstay of corporations for financial and inventory management, providing separate systems to help manage and control resources. Similarly, [IHEs] began to rely on information systems in the late 1960s, and on student information, human resource, and financial systems in the 1970s” (Gorr & Hossler, 2006, p. 9). Commercial enterprise resource planning (ERP) systems began to surface in the 1990s (Davenport, 1998) as a solution for managing the academic enterprise. However, because implementing and maintaining ERP systems required a significant amount of personnel, as well as financial and technological investment, not all IHEs were capable of implementing them.

The term “ERP” originated in the 1990s to refer to a business management software system that supports an enterprise’s core functions, such as finance, material purchasing, inventory control, distribution, and human resources (Swartz & Orgill, 2001; Wang, 2008). In higher education, the use of enterprise resource planning (ERP) systems extends to managing student information for administrative and academic purposes. Managing data at the enterprise level is the best use of institutional resources because it allows leaders to make better business decisions. This requires technology staff to stay current with technological advances that enable them to ensure the efficient and effective

use of data and systems at the institution. According to Gorr and Hossler (2006), “ERP systems on campuses can track and integrate a multitude of processes and functions, as well as maintain accurate accounting of students, faculty, and staff” (p. 10).

Because technological advancement occurs rapidly, IHEs have implemented technology on an as-needed basis over the past 20 years without much big-picture planning or cohesive integration into the implementing institution’s infrastructure. Some of these systems include home grown, legacy systems that emerged, over the years, to address the institution’s basic needs. However, the shortcomings of these disparate, independent systems brought dissatisfaction to IHEs because they did not enable a seamless interchange of data between them. This resulted in the rise of vendors developing and marketing ERP systems to “...eliminate redundant data in information systems, standardize user interfaces, and approach data standardization” (Gorr & Hossler, 2006, p.10). Therefore, an important consideration for this study was acknowledging that institutions may have legacy systems to utilize information, but it is the implementation of vendor supplied, integrated, commercial ERP systems that was the focus of this study.

The purpose of this national study was to utilize quantitative methods to examine institutional characteristics, financial resource variables, personnel variables, and customer variables of public and private institutions that have and have not implemented ERP systems, from a resource dependence perspective. Resources were examined within the context of resource dependency theory as it relates to organizations seeking to manage their environments by: using strategies to enhance their autonomy and pursue their organizational interests; acquiring, maintaining, and controlling critical resources

from the environment, and understanding that social context matters in the relationship between organizations and their external environment.

### **Literature Overview**

To provide a basis for the present study, a comprehensive review of literature over the past 35 years was performed to examine how the use of IT in higher education has evolved over several decades. This section presents a brief overview of the literature that exists through previous studies, addressing trends in the following five areas: (a) using information technology in higher education (including aligning IT units with organizational goals, and the roles of IT leaders); (b) funding in higher education (including funding IT and funding for ERP systems implementation); (c) examining ERP systems implementation (including project scope, operational process changes, and organizational benefits); (d) understanding costs of ERP systems implementation (including acquisition costs, implementation costs, and post-implementation costs), and (e) applying the theoretical framework of resource dependency theory as it relates to organizations seeking to manage their environments.

The use of IT in higher education has evolved over several decades (Katz, Kvavik, Penrod, Pirani, Nelson, National Association of College Stores, & Salaway, 2004; Gorr & Hossler, 2006), initially using a decentralized organization structure to support a variety of narrowly focused academic and administrative purposes, and later using a centralized organization structure to support the use of technology for more integrated institutional operation (Katz et al., 2004). Resources (e.g., funding and personnel) institutions have available to acquire and utilize technology affect the pace in which technology has been able to permeate IHEs. Further, implementing ERP systems

directly impacts personnel, redirects scarce financial resources from other academic and operational needs and changes the existing technology at the institution (Green & Gilbert, 1995).

As the capabilities and use of IT have evolved in higher education, so has the organization of IT units in IHEs. IT organization is critical to aligning technology with institutional goals (Chan & Reich, 2007; Teo & King, 1997; Kholi & Grover, 2008). In addition, clarifying the role of IT leaders is essential to ensure accountability for the use of technology resources, managing data, ensuring systems security, and maintaining privacy. These aspects of managing IT organizations are essential to understanding where resources should be allocated and understanding resource dependence (Chan & Reich, 2007; Hirschheim & Sabherwal, 2001) based on external sources.

Resources such as the funds allocated for technology in higher education are in the range of tens of billions of dollars each year (Mark, 2008) and originate from three main sources of appropriations: state government, federal government, and tuition and fees. The amount of funding provided by these sources to IHEs creates external dependencies (e.g., state and federal government, students, and parents) that affect the funding appropriated for institutional support, and specifically for technology operations and ERP systems implementation projects. Goldstein (2004) has identified current practices to manage finances associated with IT in higher education that describe the various sources of funding.

It is essential for IHEs to understand the project scope and potential positive or adverse operational process changes that may result from ERP system implementation because this is one of the most significant technology projects an organization may



undertake (Yusuf, Gunasekaran, & Abthorpe, 2004; Ehie & Madsen, 2005). ERP systems will drastically affect the institution's personnel, funding, and use of new and existing technology, thereby creating resource dependencies on external factors worthy of examination, as these dependencies may affect the institution's effectiveness. For example, student fees could be added to support a new ERP system implementation but student enrollment may not be consistent year to year to maintain funding for this institutional cost. Also, processes could require changes that eliminate support staff, but necessitate the hiring of more expensive technology staff, resulting in increased expenses. This study examined the use of resources and information systems because it is necessary to understand the significance of committing appropriate resources to ERP systems implementation projects (Davenport, 1998; Kogetsidis, Kokkinaki, & Soteriou, 2008).

When deciding whether or not to implement an ERP system, the major factor an institution must consider is the ERP system's cost of acquisition and the benefits to be realized once implemented (Babey, 2006; West & Daigle, 2004). However, additional costs associated with ERP systems implementation are backfill staff, human relations, loss of services, and training that need to be considered (Arindam & Bhattacharya, 2009; Koh, Simpson, Padmore, Dimitriadis, & Misopoulos, 2006; Momoh, Roy, & Shehab, 2010). In addition, post-implementation costs including data conversion from aging systems, integration of existing systems (Kvavik & Katz, 2002), supplemental training for users of the new ERP system, and maintenance of the new system begin to demonstrate resource dependence on factors such as personnel and funding.

## **Theoretical Framework**

The conceptual framework for this study was based on Pfeffer and Salancik's (1978) resource dependency theory (RDT). This theory originated in the 1970s along with a number of organization based theories. Straub, Weill, and Schwaig (2008) remark,

“RDT recognizes that the key to organizational survival is the ability to acquire and maintain resources (Pfeffer and Salancik, 1978). An organization must be open to its environment due to its dependence on that environment to obtain critical resources such as personnel, information, raw materials and technology. Resource acquisition may be problematic and unpredictable” (p. 196).

An organization will seek to operate in the environment by using resources and information effectively and efficiently in order to minimize or avoid dependence on external actors to create products or deliver services. Bhyrovabhotla (2012) reiterates,

“RDT looks at the relationships between resources and firms' actions. Thus, the central concept is of resources and how they are used. It fundamentally necessitates the linkage between resources, its use for production of [products and services] and the linkage of [these] to a firm's performance or survival” (p. 8).

Therefore, an institution's action to implement ERP systems is a method of using resources and information to provide instruction to students, its primary mission.

The five main sections of the literature review integrate into the theoretical framework because there are opportunities for IHEs to operate effectively in the environment by acquiring, maintaining, and controlling resources (e.g., financial and personnel), and using information (e.g., ERP systems) to mitigate resource dependence on external factors to deliver the primary service of instruction to students. According to Straub, Weill, and Schwaig (2008), “A resource dependency is created any time a firm relies on an external entity for a resource needed by the firm. The more critical the

resource is to the firm, the more serious is the dependency” (p. 196). Table 1 illustrates the relationship between resource dependency theory and literature review topics.

Table 1.

*Relationship between Resource Dependency Theory and Literature Review Topics*

Theme of RDT		Literature Review Topic(s) Addressed
1.	Organizations seek to manage their environments by using strategies to enhance their autonomy and pursue their interests	<ul style="list-style-type: none"> <li>• Use of Technology in HE</li> <li>• ERP Systems Implementation</li> </ul>
2.	Acquiring, maintaining, and controlling critical resources from the environment	<ul style="list-style-type: none"> <li>• Funding in Higher Education, for IT, and ERP Systems</li> <li>• Use of Technology in HE</li> </ul>
3.	Social context matters in the relationship between organizations and their external environment	<ul style="list-style-type: none"> <li>• Funding in Higher Education, for IT, and ERP Systems</li> <li>• Costs of ERP Systems Implementation</li> </ul>

For example, organizations seek to manage their environments by using strategies to enhance their autonomy and pursue their interests. In higher education, a strategy is using technology, such as ERP systems, to enhance autonomy by using information from these systems to satisfy regulatory compliance requirements of external resource providers such as state and federal government. Subsequently, institutions may be able to improve upon organizational efficiencies, by implementing ERP systems, to pursue their core interests of teaching and research. Next, the RDT theme of acquiring, maintaining and controlling critical resources from the environment is related to funding in higher education, and funding for IT and ERP systems implementation to utilize technology to benefit IHEs. By appreciating that institutions are dependent upon external actors such as students and parents, state and federal government, and donors for funding their

operations, IHEs utilize technology such as information systems to manage these external dependencies. Additionally, by understanding the importance of the social context in the relationship between organizations and their external environment, IHEs can better position themselves when dealing with external resource providers for general institutional operations and the costs associated with ERP systems implementation. A more exhaustive review of the theoretical framework is presented in Chapter 2.

### **Purpose**

The purpose of this national study was to utilize quantitative methods to examine institutional characteristics, financial resource variables, personnel variables, and customer variables of public and private institutions that have and have not implemented ERP systems, from a resource dependence perspective. Resources were examined within the context of resource dependency theory as it relates to organizations seeking to manage their environments by: using strategies to enhance their autonomy and pursue their organizational interests; acquiring, maintaining, and controlling critical resources from the environment, and understanding that social context matters in the relationship between organizations and their external environment.

### **Research Questions**

The study used four research questions to examine many institutional, financial, personnel, and customer variables that relate to the organizational environment; acquiring, maintaining, and controlling resources, and the social context of external actors affecting resource dependence for IHEs that have and have not implemented ERP systems. Important themes from the literature were addressed by each research question

and were developed within the framework of resource dependency theory. The following questions guided the study:

1. Are there differences in institutional characteristics of institutions that have and have not implemented ERP systems?
2. What resources best discriminate between institutions that have and have not implemented ERP systems?
3. For institutions that have implemented ERP systems, are there differences in resource allocations, and/or student enrollment/institutional support per student from fiscal year 2005-2006 to fiscal year 2009-2010?
4. For institutions that have not implemented ERP systems, are there differences in resource allocations, and/or student enrollment/institutional support per student from fiscal year 2005-2006 to fiscal year 2009-2010?

## **Methods**

Based upon the population, sample, data collection and data analysis, the focus of this national study was to gain an understanding of whether or not institutions are influenced by the organizational environment, resource allocations of funding and personnel, and the use of ERP systems in public and private IHEs in American higher education. In order to examine the dependency of resources, institutional information such as profile characteristics, use of technology (ERP systems or not), funding and personnel resources were studied over a five year period. Using a sample of institutions that have previously been studied (Kvavik & Katz, 2002) aided the researcher with identifying institutions to study, and utilizing data from the Integrated Postsecondary

Education Data System (IPEDS) supports the generalizability of the research for future studies that may study the use of institutional resources.

Using statistical analyses such as discriminant analysis and paired samples t-tests assisted in examining the data. Discriminant analysis provided a method to investigate differences between groups based on various characteristics. Paired samples t-tests were used to compare before and after observations on the same institutions studied.

### **Definitions**

The following definitions of terms used in this study are provided for clarification:

*Backfill:* “Additional staff hired or reassigned from other departments to replace key functional and technical staff assigned to the project because of their knowledge, skills, and abilities” (Babey, 2006, p. 22).

*Carnegie Classification:*

“The Carnegie Classification has been the leading framework for recognizing and describing institutional diversity in U.S. higher education for the past four decades. Starting in 1970, the Carnegie Commission on Higher Education developed a classification of colleges and universities to support its program of research and policy analysis. Derived from empirical data on colleges and universities, the Carnegie Classification was originally published in 1973, and subsequently updated in 1976, 1987, 1994, 2000, 2005, and 2010 to reflect changes among colleges and universities. This framework has been widely used in the study of higher education, both as a way to represent and control for institutional differences, and also in the design of research studies to ensure adequate representation of sampled institutions, students, or faculty” (Carnegie Foundation for the Advancement of Teaching, 2011).

*Change management:* According to Swaminathan (2011), “Enterprise wide culture and structure change should be managed (Falkowski et al., 1998), which include people, organization and culture change (Rosario, 2000)” (p. 25).

*Communication plan*: “An integrated approach using various media to keep all stakeholders informed during the ERP implementation project” (Babey, 2006, p. 22).

*Consultants*: “Third-party individuals who have expertise and experience in implementing ERP systems. They are hired to assist the project team in implementing the ERP system in the most efficient and effective way in the shortest amount of time” (Babey, 2006, p. 22).

*Customization*: “Modification of base system software (code) to meet a functional need that the baseline product cannot” (Babey, 2006, p. 22).

*Enterprise resource planning (ERP) system*: “Software that provides computer system integration and support to all units and functions across an organization in a single system, thus eliminating the need for individual unit databases or systems” (Babey, 2006, p. 22).

*Hardware and infrastructure*: “Physical equipment, such as servers, personal computers, cabling, network and clustering switches, backup devices, storage devices, and disaster recovery devices, required for an implementation” (Babey, 2006, p. 22).

*Institutional age*: The age of the institution, in years, calculated by subtracting the year the IHE was founded from the current year.

*Inputs*: Revenues received by IHEs from various sources such as tuition and fees, state appropriations, local appropriations, government grants and contracts, private gifts, grants, and investment return (IPEDS Glossary, 2011).

*Institutional control*: “A classification of whether an institution is operated by publicly elected or appointed officials (public control) or by privately elected or appointed

officials and derives its principal source of funds from private sources (private control)” (IPEDS Glossary, 2011).

*Institution size*: The institutional size “indicator is derived based on the institution’s total students enrolled for credit” (IPEDS Glossary, 2011).

*Legacy systems*: “Software applications used by institutions prior to the implementation of a new system” (Hossler & Pape, 2006, p. 4).

*Licensing fees*: “The cost of vendor licenses for software required for an ERP implementation. These are usually one-time fees” (Babey, 2006, p. 22).

*Maintenance fees*: “The cost of vendor support tools such as mailing list servers, help desks, updated documentation, user conferences, consultant support, and application of software patches. These are typically yearly fees and tend to increase on an annual basis” (Babey, 2006, p. 22).

*Outputs*: Expenditures spent by IHEs for institutional activities and support such as instruction, research, public service, academic support, and student service (IPEDS Glossary, 2011).

*Software*: “All programs, procedures, and routines associated with a computer system. System software controls the computer’s internal functioning. Application software directs the computer to execute commands that complete processes and solve problems” (Babey, 2006, p. 22).

*Total institutional support*: The total support of the institution is computed by adding all expenses for the day-to-day operational support of the institution. It “includes expenses for general administrative services, central executive-level activities concerned with management and long range planning, legal and fiscal operations, space management,



employee personnel and records, logistical services such as purchasing and printing, and public relations and development. Also includes information technology expenses related to institutional support activities. If an institution does not separately budget and expense information technology resources, the IT costs associated with student services and operation and maintenance of plant will also be applied to this function” (IPEDS Glossary, 2011).

*Total FTE staff.* “Term used to describe all staff employed by or employees working in a postsecondary institution, except those employed by or working in the medical school component of the institution. Includes staff employed by or employees working in the postsecondary component of a hospital or medical center that offers postsecondary education as one of its primary missions; also includes those working in first-professional schools (e.g., law schools, dental schools, schools of optometry) except medical schools” (IPEDS Glossary, 2011).

### **Limitations**

This study assumes certain aspects of ERP systems implementation and control of institutions (public or private). The assumption is that for the sample of IHEs studied that have implemented ERP systems, these commercial systems are similar based on scope, time to implement, and cost of implementation. Significant variation in these factors could skew the results of the research. For example, if one institution’s ERP implementation includes the implementation of the typical three modules of student information system, financial information system, and human resources information system, the results of the research could be different from an institution that may have

implemented one or two of the modules. Also, the costs of ERP software and hardware could vary due to inflation or other economic factors.

Whether IHEs are publicly or privately controlled may predispose them to influences derived by their governance structures and primary sources of funding. Public institutions are typically older, charge a modest amount in tuition and fees for in-state resident students, and have larger student enrollments because they were established through land grants in the late 1800s to serve state needs. Public IHEs are considered more bureaucratic because they are accountable to regulatory agencies and rely upon governance by elected officials who appropriate funding through legislation. When officials change every few years, as well as legislation, public IHEs are impacted. Alternatively, private institutions rely upon high tuition and fees, endowments, and other donations. While there are prestigious older private IHEs, there are also younger institutions that are privately controlled. Private IHEs are somewhat less bureaucratic and governed by boards and a chief executive responsible for institutional operations. Although there are differences, both public and private IHEs depend upon federal grants and contracts to fund research and contribute to institutional support. Therefore, factors such as funding sources and governance can influence an institution's operations and dependence on resources. This research sets a baseline to gain an understanding of the context of ERP systems implementation in the landscape of American higher education and generates more questions than it answers, partly because the data for the study encompasses years of recession in the United States. The next section discusses the significance of the study.

## **Significance of the Study**

Available resources are on the decline due to the economic downturn in the United States since 2007, yet technology still costs billions of dollars each year across the landscape of American higher education. Technology is essential to the function of higher education and affects all areas of an IHE, especially in service to students.

With funding for both public and private IHEs in a dire position given the recent economic downturn, this is a significant issue because institutions desire to allocate diminishing resources effectively and utilize technology to best serve the needs of students, faculty, staff, and researchers. Further, with the advent of implementing enterprise resource planning (ERP) systems in higher education, the costs and organization of technology are changing. Institutional leaders are evaluating how technology should be organized and used to gain the greatest cost savings and efficiencies possible while remaining flexible enough to meet the technology needs of key constituents.

The significance of this study was to gain an understanding as to whether emerging commercial ERP technology influences the ability of institutions to compete in the environment and deliver the primary service of instruction to students, enabling the institution to operate within available fiscal and human resources. This is important given the declining funding allocations for colleges and universities since the 2000s, and the prediction that economic circumstances in America are not expected to improve until 2015 (Carnevale, Smith, & Strohl, 2010). This study may enable senior, and executive administrators to examine tangible resources needed to implement ERP systems while considering the intangible workplace implications of utilizing ERP technology. In

addition, institutional leaders may develop strategies to minimize or avoid dependence upon external actors in the environment to acquire and maintain critical resources.

Further, the study reviewed the hidden costs of ERP systems, addressed by comparing IHEs that have and have not implemented ERP systems. Devadoss and Pan (2007), Langenwalter (2000), and Nash (2000) report that there is a high failure rate for ERP systems implementation projects, with about 60 percent of such projects failing. Additionally, half of the top 10 IT failures of all time are ERP systems implementation projects from market leaders, with losses in the range of tens of millions of dollars per project. This study examined various institutional resources, from the origins of funding and where it was allocated, and how personnel were allocated in IHEs to determine if there are similarities or differences between FY 06 and FY 10 for institutions that have and have not implemented ERP systems.

Research in the area of resource dependency theory has been primarily focused in the business sector and large corporations; the concentration of this study was in the sector of higher education. Casciaro and Piskorski (2005) state “resource dependence theory is more of an appealing metaphor than a foundation for testable empirical research” (p. 167). Thus, this study will contribute to the larger body of knowledge utilizing RDT to establish empirical research.

## **Summary**

Applying knowledge gained through investigating how organizations work efficiently and effectively will make the best use of the limited resources accessible to IHEs. In the 21st century and beyond, technology will continue to play a prominent role in the way business is conducted in every facet of society. Therefore, understanding the

costs and implications of technological advances and recognizing the dependence on external factors in order to minimize or avoid them is necessary for IHEs to be sustainable in an uncertain economic climate and is worthy of investigation.

In this chapter, a brief synopsis of the literature review, theoretical framework, purpose of the study, research questions, research methods, definitions of key terms, limitations of the study, and significance of the study have been presented. The next chapter will provide an in-depth discussion of the relevant and current literature pertinent to this study.

## CHAPTER 2: LITERATURE REVIEW

### Overview

“Information technology (IT) has found its way into every aspect of higher education (IHE)” (McClure, 2003, p. 1). Technology is a vital component of higher education because it is integral to delivering services to the academic enterprise while maximizing the use of limited institutional resources. The transformation of IT continues, and we are beginning to deal with technology in higher education as a “grown-up instead of the unruly youngster as Hawkins and his contemporaries described in 1989” (McClure, 2003, p. 1) in *Organizing and Managing Information Resources on Campus*. Enterprise resource planning (ERP) systems have become the technological solution of choice to facilitate the delivery of operational services efficiently, and within the context of this study related to ERP systems, the use of the term “business” refers to the operations or the academic enterprise of IHEs.

The role of ERP systems has expanded over time. Swartz and Orgill (2001) state “The range of functionality of ERP systems has further expanded in recent years to include more applications, such as grants management, marketing automation, electronic commerce, student systems, and supply chain systems” (p. 20). Specifically, utilizing an institution’s human resources, that of technology staff, is integral to the implementation of ERP systems, and understanding the placement of technology units within the institutional structure and how they are organized represents its functional importance to institutional operations. Further, Katz et al. (2004) remark, “The lively and ongoing conversation about the nature of the [Chief Information Officer] CIO position has reiterated the importance of establishing high-level reporting relationships, and especially

an official place on the executive team” (p. 23). Through the implementation of ERP systems, leaders have come to realize there is critical institutional dependence on resources and information. The purpose of this national study was to utilize quantitative methods to examine institutional characteristics, financial resource variables, personnel variables, and customer variables of public and private institutions that have and have not implemented ERP systems, from a resource dependence perspective.

A thorough review of the literature was performed to provide a basis for the study, and this chapter focuses on the larger body of knowledge that exists through previous studies surrounding the following areas: (a) using IT in higher education (including aligning IT units with organizational goals, and the roles of IT leaders); (b) funding in higher education (including funding for IT and ERP systems implementation); (c) examining ERP systems implementation (including project scope, operational process changes, and organizational benefits); (d) understanding costs of ERP systems implementation (including acquisition costs, implementation costs, and post-implementation costs), and (e) applying the theoretical framework of resource dependency theory as it relates to organizations seeking to manage their environments by: using strategies to enhance their autonomy and pursue their organizational interests; acquiring, maintaining, and controlling critical resources from the environment, and understanding that social context matters in the relationship between organizations and their external environment.

## **IT in Higher Education**

The utilization of technology in higher education has reached an acceptable level of maturity as evidenced by the global implementation of technology in today's society (Ramcharan, 2006). According to Katz et al. (2004), IT in higher education has been transforming over the past 60 years: in the 1950s, computers began to replace tabulating equipment with data processing equipment; from the mid-1960s through the 1970s, systems design and development was the focus in order to move away from data processing to information management, and the integration of separate systems came to be recognized as beneficial due to the capabilities of large mainframe computers, which heightened the necessity for strategic planning; by the 1980s the title "CIO" or Chief Information Officer was formulated to describe the concept of a senior executive of the organization responsible for IT policy, management, control and standards; and by the 1990s into the early 2000s, the use of technology in higher education expanded to include administrative computing, academic computing, telecommunications, infrastructure and network support, instructional technology and research computing. In addition, Green and Gilbert (1995) state:

“...we may expect major, substantive benefits from more widespread academic uses of information technologies--in the areas of content, curriculum, and pedagogy. Further, the demands and expectations of students and faculty for information technology are increasing the pressure on colleges to make it readily available” (p. 8).

Therefore, there are significant changes in IT that affect the ability of IHEs to deliver services to the satisfaction of students, faculty, and staff.

Over the past 20 years, due to rapid technological changes and advances, leaders of IHEs have been trying to keep pace and manage these changes and advances. This is especially challenging because of the perception that leaders operate at a slow pace in



higher education, and IT costs have increased at a rapid pace without increases to related budgets. Therefore, leaders primarily make organizational changes that may have less monetary impact. Katz et al. (2004), observe:

“Some colleges and universities distributed computing units throughout the institution in attempts to better serve end users. As computing became more widespread and IT costs increased, the movement toward information resources management began, and the need for a seamless infrastructure became apparent” (p. 23).

There are many uses of IT in higher education to develop the seamless infrastructure described by Katz et al. (2004). Recently, the 11 significant uses of IT in higher education described by Goldstein (2010) are: custom applications development, desktop computing support, help desk management, academic and research computing, instructional technology, operations/data center management, administrative information systems, network infrastructure and services (i.e., systems administration and database administration), web support services, IT procurement (i.e., hardware and software), and IT security. Thus, the scope of technology services that IHEs need to manage has diversified and produced the need for the management of these resources.

Moreover, Katz et al. (2004) affirm, “The role of the central IT organization became every bit as much a provider of services as of cycles, application development, and implementation. Such services included training, consultation, support, and the development of institutional standards” (p. 23). The following institution-wide systems were integral to developing institutional standards: electronic mail, learning/course management, student information, financial information, and human resources information. These standards were meant to ensure IHEs utilize the information available to them in a consistent way. Kvavik and Katz (2002) comment,

“Financial, human resources, student, and other information systems provide the foundation on which the business of the higher education enterprise sits. Higher education’s business practices and processes, and the information that guides decision making in large areas of the academy, interact with and derive from these information systems” (p. 5).

Therefore, one significant use of technology in higher education is the implementation of a comprehensive system to assist the institution with managing student, human resources, and financial information. This can be accomplished with the implementation of ERP systems.

Swartz and Orgill (2001) explain, “The term enterprise resource planning [ERP] was coined in the early 1990s. The ERP project yields a software solution integrating information and business processes to enable sharing throughout an organization of information entered once in a database” (p. 20), and Kvavik and Katz (2002) add, “These systems are by definition critical to the institution’s mission” (p. 5). Consequently, institutions can utilize ERP systems to integrate resources and business processes to improve their operations to deliver services to students, faculty, and staff.

Since information systems have evolved over the past six decades, implementing ERP systems is becoming commonplace, leading to dramatic change at institutions now tasked with managing the fiscal and human resources needed to implement ERP systems. “As colleges and universities have been asked to be more efficient and to manage resources more like businesses do, they have sought management tools to achieve these goals” (Gorr & Hossler, 2006, p. 7). Moreover, 11 years earlier, Green and Gilbert (1995) explain,

“...the rising financial pressures confronting higher education also have focused attention on the promise of technology to improve productivity in higher education. The stated hope of Green and Gilbert (1995) is that computing and information technologies will yield new levels of institutional and instructional ‘productivity’” (p. 8).

Hence, IHEs have had to manage scarce fiscal and human resources over many years and have looked to technology as an answer to improve productivity. This continues to be the case due to the recent downturn of the United States' economy, Goldstein (2010)

comments,

“From 2007 to 2010 the United States economy experienced its worst period of decline since the 1930s...The recession arrived on the doorstep of higher education in 2008. Billions of dollars were lost from institutional endowments, states cut spending on public higher education...” (p. 11).

Consequently, IHEs need to handle the resource limitations facing them, and there is a natural progression to, strategically, realign technology functions to support the enterprise.

**Aligning IT units with organizational goals.** One type of strategic realignment is consolidating technology staff from many areas within the institution into a single, central technology unit. The challenge here is for the central technology unit to continue to support the diverse technology needs of the various colleges and divisions while these units have evolving and increasing demands for technology. As distributed computing units became prevalent throughout institutions in attempts to serve students more efficiently, IT costs increased, and as the movement toward information resources management began, it was apparent there was a need for seamless infrastructure on campuses (Katz et al., 2004).

Researchers in the area of IT services have examined the necessity and benefits of aligning IT units with business goals (Chan & Reich, 2007; Teo & King, 1997; Kholi & Grover, 2008), or in the academic enterprise of higher education, the academic mission of institutions. Nworie (2006) states:

“Academic technology units in higher education have witnessed tremendous change in the last one and a half decades. The changes have

led to reorganizations, realignments, adoption of innovative administrative structures, increased demands for services, and the addition of new roles for their personnel” (p. 105).

Thus, with the rapid pace of technological advancements, IT units are progressively changing to ensure that resources are used effectively and efficiently. As “central IT organizations [absorb] the campus utility functions of administrative systems and communications” (McClure, 2003, p. 8), including the use of ERP systems, eventually a period of stability will emerge. In addition, Leslie and Rhoades (1995) describe “The more complex the technology or the technological demands internally, the more complex the organizational and administrative structures of the organization” (p. 195).

However, there are differing views on the alignment of IT in higher education. The research literature of Lackey and Brown (2002); Bieberstein, Bose, Walker, and Lynch (2005); and Peterson (2004) indicated structural flaws hindering the placement of IT within corporations and IHEs. Chan and Reich (2007), and Hirschheim and Sabherwal (2001) recognized that aligning IT is complex and interdependent upon business and IT motivators which will have a positive effect on the organization’s performance. Therefore, where the technology staff fit within an institutional structure is crucial, and this has been a source of debate for some time. Goldstein and Pirani (2008) remark:

“Technology has not been the only driver of transition. The role and positioning of the IT organization and the IT leader have also undergone multiple transitions. In arguably less than 30 years, many institutions have gone from separate central technology organizations to today’s IT group with broad responsibilities for academic and administrative computing as well as enterprise infrastructure” (p. 9).

Three ideologies are the basis of Hirschheim and Sabherwal’s work (2001) extending the concept of alignment: organizational performance is based on structures and the capabilities to execute strategic decisions, IT is an influence on business strategy, and

strategic alignment is a process. Thus, IT must be recognized as a strategic part of the enterprise and evaluated seriously in order to maximize its benefits for the greatest efficiencies and effectiveness for institutional operations. Nworie (2006) observes:

“In the midst of the changes, institutions continue to investigate the best approach to the organization of their academic technology to best serve faculty and the instructional needs of the institution. Proper organization and effective administration can lead to a thriving unit that efficiently supports the instructional goals of the institution” (p. 105).

In addition, according to Zehir and Keskin (2003), the use of technology affects how organizations are structured and restructured; while human resources staff attempts to generalize the use of IT employees within the organization, it is essential to consider that IT employees enhance the internal activities and processes which are subsequently necessary to improve the financial performance and competitiveness of the organization. This shows that IT transcends the entire organization and facilitates change across several departments. The important aspect to distinguish the organization structure of technology staff is to understand how technology units meet the needs of the institution in a centralized and cost effective way, versus a decentralized and cost intensive way, as is the case with the dispersion of technology staff throughout schools, libraries, and divisions at the institution to meet each area’s specific needs. According to Green and Gilbert (1995):

“Clearly, technology has brought both enhanced productivity and reduced costs to some parts of higher education. Like many corporations, campuses routinely and effectively use technology in many administrative areas. As in the corporate domain, computers have improved productivity related to a wide range of data management and transaction processing activities: personnel files, course schedules, library catalogs, budgets and accounts receivable, student transcripts, and admissions information” (p. 11).

Some colleges and universities may indicate that IT units are the source of pressure to automate services, and the stress comes from the complexities of managing the variety of

systems used by academic and administrative areas within a college or university. Creating a uniform operating environment and bringing all the systems together is a way to decrease the work of a particular IT unit, however, this would require integrating data and systems that can be managed by a centralized IT unit. A compelling argument presented by Chillingworth (2006) explained that different faculties of a college or university “have their own library and technology systems, but as universities become more competitive and business minded, they are moving over to business-wide applications such as the ERP systems offered by IT giants like IBM, SAP, and Oracle” (p. 4). Five years earlier, these were the popular ERP systems vendors cited by Swartz and Orgill (2001). There is an expectation that IT leaders will lead the institution in managing technology operations, and specifically large-scale ERP systems implementation projects.

**Roles of IT leaders.** “The role of the Chief Information Officer [CIO], one of the newer positions in higher education senior leadership, continues to transform and evolve” (Lambert, 2008, p. 36) as the placement of the central IT unit is solidified in the institution’s organization structure. However, there are other senior IT leadership positions that exist in higher education due to the need to meet specific technology demands of colleges, schools, and divisions at institutions, which are not directly involved with the central IT unit. Depending upon the size of the institution, these senior level positions are typically referred to as IT Manager, Director of IT, or Executive Director of IT. Interestingly, all senior level IT leaders face similar challenges.

Technologies changing at a rapid pace augment the CIO’s role. Much of the research “focused on the emergence of the CIO as an academic leader who projects

organizational alignments that serve to integrate pedagogic support centers, libraries, and IT organizations” (Lambert, 2008, p. 36). The role of the CIO indicates a significant opportunity for the institution because this person’s input can assist the highest level of institutional leadership in utilizing IT in significant ways to improve institutional operations. However, this change in the CIO’s role can also be driven by other factors such as “integration of information resources/technology/services with institutional mission, goals, priorities, planning and funding strategies; challenges of IT staffing; funding/generating revenue; managing expectations; and determining the cost and the appropriate amount or level of services” (Viswadoss, 1999, pp. 24-25). Therefore, the CIO is a key leader who leverages a variety of resources available to the institution. “Increasingly, the CIO is working with new executive partners across the institution [such as vice presidents for finance, human resources, student affairs, and research because] business processes that were not traditionally dependent on digital technologies now require complex central enterprise systems” (Lambert, 2008, p. 36). Institutional business processes include, but are not limited to, admitting students, hiring and paying employees, procuring goods and services, and administering research grants. Thus, what were referred to as “enterprise applications” in the early 2000s (financial information systems, student information systems, and human resources information systems) have changed to include classroom management and instructional delivery systems (Lambert, 2008).

Additionally, Mark (2008) states “Library, education, computer science, and business literature all stress the increasing importance of instructional technology in higher education. Phipps and Wellman (2001) noted that ‘instructional technology is

bringing rapid and profound change to higher education” (p. 408). Therefore, new strategic opportunities to serve students continue to emerge at the enterprise level, and IHEs anticipate the CIO will lead these efforts. This is echoed by Lambert (2008) when he writes “fundamental shifts in mission [are evident] with the emergence of the ‘global’ university, [meaning] the university whose programs can be delivered anytime/anyplace...” (p. 37) will create a challenging environment for the CIO.

Another significant challenge is ensuring information security to protect the institution from many technological threats and vulnerabilities. This is clearly demonstrated by the considerable amount of “time CIOs spend addressing continuity [of operations] and emergency management planning across the institution or in how much pressure CIOs [experience] when the campus e-mail or web services misfire” (Lambert, 2008, p. 37). Electronic mail and web services are mission critical systems which affect communication at all levels. In addition, ERP systems are a cause for concern to maintain a high level of security because of the vast amount of data that are available in one comprehensive, enterprise system. Therefore, “...CIOs have new opportunities to exploit, showing how technology can add value to the future strategies of the institution” (Lambert, 2008, p. 37), thereby garnering importance to their role within the institution.

### **Funding in Higher Education**

A variety of inputs and outputs determine funding in higher education, and it is a complex topic “because of its multiple sources of revenue and its multiple outputs...” (Johnstone, 2001, p. 3). The level of the institution (2-year or 4-year) and institutional control (public or private) affects the inputs and outputs of an organization to produce products and/or services (e.g., measured in student enrollments, graduates, student



learning, or the scholarly activity of the faculty) of the IHE (Johnstone, 2001). This section will briefly review inputs, or revenue, and outputs of IHEs including personnel to deliver services, and then discuss funding of IT and ERP systems implementation.

The inputs, or revenues, for the academic enterprise are derived from three main sources: (a) students and parents that pay tuition and fees; (b) taxpayers that pay taxes to local, state, and federal governments that in turn provide funds for institutional support, and (c) philanthropists that contribute donations, endowments, and grants to institutions (Johnstone, 2001). These inputs vary depending on the type of institutional control. For example, private institutions rely heavily upon tuition and fees, and public institutions depend upon state funded support; however, both public and private institutions depend upon loans and grants provided to students by the federal government (Hauptman, 2001).

Further, the impact of these inputs varies depending upon the level (i.e., 2-year or 4-year) and classification (i.e., doctoral/research universities, master's colleges or universities, or community colleges) of institutions. At 4-year doctoral/research universities, federal grants and contracts support the bulk of campus-based research activities for institutions in both the public and private sectors (Hauptman, 2001). For masters' degree granting colleges and universities, these 4-year institutions are commonly under public control and faces pressures to accommodate growing numbers of students with limited state support (Hauptman, 2001). Institutions classified as community colleges provide 2-year programs, and typically rely upon local and state support from taxpayers to contribute toward their funding (Hauptman, 2001).

As funds are received by the institution, these resources need to be allocated appropriately to support the institution's operations. The expenditures of an institution are

its outputs, and the four primary areas of expense are instruction and academic support, student services, research, and administration (Waggaman, 2001). Instructional and academic support costs encompass faculty and staff salaries and benefits, libraries, development of curriculum and course materials, technology, and facilities to deliver instruction to students. IHEs also provide services to students that engage them in social ways, in addition to, academic methods. Further, faculties at IHEs are increasingly interested in conducting research, and the institution needs to utilize significant funding to maintain or enhance its research infrastructure (Waggaman, 2001). Although the three core areas of expenditure previously described are significant, there are many expenses for administration or institutional support that need to be considered for the day-to-day operational support of the institution. Legal and fiscal operations, space management, human resources management, and technology management must all be considered as part of the overall picture of outputs (IPEDS Glossary, 2011).

The expenditures of IHEs are heavily related to the personnel needed to operate the institution. For each area of expenditure described previously, there are corresponding personnel to manage these services and support functions. Faculty deliver instruction and academic support; professionals manage the delivery of student activities and enrollment; a variety of technology and non-professional staff besides faculty manage research activities including supporting the infrastructure and facilities, and an array of executive, administrative, and managerial staff manage a variety of academic and administrative units (IPEDS Glossary, 2011).

Organizations exist to provide products or services, and the outputs, or expenditures, of an enterprise are where funds are allocated to deliver the products or

services. In higher education, the primary service is teaching and learning; therefore, “...the dominant measure of efficiency...is the cost per student credit hour, or cost per full-time equivalent student.” This cost is a function of the average faculty and staff costs, the prevailing faculty/staff-to-student ratio, and expenditures for items other than teaching, whether technology, facilities, student affairs, marketing, or general administration (Johnstone, 2001, p. 18). For the academic enterprise to be successful, it needs to utilize its resources effectively and efficiently, and technology is a mechanism IHEs can use to maintain or increase the ability to be successful.

**Funding of IT.** Information technology costs are typically expenses associated with administrative costs as they are measured and reported to governing bodies. Leslie and Rhoades (1995) remark, “Whatever categories are used to measure and explain administrative costs, there will be some dispute about definitions” (p. 195) for “academic support” and “administrative” costs in higher education, but they conclude that either of these terms will include costs associated with computing or technology. American colleges and universities, both public and private institutions, “were expected to spend \$6.94 billion on technology during 2006, a 35% increase compared with the prior year” (Mark, 2008, p. 406). The three types of funding for technology at public IHEs originate with the state government, the federal government, and tuition and fees.

States appropriate funding for public IHEs to support the core functions and mission of these institutions, including technology infrastructure, technical management, and support staff. It is pertinent to note that technology “is changing how we organize, fund, and evaluate our institutions” (Katz & Rudy, 1999, p. 5). However, Mark (2008) refers to Glick and Kupiec (2001) when she writes “Information technology expenses

continue to mount, and public support wavers, placing the burden on administrators to educate the public and national leaders about the importance of maintaining an IT infrastructure” (p. 408). Moreover, according to Zusman (2005), higher education has been portrayed as one of a small number of state-supported activities, discretionary in nature, setting up the potential for legislatures to cut spending there. The result is a waning of financial resources for both public and private IHEs. Mark (2008) states,

“Goldstein et al. (2004) identified the financial trends affecting higher education including declining state funding, decreased endowment returns, and increased costs for expenses such as health benefits, financial aid, and utilities; these factors have caused virtually all higher education institutions to repeatedly cut budgets, including IT” (p. 412).

Thus, the amount of funding available for technology from states is decreasing, and these resources must be used prudently.

Grant funds appropriated through government bodies in the United States such as the Department of Education, or through philanthropic foundations such as the Bill and Melinda Gates Foundation have specific grant objectives that need to be fulfilled.

Therefore, grant funds are often allocated to support technology initiatives to accomplish grant objectives within a given time frame. Breneman and Finney (2001) remark that colleges and universities have the ability to raise funds from non-state sources, including tuition increases, private fundraising, and federal grants. In the 1990s, federal support for research through grants increased by 20%, but this growth is not sustainable because the federal government is working to reduce the deficit and balance the budget (Breneman & Finney, 2001).

Tuition and fees collected to support a variety of student and auxiliary services at IHEs are often appropriated to support technology personnel within service areas such as residence life and central IT operations. According to Breneman and Finney (2001), “For

the first time since the mass expansion of public colleges and universities, tuition overtook state government appropriations to institutions in providing the largest share of revenues for higher education” (p. 162). Another fee, a usage or cost recovery fee was instituted to recover costs associated with technology; IHEs began levying charges for network access in dormitories, and services such as scanning and laser/color printing (Ringle, 1992). Thus, an assortment of charges are applied based on the specific needs of the student population that may go above and beyond the traditional IT services customers expect institutions to provide.

In their research study, Goldstein (2004) references “a host of current financial management practices related to IT in higher education; to describe the state of practice in this critical area; and to identify funding practices that appear to contribute to the overall effective function of the IT operation” (p. 1). These practices included a range of activities such as governance and technology management. Goldstein (2004) states, “Most larger IT shops are funded from a variety of sources, including student and other technology fees, institutional budget allocations, and chargebacks for services” (p. 16). These sources of funding could be used by the central IT office, or other decentralized IT units within an institution to address explicit technology needs for institutional operations. One central use of technology for IHEs is the implementation of ERP systems.

**Funding for ERP systems implementation.** ERP systems are an expensive venture and utilize a multitude of financial and human resources. “[They] are among the largest single concentrated investments in dollars and human resources ever made by higher education in any area” (Kvavik & Katz, 2002, p. 17). Moreover, the investment is

not in the millions, but billions of dollars. “At the end of the twentieth century and into the twenty-first, higher education [in the United States] has invested, by a conservative estimate, \$5 billion in administrative and [ERP] systems” Kvavik and Katz (2002, p. 11), and Swartz and Orgill (2001) add, “Universities often spend in excess of \$20 million each to implement modern [ERP] projects” (p. 20). Thus, the investment in ERP systems is significant and presumes the promise of improved performance for an institution.

According to Oberlin (1996), “Information Technology promises to deliver big benefits down the road, but there will also be big expenses” (p. 365). Funding for expensive ERP projects at public IHEs is primarily from the state; however, fees, paid by students, were often introduced to assist with procurement of human and physical resources needed during the implementation and maintenance phases of the project. Accordingly, Ringle (1992) remarks, “A surprisingly large number of institutions still rely heavily on one-time funding sources, including capital allocations, discretionary funds, gifts, and grants, to subsidize operational increases in technology support” (p. 360). Typically, ERP projects were funded through one-time capital allocations by the state (Kvavik & Katz, 2002).

As components of the term “ERP” may indicate resource planning for the enterprise, there are dependencies associated with the undertaking of an ERP project. According to Leslie and Rhoades (1995), “...resource dependency links organizational structures (and expenditure patterns) to the organization’s economic dependency on external organizations. Organizations develop structures that are complementary to the structures of the organization’s resource providers” (p. 194). Thus, IHEs model their

organizational structures after the structures utilized by external sources such as state government.

### **ERP Systems Implementation**

ERP systems implementation is the most significant technology project an institution of higher education may undertake because of the resources that are dependent upon each other to achieve success. According to Green and Gilbert (1995), institutions hope that IT will yield new levels of institutional and instructional “productivity” to reduce costs associated with many administrative areas such as data management and transaction processing activities associated with personnel files, course schedules, library catalogs, budgets and accounts receivable/payable, student transcripts, and admissions information. Thus, Momoh et al. (2010) state, “...ERP [systems] implementations are challenging due cross-module integration, data standardization, adoption of the underlying business model, compressed implementation schedule and the involvement of a large number of stakeholders (Soh et al., 2000)” (p. 545). Undertaking ERP systems implementation may be affected by the placement of technology workers within an institution, the funding of IT, and understanding how ERP systems can play into the strategic alignment or resource dependence of technology.

Momoh et al. (2010) summarize the work of Davenport (1998), Themistocleus and Irani (2001), Muscatello et al. (2003), Ndede-Amadi (2004), and Elbertsen et al. (2006) and discuss relevant considerations of ERP systems implementation:

“Elbertsen et al. (2006) advise that the strength of ERP systems lies in integrating modules by coupling them, but this strength can be considered its weakness; the close coupling of modules means less responsiveness to the local requirements in particular functional areas. By their very own nature, enterprise systems can impose their own logic on a company’s strategy, organization, and culture (Davenport, 1998). Themistocleus and

Irani (2001) emphasize that the non-flexible nature of ERP solutions forces organizations to fit the package and abandon their way of doing business. This problem affects companies and in some cases has led organizations...to bankruptcy (Davenport, 1998; Muscatello et al., 2003). Furthermore, to highlight the fact that ERP solutions constitute cross-module integration, Ndede-Amadi (2004) argues that one key to a successful process redesign effort in an ERP implementation is to examine end-to-end processes, which are vital to the success of a company. End-to-end process design enables the strengthening of process integration” (p. 545).

For example, in higher education, the end-to-end process within a student services module includes admission, advising, course scheduling and selection, financial aid packaging and acceptance, tuition and fees payment, grade submission, and transcript retrieval. These processes are closely merged with the financial module of an ERP because the finances related to paying tuition and fees needs to be recorded correctly.

According to Davenport (1998), since ERP systems are modularized, there is a direct relationship between the number of modules selected for implementation at the outset and the costs, risks, and changes involved during implementation; the greater the benefits, the greater the cost and risk (Momoh et al., 2010). Therefore, ERP projects are typically implemented one module at a time. Others such as Ash and Burn (2003) and, Aloini, Dulmin, and Mininno (2007) review the complications associated with ERP systems implementation and integration with legacy systems depending upon the number of modules selected for implementation. According to Momoh et al. (2010),

“Aloini et al. (2007) caution that the number of implementation modules increases project complexity. Although, internal integration of a single module can pose problems, Ash and Burn (2003) found in a global study of ERP implementation that an added complexity is the integration of ERP environments with non-ERP environments, which has complex management implications” (p. 545).

Consequently, if an organization has no existing integrated system of managing its operations, then it will be more difficult to implement ERP systems. According to



Youngberg, Olsen, and Hauser (2009), ERP systems implementation is increasingly complex because of the significant amount of data that need to be managed. Within the context of higher education, there are hundreds of thousands of records that can be captured in one module of an ERP system, let alone two or more interrelated modules. Therefore, project scope, operational process changes, and organizational benefits are key considerations to undertaking ERP systems implementation.

**Project scope.** According to Momoh et al. (2010), the scope of

“ERP modules has been defined based on best practice business processes, which are coherently linked to each other, it is imperative that implementing organization’s business processes are correctly mapped to the ERP processes. Implementing these processes incorrectly may lead to very poor integration between the modules in the system” (p. 545).

For example, in higher education, it is vital that the student services module be integrated seamlessly with the financial and human resources modules because something as basic as a student’s primary record identifier can have implications for the payment of tuition and fees in the financial module or if the student is hired by the institution and is tracked in the human resources module, or if an employee becomes a student of the institution. “This challenge will in turn affect the [scope of the] ERP [systems] implementation; thus, it would be useful if practitioners understood the kinds of operational challenges that they may be faced with should their system lack proper module integration” (Momoh et al., 2010, p. 545).

In general, ERP systems implementation projects have revealed organizational ineffectiveness at the outset. According to Momoh et al. (2010), a number of companies have not realized the full benefits that an ERP has to offer because of “their poor understanding of ERP business implications” and unwillingness to realign departments or restructure processes (Yusuf et al., 2004; Ehie & Madsen, 2005). This is a concern for

IHEs because of the rigid nature of its organization structures that could affect the project scope. According to Momoh et al. (2010),

“Langenwalter (2000) stipulates that many companies that attempt to implement ERP solutions run into difficulty because the organization is not ready for integration, and the various departments within it have their own agendas and objectives that may often conflict with each other” (p. 546).

As institutions evaluate and document their needs, they need to have an understanding of the functionalities of ERP systems in order to identify gaps between what the software offers and their precise business requirements are (Davenport, 1998; Soh et al., 2000; Momoh et al., 2010), and keeping this in narrow focus will help define and control the scope of the ERP project. Typically, in higher education, institutional processes are ingrained over decades; hence the integration of ERP systems into a new norm may be difficult. Further, when viewing this from a resource dependence perspective, institutions are challenged with maximizing the use of financial and human resources within a given budget for ERP systems implementation which will affect the scope of the project and its success.

Change management is another aspect of ERP systems implementation that affects the scope of the project. Change management needs to be considered within the context of resource dependence and cost increases, and the overall success or failure of the implementation. According to Momoh et al. (2010),

“In a case study on a large manufacturing organization carried out by McAdam and Galloway (2005), they observed that a lack of change management was one of the major causes of implementation failures. This multinational manufacturing company...employs 10,000 employees across Ireland, UK, Europe, and the USA, and implemented SAP [a common ERP system]. The essence of the case study was to explore the organizational issues involved in implementing an ERP solution as the main approach to change management. Two change management failings that became apparent early on and were rectified during the ERP project

were the lack of communication with the employees, and an apparent failure to recognize the impact and complexity that such a change project would have on the entire business (McAdam & Galloway, 2005)” (p. 546).

This is similar to higher education because organizational issues and resource dependencies emerge when established processes need to change in order to fit the ERP system.

In addition to managing change, the resistance to change is a common problem associated with ERP systems implementation (Momoh et al., 2010). It is crucial to have champions for change working in the institution’s best interests. According to Momoh et al. (2010), “factors relating to top management support, assignment of best people to implementation teams, and concentrated involvement of people from the field are important in reducing the resistance to change involved in ERP implementation (Cissna, 1998)” (p. 547). Having supportive team members engaged in the implementation will help curtail “new requirements emerging after the implementation begins” (Momoh et al., 2010, p. 547) and adding costs to the project. Therefore, there are significant complexities in implementing ERP systems because financial and human resources are dependent upon the technology at hand and clearly defining the scope of the project is necessary to focus on the utilization of these resources.

**Operational process changes.** Changes to operational processes are an inevitable part of implementing ERP systems; it is not only a matter of installing new software (Yusuf et al., 2004). There are organizational changes that affect the structure and culture of an institution because ERP systems implementation entails the delicate weaving of tasks, people, and technology (Momoh et al., 2010) in order to facilitate dependent resources working together. Higher education is notorious for being slow to change; by

its fundamental nature, IHEs are institutionalized to carry out operations methodically and within a prescribed hierarchy.

According to Morris and Venkatesh (2010), “More than other systems, ERP systems have the potential to dramatically alter jobs and operational processes. Moreover, the degree of shock to the organization resulting from such systems is likely to vary across implementation stages” (p. 144). These stages include acquisition, implementation, and post-implementation. The initial acquisition phase includes planning, analysis, and requirements gathering; the implementation phase includes installing the software and incorporating the technology with operational processes, and the post-implementation phase includes integrating existing systems with the new ERP system (Cooper & Zmud, 1980; Markus & Tanis, 2000). These activities have a certain shock value for institutions because employees will prepare for a significant number of changes from the processes they have been following for several years or decades before. Thus, employees’ job characteristics and their job satisfaction are likely to be impacted by ERP systems implementation.

According to Morris and Venkatesh (2010), it is necessary to understand “how and why an ERP systems implementation affects the relationship between employees’ job characteristics and their job satisfaction” because more research has been conducted involving the adoption and use of technology, including ERP systems implementation, and organizational changes (Orlikowski & Barley, 2001; Venkatesh, 2006; Devadoss & Pan, 2007; Venkatesh, Davis & Morris, 2007; Morris & Venkatesh, 2010). Therefore, as processes change and tasks are redefined, employees’ dependence on technology increases, but they are constrained by learning how to use technology effectively. The

consequences that are applicable in the higher education sector include resource dependence among employees, vendors or consultants, and the technology itself because these resources are dependent upon each other to ensure a successful ERP systems implementation and use of the system thereafter. The results and post hoc analysis by Venkatesh et al. (2007) indicate "...that the demands associated with learning the new skills required following ERP systems implementation had a detrimental influence on job satisfaction, a finding that is likely to resonate with IT professionals who have actually had to implement such systems" (p. 154). Therefore, one of the most valuable resources for an institution, its personnel, is affected considerably by ERP systems implementation, and training becomes an essential component of the implementation and post-implementation phases.

**Organizational benefits.** One of the reasons organizations undertake ERP systems implementation is to reap organizational benefits. Job satisfaction is one organizational benefit, as well as changing business processes to improve efficiency. However, achieving efficiency takes time. IT leaders face challenges to attain an adequate return on investment within the first year of implementation (Davenport, 1998), and it often takes two or three years to confirm organizational benefits have materialized (Gattiker & Goodhue, 2005). This is consistent with the slower pace at which higher education moves; the pace is not comparable with industry because ERP systems evolved out of the manufacturing sector.

Some challenges institutional leaders face include employees' resistance to change or inadequate skills to use the ERP system, resulting in lower productivity and efficiency. According to Morris and Venkatesh (2010), "...the time needed for

employees to adapt to the software and embedded business processes that comprise the ERP solution may be substantial” (p. 156). In order for employees to navigate the implementation and post implementation stages quickly and attain the performance benefits that ERP systems promise, managers can institute organizational approaches such as training and reward systems sooner rather than later (Morris & Venkatesh, 2010). Therefore, there is inferred resource dependence between funding and personnel. In order for personnel to improve performance, funding for training and rewards is necessary to improve skills and provide organizational benefits.

Another organizational benefit is redesigning business processes that are in line with the selected ERP system. This is one option, or with additional funding, the organization may choose to customize the ERP system to fit its business processes (Koch, 2000). Most cost conscious organizations opt not to customize the ERP system. According to Morris and Venkatesh (2010), “This implies that existing business processes must often be redesigned to fit those embedded within the chosen ERP solution to become a benefit to the organization” (p. 156).

Further, not managing ERP systems implementation carefully, could result in lower job satisfaction for some employees because some anticipated gains in efficiency and effectiveness may only be relevant to managers, and not to those that carry out the day-to-day activities (Morris & Venkatesh, 2010). This is especially true in higher education where academic faculty desire to focus on their missions, to teach and conduct research; they are not particularly concerned with the use of ERP systems to accomplish their missions. According to Morris and Venkatesh (2010):

“...results suggested that the influence of ERP systems implementation may be more complex than previously thought, at least in the immediate

aftermath following implementation. In looking at some of the downstream consequences arising from ERP systems implementation, the results suggest that managers should not only consider the ERP system as an important technological artifact in the organization, but also view it as a key driver of job design and organizational change strategies as well” (pp. 156-157).

Therefore, organizational benefits could arise from understanding resource dependence as strategies to manage institutions efficiently and effectively through the implementation of ERP systems.

### **Costs of ERP Systems Implementation**

Oftentimes, institutions fail to understand the total cost of ownership (TCO) of technology. “[TCO] includes not only the implementation costs of software and hardware but acquisition and long-term ongoing support costs as well, especially for ERP systems” (Babey, 2006). It includes “all direct and indirect costs that might be associated with the life-cycle stages of an ERP project, including its implementation, operation, and eventual replacement” (West & Daigle, 2004, p. 3). The three major stages for ERP projects are acquisition, implementation, and post implementation. Allocating the appropriate human and financial resources for these stages, as well as for ongoing support, maintenance, and replacement are critical (Babey, 2006). According to Green (2005), ERP systems implementation involves a substantial investment of resources and is not for the “faint of heart.” Reviewing the costs of ERP implementation will provide a deeper understanding of the allocation and dependences of resources that can be identified as a result of these large, time-intensive, and expensive projects.

**Acquisition costs.** Acquisition costs, sometimes forgotten, are the “early costs associated with the process of deciding whether or not to implement an ERP system. Initial planning and acquisition costs are a real part of ERP implementation costs and

should be included in the budget” (Babey, 2006, p. 23). In this stage, human resources account for the largest expense due to the amount of time necessary to evaluate, analyze, make decisions about pursuing ERP systems implementation, and then plan for it.

According to Babey (2006), the commitment of time includes:

“Numerous meetings with campus stakeholders to determine whether implementing an ERP system is in the best interests of the institution and to gain buy-in...to identify and review ERP systems available in the marketplace...[have] vendor demonstrations, and [make] visits to selected institutions to see ERP systems in working environments” (p. 23).

Additionally, in the acquisition phase, developing the request for proposal (RFP) requires more staff time once the decision is made to go forward with an ERP systems implementation because the RFP must be well thought out and comprehensive (Babey, 2006). A statement of user requirements should be elicited by the central technology organization from the many campus constituents that will utilize the new ERP system. If any essential features or elements of the system are excluded from the RFP, it can result in costly problems or delays for the implementation; therefore, “allocating sufficient staff time to carefully analyze the responses to the RFP must be a planned cost” of acquisition (Babey, 2006, p. 23). The resource dependence between personnel, funding, and vendors is apparent when evaluating acquisition costs.

**Implementation costs.** As they are essential to the acquisition phase, human and financial resources are also crucial to the implementation phase of ERP systems. There is a substantial amount of work employees undertake during ERP system implementation, and many administrators fail to understand the value of this time to account for the cost involved to compensate employees for the additional work (Powel & Barry, 2005).

Moreover, additional employees need to be hired or reassigned as backfill for those that are assigned to work on the ERP system, and resources from consulting companies and



the ERP software vendor are necessary to have the expertise needed for the implementation. “Most decision-level administrators understand that their top functional and technical people should be assigned to the implementation project; however, they often fail to understand exactly how much of these individuals’ time will be required to implement an ERP system” (Babey, 2006, p. 26).

Further, Powel and Barry (2005) summarize that the cost of acquisition increased two-fold at Gonzaga University, with much of it including internal human resources dedicated to the ERP system implementation. Kvavik and Katz (2002), in their study of the University of Minnesota’s ERP system implementation, quoted a respondent stating, “We clearly underestimated the personnel resources required for implementation” (p. 45).

According to Babey (2006):

“The average percentage of total ERP system costs associated with in-house staff as reported in the 2004 Educause Core Data Study was 19.6 percent. The percentage ranged from a high of 23 percent for doctoral institutions to a low of 17.8 percent for bachelor’s institutions (Hawkins, Rudy & Nicolich, 2004). IHEs also fail to consider to what degree ongoing services can be negatively affected when key staff members are assigned to an ERP system implementation project” (p. 26).

Therefore, it is imperative to have a thorough understanding of the time and human resources needed to implement ERP systems, or IHEs will suffer the consequences.

The review of literature emphasizes the “need to present the critical factors that challenge ERP [systems] implementations, from a failure perspective. This stresses the urgency to address and correct these factors, from both research and industry perspectives” (Momoh et al., 2006, p. 559). These factors include human relations, job satisfaction, indirect costs, and loss of services. According to Morris and Venkatesh (2003),

“...the implementation of ERP systems cause greater change with broader impacts on employees; thus, fundamentally changing the nature of tasks, workflows, and by extension the jobs themselves (Davenport et al., 1996; Liang et al., 2007; Mullarkey et al., 1997). The importance of understanding ERP-initiated organizational change is evidenced by data indicating that the percentage of ERP failures is over 60 percent (Devadoss & Pan, 2007; Langenwalter, 2000), as well as trade press reports showing that half of the top ten IT failures of all time were ERP systems from market-leading vendors, with losses ranging from \$6 million to well over \$100 million (Nash, 2000)” (p. 143).

These costs are not solely related to implementation of the ERP system. The next section discusses human relations.

**Human relations.** When it is not accounted and planned for, the human element increases the chance of failure of ERP systems implementation. Therefore, institutional leaders need to be cognizant of the external resource dependence created by relying upon consulting companies and the ERP software vendor to implement the system at the institution. Additionally, there are direct and indirect costs related to a variety of human resources utilized for the implementation project. These resources include faculty, staff, and students who will use the new system, consultants to fill in when and where needed as the implementation carries forward and after implementation, and trainers to ensure users of the system have the proper instruction to use the ERP system.

Further, Momoh et al. (2010) identified that assigning a company’s best staff to help implement ERP system implementation projects is a critical success factor, but one that is not discussed in depth in literature. Although organizations may understand the principle of utilizing talented employees, leaders are conflicted about reassigning them fully to the ERP system implementation because they are worried that day-to-day activities will be adversely affected. The consequences of not assigning the most skilled employees to ERP projects need to be addressed. According to Momoh et al. (2010),

these consequences were "...drawn from case studies where business problems were actually experienced after neglecting to apply a critical factor. It would be most useful to highlight the exact business issues that were encountered in terms of loss of revenue or inefficient operations" (p. 557), due to not re-assigning skilled staff for ERP implementation. Knowing these business scenarios would substantially influence managers to assign their best staff for the project to ensure long term needs are addressed.

**Indirect cost: loss of services.** It is important for IHEs to understand the implications of time and effort expended by their limited human resources assigned to ERP systems implementation because this can result in the loss of services. Employees who fulfill key functional roles using their institutional knowledge have to deal with the pressures of working on a large-scale project and ensure their offices run smoothly. According to Babey (2006), "In many instances these staff members are expected to participate fully in the implementation and to continue in their daily roles. They quickly become emotionally drained and physically exhausted. They get sick and, in short, burn out. Some decide to resign" (p. 26). Those that remain often become ineffective due to stress and illness, leading to delays in the project, loss of services, and inevitably increasing the cost of the implementation (Babey, 2006).

Replacing employees is costly because of the time and effort involved in recruiting and training new staff, adding to the loss of existing services during the gap between when positions are unfilled and when employees are ready to be productive members of the project team. In addition, "Services in key functional units can be disrupted or delayed, affecting customer service and satisfaction. In a competitive market, poor services can be a factor in current students leaving an IHE or new students choosing

to go elsewhere” (Babey, 2006, p. 27). For example, if students cannot register for classes or receive advising due to poor service levels, they may explore other options outside the current institution.

In order to minimize the loss of services, IHEs can use external consultants.

According to Babey (2006),

“IHEs tend to think they can successfully implement an ERP system without spending money on external consultants. Often IHEs fail to understand the complexities of an implementation and thus fail to engage enough consultant time. What seems like a prudent decision at the beginning of the project becomes costly when new processes are not as efficient as expected because consultants were not available to help set up the optimal process” (p. 27).

Consultants often specialize in specific technologies and have many years of experience in a particular industry. This level of specialization would benefit organizations implementing ERP systems. According to Babey (2006), “The learning curve for in-house staff to gain the expertise and skills that a good consultant brings to ERP systems implementation could add months or even years to an implementation timeline” (p. 27). Further, Babey (2006) explains that some institutions falsely believe that their internal employees can learn a new programming tool such as Oracle in enough time to be productive and eliminate the need for a consultant with this experience; however, after a few months of going down this path, the IHEs decide to contract with consultants to ensure the project is readjusted to the timeline for completion. The result was a loss in valuable services the internal employees could have provided, as well as a loss in service and an indirect increase in cost to the ERP systems implementation project.

**Training costs.** Another cost of implementation is training staff at all levels, the staff implementing the project, functional and technical staff that will maintain the new system, and end-users who will interact with the system on a day-to-day basis.

“Implementing a new system without fully training all users is a waste of time and money, yet many institutions do not adequately fund an ongoing training program” (Babey, 2006, p. 28). The high cost of training is due to employees having to learn new processes, as well as a new system interface (Koch, 2006). In addition, Kvavik and Katz (2002) discuss that implementation budgets do not account for training needs adequately. Koch (2006) recommends, “Take whatever you have budgeted for ERP training and double or triple it upfront. It will be the best ERP investment you ever make” (p. 5).

Momoh et al. (2010) discuss critical factors that cause ERP systems implementation failures including training and other human factors. They cite Arindam and Bhattacharya (2009), “ERP systems implementation requires extensive employee training” (p. 29). Further, Koh et al. (2006) in their case study on six manufacturing organizations of different sizes related that many employees were not familiar with computers; thus, they were not trained to use the systems (Momoh et al., 2010). This resulted in: “erroneous data input; poor use of the systems; increasing costs of training services offered by the vendors; employee resistance to integration of the ERP system into the business process; and the need to hire information technology personnel” (Momoh et al., 2010, p. 547). There is ample support of training as a critical need in ERP systems implementation.

Further, “as IHEs realize that training needs do not necessarily end, they are beginning to fund full-time, ongoing trainer positions. The trainer is then responsible for developing and implementing an end-user training program” (Babey, 2006, p. 29). The timeliness and delivery of training programs is beneficial for users of the system because of the variety of learning needs that employees may have (Kvavik & Katz, 2002). If

training is delivered too far in advance, then end-users may not remember the information to use the new system. They also necessitate that training materials are accessible to remind them of procedural tasks as they are using the system. Regularly scheduled training classes need to be available for new employees that are hired. “Some institutions create full-time trainer positions rather than rely on ad hoc training or training carried out by someone who does not have professional training experience or expertise” (Babey, 2006, p. 30). Thus, training costs are part of implementation and post-implementation.

**Post-implementation costs.** Over the course of acquisition and implementation, institutions learn that existing employees and their skills may not be adequate for the post-implementation environment. As previously discussed, training is a continuing cost of ERP implementation. “If resources are not devoted to training staff to function in the ERP system environment, the system will not be used to its fullest potential and people will return to the home grown shadow systems they developed over time to accomplish tasks that university systems would not” (Babey, 2006, p. 29). Therefore, post-implementation costs typically include new functional and technical support positions inclined to require more advanced skills, knowledge, and abilities than many existing roles, and these will likely cost more to fill in order to increase the maximum advantages from the new ERP system for the institution (Babey, 2006, p. 30).

Among these new functional and technical roles include report writer, system coordinator and IT security officer. “Most ERP systems deliver very few reports, leaving IHEs to develop their own, and the more complex the institution, the more reports it tends to need; thus, the role of report writer has emerged” (Babey, 2006, p. 31). A new system also brings with it a need to coordinate activities between functional end-users and IT

staff. “The role of system coordinator...is typically responsible for: maintaining the integrity of the data in the system; assisting functional staff with system challenges; liaising among the functional office, IT, and other campus units; and working with IT staff to resolve system glitches while developing and maintaining a systems operations calendar” (Babey, 2006, p. 31). As previously mentioned, maintaining the security of enterprise systems is a significant need (Lambert, 2008). Therefore, “the IT security officer is another role...on campuses that have ERP systems [because] databases store a large amount of confidential information, and security measures must be put in place and monitored to protect that information from falling into the wrong hands” (Babey, 2006, p. 31). These three roles are among many that require specialized skills and experience to meet the demands of the organization; they contribute to the hidden costs of the overall ERP systems implementation and on-going maintenance for years and decades in the future.

Another cost of post-implementation is cleaning up and integrating existing systems. Babey (2006) remarks “There are a few [unique costs] that all institutions will incur to one degree or another. The cleanup of data on the existing systems, whether paper or computer, is one example” (p. 31). Part of the cleanup will include entering data from paper records, or ensuring the data in existing systems matches the definition of new data elements in the ERP system to be converted or migrated accurately. Both of these factors will be time consuming and costly based upon the decision to carry forward a predetermined amount of historical records. According to Babey (2006), “Much depends on how much data is being migrated and how easily it maps to the new system.

Building and testing links between the ERP system and other university software and Web sites is often an underestimated cost as well (Kvavik & Katz, 2002)” (p. 31).

The costs of post-implementation need to be accounted for because they are extensive and include a variety of items: training, new positions, systems integration, and upgrades to new versions of the ERP system. These costs also need to be incorporated into the institution’s annual operating budgets. According to Babey (2006),

“Postimplementation costs cannot be forgotten because they are substantial. They become part of the institution’s operating budget, and staffing costs are associated with every patch, fix, new release, or new version of the system. If any modification was made to the underlying code, the code has to be recreated every time a new release or version is installed” (p. 31).

With new releases or upgrades, the ERP system may require additional consulting time for those with the expertise required to perform this work in a timely manner. In addition, as the years progress, new hardware and software license fees need to be funded, and “part of ongoing training for functional users and technical staff is attendance at professional conferences, workshops, seminars, and vendor user-group meetings. These activities should be funded as ongoing ERP system implementation costs” (Babey, 2006, p. 32).

Ramirez (2003) identified a strong relationship between a solid investment in IT and increased productivity. The study claims that this relationship has been a topic of research for the past five to six decades. The majority of earlier studies in the field provide some degree of evidence of a direct connection, and more recent studies have consistently shown that IT investment significantly benefits the overall performance of a company. The implementation of an ERP system is a significant IT investment (Kvavik & Katz, 2002; Babey, 2006) made by an institution striving to improve productivity,



efficiency, and enhance the services offered to customers of the institution (namely students, faculty, and staff). If the necessary financial and human resources are not expended toward this effort, the implementation of ERP systems will not be efficient or effective, and will result in unhappy stakeholders and customers because a new system may not meet the needs of the institution (Babey, 2006). “The budget must include funds for the three project stages—acquisition, implementation, and postimplementation—as well as funds for ongoing support, maintenance, and replacement. Each stage has critical components that must be funded [and], all stages have critical human resource costs” (Babey, 2006, p. 32). Therefore, the dependence between human and financial resources is evident when attempting to determine the actual cost savings and measure the efficiencies and effectiveness of the services delivered by using ERP systems.

This section has addressed the variety of financial and human resources that are dependent upon each other through institutional support to deliver services, utilizing technology as a matter of normal operations, and improving operations to deliver services through technology, by way of implementing ERP systems. The next section will discuss the theoretical framework of this study.

### **Theoretical Framework**

Of the various theories used to understand the complexities of management, organization, and the use of resources, resource dependency theory (RDT) was applied to this study. This section will first discuss the origins, major components, and assumptions of RDT, then review relevant studies and findings from empirical research using RDT in higher education and the use of technology, and conclude with considerations of the

prevalence of using RDT in recent times, and how the major components of RDT were applied to this study.

**Origins.** There was an upsurge in the study of organizations in the 1970s (Davis & Cobb, 2009), and “resource dependency theory is perhaps the most comprehensive in the scope of its approach to organizations” (p. 3). In 1978, *The External Control of Organizations: A Resource Dependence Perspective* by Jeffrey Pfeffer and Gerald Salancik discussed many aspects of RDT that involved the importance of exchange and power in and around organizations and how organizations seek to manage their environments (Davis & Cobb, 2009). The study of power and resource dependence evolved during a period of tremendous corporate and industrial growth in the 1970s and 1980s. In the three decades since its inception, the influence of RDT extends to many disciplines such as management, sociology, education, health care, public policy, and other similar areas (Davis & Cobb, 2009).

**Major components of RDT.** “Resource dependence was originally developed to provide an alternative perspective to economic theories of mergers and board interlocks, and to understand precisely the type of interorganizational relations that have played such a large role in recent ‘market failures’” (Pfeffer, 2003, p. xxv). The five elements that have been widely studied within this context of RDT are mergers and acquisitions, joint ventures, boards of directors, political action, and executive succession. However, within their greater body of work, Pfeffer and Salancik (1978) discuss four broad themes centered around the theory of resource dependence that affect organizational effectiveness: (a) where organizational power and dependence come from, and how those that lead organizations use their power and manage or avoid their dependence is essential

for understanding internal and external actions of organizations (Davis & Cobb, 2009); (b) organizations seek to manage their environments by using strategies to enhance their autonomy and pursue their interests (Wang, 2008; Davis & Cobb, 2009); (c) acquiring, maintaining, and controlling critical resources from the environment (Straub et al., 2008; Hillman, Withers & Collins, 2009; Callen, Klein & Tinkelman, 2010); and (d) social context matters in the relationship between organizations and their external environment (Wang, 2008; Davis & Cobb, 2009).

First, the theme of RDT concerning the source and use of power is not applicable to this study but will be discussed briefly. The remaining three themes of RDT are applicable to this study will be reviewed later in this section. According to Pfeffer and Salancik (1978) a theme of RDT is:

“...the importance of the construct of power for understanding both intra-organizational and inter-organizational behavior. The importance of social power as an idea is an almost inevitable outgrowth of the focus of dependence and interdependence (Blau, 1964; Emerson, 1962) and the constraints that result from dependence and attempts to manage or mitigate those” (pp. xii-xiii).

Therefore, the balancing and rebalancing of power is a fundamental concept to understand when evaluating the dependence upon external sources that provide valuable resources, products, or services to the institution. This theme has been widely studied in corporations since the late 1970s.

Second, the organizational environment sets the tone for the firm in industry and how it will utilize resources to its advantage because organizations seek to manage their environments by using strategies to enhance their autonomy and pursue their interests. Pfeffer and Salancik (1978) state, “Organizations seek to avoid dependencies and external control and, at the same time, to shape their own contexts and retain their

autonomy for independent action” (p. 261). By using information, organizations attempt to shape their own contexts and retain autonomy for independent action. “How an organization learns about its environment, how it attends to the environment, and how it selects and processes information to give meaning to its environment are all important aspects of how the context of an organization affects its actions” (Pfeffer & Salancik, 1978, p. 14). Thus, organizations can utilize information available through information systems for decision making. Pfeffer and Salancik (1978) recognize,

“Organizational information systems offer insight to those seeking to analyze and diagnose organizations. Information which is not collected or available is not likely to be used in decision making, and information which is heavily represented in the organization’s record keeping is likely to emphatically shape decisions” (p. 13).

Consequently, organizations such as IHEs can utilize information through information systems, such as ERP systems, to retain their autonomy by enhancing their competitive advantage in the environment and pursue their organizational interests. As a result of the recent economic downturn, IHEs are transforming to address these constraints. Therefore, competitive advantage within higher education is increasingly salient; those with an advantage will be better positioned to structure changes to their benefit.

A third theme of RDT is organizations seek to acquire, maintain, and control critical resources from the environment. These resources, or inputs, are needed to operate the firm (IHE) and produce a service (instruction to students) cost effectively by allocating resources (expenses) appropriately once they are obtained. “One critical concern facing most organizations is that of obtaining sufficient resources. Considering this, it seems reasonable that those who contribute most to maintaining organizational resources would develop power in the organization” (Pfeffer & Salancik, 1978, p. 232). Moreover, since acquiring, maintaining, and controlling critical resources from the

environment is a key to organizational effectiveness, organizations "...facilitate exchanges that reduce organizational resource dependencies, to increase the flow of a variety of kinds of resources" (Callen et al., 2010, p. 104).

As previously discussed, resources available in higher education are waning; thus, institutions have difficult decisions to make about how to allocate available resources wisely. The internal resource allocations (expenditures) toward producing a service could affect the organization's future dependences. Pfeffer and Salancik (1978, p. xii) observe "the need for resources, including financial and physical resources as well as information, obtained from the environment, made organizations potentially dependent on the external sources of these resources – hence the characterization of the theory as resource dependence." IHEs depend on external sources such as students, parents, state and federal governments, or private funding sources to operate. Callen et al. (2010) reiterate, "[RDT] emphasizes that the acquisition and maintenance of human, financial, and other resources is essential..." (p. 104). Once resources are acquired, they need to be maintained and controlled or allocated prudently.

Fourth, RDT advocates that the social context matters in the relationship between organizations and their external environment. According to Pfeffer and Salancik (1978), "The relative magnitude of an exchange as a determinant of the importance of the resource is measurable by assessing the proportion of total inputs or the proportion of total outputs accounted for by the exchange" (p. 46). In higher education, the total inputs (revenues) originate from a few key sources, and the proportion of outputs accounted for are limited to the funds received. "An organization that creates only one product or service is more dependent on its customers than an organization that has a variety of

outputs that are being disposed of in a variety of markets” (Pfeffer & Salancik, 1978, p. 46). In higher education, institutions are dependent upon delivering two main services: instruction, including student services support, and research, including academic support. Therefore, IHEs are dependent upon the social context of customers such as students, parents, and government entities for their resources (revenue) by way of tuition and fees, state appropriations, and federal grants and contracts. Also, within the social context, external actors have

“...the ability to make rules or otherwise regulate the possession, allocation, and use of resources and to enforce the regulations. In addition to being a source of power, the ability to make regulations and rules can determine the very existence and concentration of power.” (Pfeffer & Salancik, 1978, p. 49).

This is the case when government and private donors are involved for both public and private IHEs. Government entities have the ability to impose regulations and restrictions on the use of funds provided to IHEs. In addition, private donors often impose their directives regarding the use of donations. These limitations affect the relationship between IHEs and the organizational environment.

Table 2 provides an overview of RDT and highlights of some assumptions: organizational, resource, customer, information, and dependence when examining organizations within the problem domain from a resource dependence perspective.

Table 2.

*Overview of Resource Dependency Theory*

<b>Key Idea</b>	<ul style="list-style-type: none"> <li>• The key to organizational survival is the ability to acquire, maintain and control human, financial, and other resources such as information, raw materials and technology (Pfeffer &amp; Salancik, 1978; Straub et al., 2008; Callen et al., 2010; Hillman et al., 2009)</li> </ul>
<b>Unit of Analysis</b>	<ul style="list-style-type: none"> <li>• Dependency between the organization and resources</li> </ul>
<b>Organizational Assumptions</b>	<ul style="list-style-type: none"> <li>• Organizations rely on and interact with external actors for resources out of their control (Froelich, 1999)</li> <li>• The social context of organizations shape the decisions made about organizational issues (Wang, 2008; Davis &amp; Cobb, 2009)</li> <li>• Although constrained by their environments, organizations seek autonomy to pursue organizational interests (Wang, 2008)</li> <li>• Organizational units may operate independently, but depend on the combined efforts of all (Tillquist, King &amp; Woo, 2002)</li> </ul>
<b>Resource Assumptions</b>	<ul style="list-style-type: none"> <li>• Ability to acquire or raise resources and utilize them efficiently and effectively</li> <li>• There is a shifting reliance on the source of funds (Froelich, 1999)</li> <li>• Resources are scarce, inadequate, unstable, and not assured; availability is uncertain (Froelich, 1999)</li> </ul>
<b>Customer Assumptions</b>	<ul style="list-style-type: none"> <li>• Organizations are dependent upon customers that impact the flow of resources (Straub et al., 2008)</li> <li>• Organizations are dependent upon the demands of customers (Wang, 2008)</li> </ul>
<b>Information/ Technology Assumptions</b>	<ul style="list-style-type: none"> <li>• Information is a resource used to enhance survival</li> <li>• Organizations control IT resources to improve performance (Straub et al., 2008)</li> <li>• Studies have found a relationship between IT and sustained competitive advantage (Straub et al., 2008)</li> <li>• IT provides process support, coordination, and control mechanisms (Pfeffer &amp; Salancik, 1978) in support of maintaining and making efficient the acquisition of resources critical to the viability of the organization (Tillquist et al., 2002)</li> </ul>
<b>Dependence Assumptions</b>	<ul style="list-style-type: none"> <li>• Approaches to managing dependence include: complying with demands of critical resource providers, avoiding control, and avoiding dependence by maintaining alternative sources of key inputs (Froelich, 1999)</li> <li>• Organizations will choose to own, nurture, have exclusive access to and control strategic resources that will lead to improved competitiveness (Straub et al., 2008)</li> </ul>
<b>Problem Domain</b>	<ul style="list-style-type: none"> <li>• Dependencies between external actors to the organization</li> <li>• The environment is open (Katz &amp; Kahn, 1966; Froelich, 1999)</li> <li>• Organizations are constrained by the environment as a consequence of their resource needs (Froelich, 1999)</li> <li>• Attempts to control external interdependencies may produce new patterns of dependence (Pfeffer, 1987; Hillman et al., 2009)</li> <li>• Organizations can use information and allocate resources to improve survival.</li> </ul>

**Assumptions of RDT.** There are some assumptions regarding organizations, resources, customers, information/technology, and dependence using RDT. Organizations rely on the social context of their environment to make decisions and interact with external actors while pursuing their organizational interests with some degree of autonomy (Pfeffer & Salancik, 1978; Froelich, 1999; Tillquist et al., 2002; Wang, 2008; Davis & Cobb, 2009). Another assumption is organizations have the ability to acquire or raise resources in an environment of uncertainty; resources can be scarce, inadequate, unstable, or not assured, and organizations may shift their reliance on some sources of funds over time (Pfeffer & Salancik, 1978; Froelich, 1999). With regard to customers, they will significantly impact the flow of resources, and organizations are heavily dependent upon them for revenue (Straub et al., 2008; Wang, 2008). In addition, RDT conjectures that information is a resource used to enhance decision making and organizations control IT resources to improve performance and their competitive advantage (Pfeffer & Salancik, 1978; Tillquist et al., 2002; Straub et al., 2008; Davis et al., 2009). Lastly, assumptions are made about organizations managing dependence within the environment by complying with the demands of resource providers or by nurturing relationships to have exclusive access to strategic resources (Pfeffer & Salancik, 1978; Froelich, 1999; Straub et al., 2008). These assumptions were considered carefully in the application of RDT to this study.

**Findings from empirical research.** Empirical research involving RDT in higher education and/or information technology is limited. As previously stated, the origins of RDT encompassed research focused on corporations to predict power and relationships related to mergers and acquisitions, joint ventures, boards of directors, etc. Later research



involves studying RDT within the context of non-profit organizations. Empirical research in higher education within the framework of RDT involves the use of time, faculty dependence on external resources, and student enrollments. Within the domain of RDT in the IT sector, there are empirical studies that examine when and why organizations implement information systems, and the use of information systems for coordinating organizational activities. Quantitative analysis is predominantly used to test research hypotheses for these studies in higher education and IT. A brief synopsis of studies in these two areas is discussed forthwith.

***Higher education sector.*** Pfeffer and Salancik (1974) studied academic departments within the University of Illinois and “found that departmental power was best predicted by the proportion of outside grant and contract money the department brought to the university, closely followed by the department’s national prestige and graduate program size” (Pfeffer & Salancik, 1978, p. 232). This is a notable perspective regarding the IHE’s dependence on an external resource, funds from federal grants and contracts, which affects its customer base in the size of a department’s graduate program.

Another study by Pfeffer and Moore (1980) “replicated and extended in a study of resource allocations on two University of California campuses” (Pfeffer, 1981). This study revealed “The possibility that enrollments or changes in enrollments might be used more effectively in the bargaining for more resources by the high paradigm departments...” (Pfeffer, 1981). Thus, allocating resources strategically provides the possibility of an increase in servicing customers, which could then be used as a justification for obtaining more resources.

Norris (2003) utilized resource dependency theory as the framework to study faculty research using “regression analysis...to examine the relationship between faculty resource dependence and faculty members’ time allocation, productivity, and satisfaction” (p. iv). This study surmised “that increased dependence on industry funding relative to federal government funding has a small effect on time allocation and no significant effect on productivity and satisfaction” (Norris, 2003, p. v). Therefore, funding from an external source such as the federal government had little effect on subjective factors such as faculty members’ time allocation, productivity, and satisfaction.

***Information technology sector.*** Tillquist et al. (2002) utilized RDT “to construct a conceptual modeling tool called the dependency network diagram for the analysis and design of organizational information systems” (p. 91). They concluded that using IT can strategically influence the control and coordination of activities. In addition, “Competitive and cooperative dependencies, created as organizations contend for scarce resources, affect internal arrangements and external relations to ensure organizational survivability (DiMaggio & Powell, 1991; Hannan & Carroll, 1992; Hawley, 1950; Parsons, 1956a, 1956b)” (Tillquist et al., 2002, p.93).

Wang (2008) studied IT assimilation of ERP systems in Fortune 1000 companies within the frameworks of RDT and institutional theory analyzing 11 years of survey data. Wang examined “...the longitudinal effects of external pressures on the assimilation of IT innovations [such as ERP systems] in organizations, making the distinction between pressures from organizations’ exchange partners and pressures from the institutional environment” (p. 1). Wang (2008) posits that internal factors such as “top management

support, the size of a firm's IT staff, and the time elapsed since the firm adopted ERP were significantly related to ERP assimilation in all years” (p. 11). Most importantly, according to Wang (2008), “RDT suggests that firms comply with the expectations of their institutionalized exchange partners (i.e., whom to listen to), [investors, suppliers, and customers]” (Wang, 2008, p. 12).

Straub et al. (2008) utilized RDT to “...analyze how organizations control their [IT] resources to improve organizational performance” (p. 195) and used a part of the Strategic Control Model to test management’s control of strategic resources, such as IT, to avoid dependency on external factors. They found higher performance is a result of using IT as a strategic resource for effective decision-making, and “it is critical that a...firm-wide process for decisions on locating IT control is in place to capture business value” (Straub et al., 2008, p. 195). This is consistent with a major theme of RDT that organizations try to minimize or avoid dependency on external actors when resources are essential.

Davis et al. (2009) studied the use of information systems in nursing homes within the framework of RDT. Davis et al., determined, “The use of [information systems] may assist nursing homes to improve service delivery by collecting and analyzing service, finance, and administrative data that are necessary to achieve operational efficiencies” (p. 141). Thus, nursing homes with innovative information systems may be perceived as giving a better quality of care than those that do not have advanced systems, and this could give those that use IT strategically a competitive advantage in the marketplace to enhance organizational effectiveness.

**Prevalence of RDT.** According to Hillman et al. (2009, p. 1404) “Thirty years have passed since Pfeffer and Salancik’s (1978) seminal work on...RDT. During this time, RDT [was] applied broadly across the research domain to explain how organizations reduce environmental interdependence and uncertainty.” Other researchers have discussed power as a mitigating factor for organizations to be successful by allocating resources and using information to their advantage. Power is not a theme that was examined in this study.

“As of July 2008, *External Control* [was] cited 3,334 times over the 30 years since its publication, making it one of the most highly cited works ever in the study of organizations” (Davis & Cobb, 2010, pp. 12-13). Therefore, this theory is relevant at present and provides a useful framework for the researcher to study ERP systems implementation in higher education. Further, “...resource dependence theory is perhaps the most comprehensive in the scope of its approach to organizations, combining an account of power within organizations with a theory of how organizations seek to manage their environments” (Davis & Cobb, 2010, p. 1). ERP systems are mechanisms for organizations to manage their organizations to enhance the delivery of a service or make a product. In the case of IHEs, ERP systems are utilized to serve students effectively and efficiently, thereby enhancing the student experience.

Additionally, Hillman et al. (2009) posit

“RDT recognizes the influences of external factors on organizational behavior and, although constrained by their context, managers can act to reduce environmental uncertainty and dependence. Central to these actions is the concept of power, which is the control over vital resources (Ulrich & Barney, 1984)”(p. 1404).

This study does not examine if IHEs exert power over the external actors they rely upon for resources. Since IHEs primarily depend on external sources of funding from state,

federal, and private entities, ERP systems can reduce environmental uncertainty and dependence on these resources by providing leaders timely information upon which to formulate and make decisions to enhance their ability to be competitive in the market.

**Application of RDT to this study.** As previously stated, the theme of power will not be examined in this study. Each of the remaining three central themes of RDT was applied to this study as follows.

First, ERP systems implementation is one strategy to enhance the autonomy of organizations and pursue their interests. For example, ERP systems can enable organizations to streamline processes and achieve greater efficiency. In the organizational environment, efficiency can offer a competitive advantage over others in the industry and enhance an organization's effectiveness. In addition, in higher education, one interest of institutions is to serve students at an acceptable cost; especially for public institutions the lower the cost per student, the better. Therefore, if IHEs can lower the cost of institutional support per student, and allow for possible reallocation of funds to other areas of the institution, they could reduce their dependence on external sources. Another interest of IHEs is to meet the demands of customers. In the current technological era, customers (students) demand better technologies to enhance their student experience outside the classroom. ERP systems are one way to improve the student experience of applying for admission, enrolling in classes, paying tuition and fees, checking grades, obtaining transcripts, etc. An enhanced student experience could provide a competitive advantage. This theme of RDT is applicable to this study because by examining IHEs that have and have not implemented ERP systems, an evaluation of similarities and/or differences in financial and personnel resource allocations, and customer variables such as student

enrollments and institutional support per student can be made by comparing two fiscal years, as outlined in research questions 3 and 4, to determine if there are any effects of implemented ERP systems.

Second, acquiring and maintaining funding in higher education is challenging especially during periods of economic uncertainty (e.g., the current great recession in the United States); thus, once funding is acquired, it is essential for IHEs to control it. ERP systems are one mechanism to control resources through organizational changes and a better use of coordinated information. However, the costs of ERP systems are significant and affect the long term operating costs of IHEs. As previously discussed, ERP systems implementation brings with it a variety of costs to the institution, including personnel, training, hardware and software costs. When ERP systems are fully functional, an assumption is that organizations will reap the benefits of information coordination and organizational efficiencies to control resources that are acquired. Since ERP systems are designed to capture and easily retrieve information, IHEs would have an advantage in the possession and allocation of resources to enhance an organization's effectiveness.

Bhyrovabhotla (2012) comments:

“RDT uses the firm as the unit of analysis...RDT looks at the relationships between resources and firms actions. Thus the central concept is of resources and how they are used. It fundamentally necessitates the linkage between resources, and its use for production of outputs and the linkage of outputs to firm's performance or survival” (p. 8).

Therefore, a firm's action, such as implementing ERP systems, is a mechanism for IHEs to utilize information to adjust operations, and enhance its competitiveness to become a more effective and efficient provider of academic and student services. Using research question 2, this study intends to determine which resource allocations predict membership in groups of IHEs that have or have not implemented. Also, using research

questions 3 and 4, this study will examine similarities and/or differences between IHEs that have and have not implemented ERP systems to determine if there are effects on resource allocations, student enrollments, and institutional support per student between FY 06 and FY 10.

Lastly, understanding the context of the organizational environment is paramount for institutional leaders to manage their relationships with external actors. Utilizing information could enhance or maintain external relationships to acquire resources with an understanding of the social context of the environment. According to Bhyrovabhotla (2012), it is necessary for "...firms to leverage their control over possession and allocation of resources of use to other actors or firms" (p. 7). Using information effectively could help IHEs influence donors and substantiate requests for funding to government agencies. Providing information in a timely manner could also be a requirement of those that provide resources. Therefore, IHEs utilizing commercial ERP systems may have an advantage over those that do not utilize current technology because IHEs without ERP systems may not have coordinated information readily available. Having an understanding of institutional characteristics and resource allocations that predict membership in groups of IHEs that have or have not implemented ERP systems will educate institutional leaders about where they fit in the landscape of higher education and understand the external actors they need to cater to in the social context of the organizational environment. Research questions 1 and 2 address this theme.

In higher education, institutions can be operationalized as firms that utilize commercial ERP systems to process information in a coordinated manner to improve efficiencies and thereby increase the ability to operate effectively in the environment and

pursue their organizational interests. According to Davis, Brannon, and Whitman (2009), information systems may assist with complying with federal, state, and accrediting agency mandates, in addition to controlling resources, monitoring productivity, improving communication, and increasing efficiencies in documentation. By complying with requirements of regulatory agencies that are also sources of funding, IHEs can enhance their ability to retain autonomy and address the social context of external actors in the environment. For institutions that do not have commercial ERP systems, they typically have legacy systems that have evolved to meet their basic needs for information management and day-to-day operations.

### **Summary**

This chapter reviewed the relevant literature that focused on various aspects of using IT in higher education, resources that can be aligned with organizational goals, the many inputs and outputs of higher education, and financial and human resources involved with ERP systems implementation. The purpose of this national study was to utilize quantitative methods to examine institutional characteristics, financial resource variables, personnel variables, and customer variables of public and private institutions that have and have not implemented ERP systems, from a resource dependence perspective.

This chapter devoted a section to review the origins, major components, and assumptions of resource dependency theory (RDT), and review relevant studies and findings from empirical research using RDT in the sectors of higher education and IT. This section further reviewed the prevalence of using RDT in recent times and how the main components of RDT were applied to this study.



While there have been studies about resource dependence in higher education, there is a gap in the literature about how resource dependence affects the organizational environment and delivering services with ERP systems being implemented. While there is literature on the different funding sources for IHEs and ERP systems implementation, examining financial and human resource allocations because of these implementations is limited. Lastly, while there is literature on the use of ERP systems in business, there is little research studying ERP systems utilized in higher education. The next chapter describes research methods, including research design, data sources, sample institutions, data collection procedures, variables, data analyses procedures, and research questions.

## **CHAPTER 3: RESEARCH METHODS**

### **Introduction**

Typically, the research involving resource dependency theory (RDT) has been applied in the business sector, but there is ample room to extend the investigation into higher education and the resources (e.g., financial and personnel) utilized to efficiently and effectively operate institutions of higher education (IHEs). ERP systems implementation costs millions of dollars for IHEs. Accordingly, this study examined resource allocation and dependence relating to ERP systems implementation in the higher education environment. While an integral part of streamlining operations for the institution, ERP systems also assist with minimizing or avoiding resource dependencies which could affect the current and future operations of the institution and the primary service to deliver instruction to students. Therefore, the purpose of this national study was to utilize quantitative methods to examine institutional characteristics, financial resource variables, personnel variables, and customer variables of public and private institutions that have and have not implemented ERP systems, from a resource dependence perspective. This chapter will discuss the research design, data sources, sample institutions, data collection procedures, variables, data analyses, and research questions under investigation.

### **Research Design**

This national quantitative study used secondary institutional data drawn from the U.S. Department of Education's Integrated Postsecondary Education Data System (IPEDS) which is collected through annual surveys of IHEs receiving federal funds. IHEs in the sample included 2- and 4-year public and private institutions. Descriptive

discriminant analysis was used to study group differences (ERP systems implemented or not implemented) using control variables categorized into four areas: institutional characteristics, financial resource variables, personnel variables, and customer variables. Dummy variables were used to signify some level of effect by the categorical variables identified. Additionally, paired samples t-tests were utilized to test pre and post ERP systems implementation, to compare continuous variables from fiscal year 2005-2006 (FY 06) to fiscal year 2009-2010 (FY 10). As another comparison, paired samples t-tests assessed the same continuous variables from FY 06 and FY 10 for IHEs that have not implemented ERP systems.

### **Data Sources**

The research study provides synthesis and analysis of the national Integrated Postsecondary Education Data System (IPEDS). This data source is a compilation of annually submitted institutional data that are required by the federal government for institutions accepting federal aid, and approximately 6,700 institutions currently submit data from across the United States. The information pulled from the IPEDS data source deals with institutional resources such as personnel and funding.

A sample of 194 institutions was utilized in this study, 97 IHEs that have implemented ERP systems and 97 IHEs that have not implemented ERP systems. Approximately one-third of the sample of 97 IHEs that have implemented ERP systems were the institutions examined in a 2002 EDUCAUSE Center for Applied Research (ECAR) study by Kvavik and Katz, and the remaining IHEs through the researcher's professional contacts in the higher education IT community; see Appendix 1 for a list of these 97 institutions. The data from the Kvavik and Katz study (2002), as discussed in the

previous chapter, explores ERP systems implementation at 33 various institutions of higher education. The remaining 64 institutions were selected and verified by the researcher from information obtained from professional contacts. Additionally, 97 institutions that have not implemented ERP systems, see Appendix 2, were studied. The institutions that have not implemented ERP systems were determined using a random selection method created by the researcher with programming in Microsoft Access using structured query language (SQL). The majority of variables studied were collected from IPEDS for FY 06 and FY 10 for the sample of 194 institutions that have and have not implemented ERP systems. These fiscal years were chosen because the variables used in this study were consistently available through IPEDS over these years.

The first data source, IPEDS, was established as the core postsecondary education data collection program for the U.S. Department of Education's National Center for Education Statistics (NCES); it is a system of interrelated surveys conducted annually by NCES. "IPEDS gathers information from [approximately 6,700 institutions,] every college, university, and technical and vocational institution that participates in the federal student financial aid programs" (IPEDS, 2011). Data from IPEDS consists of numerous institutional variables that can be utilized for research purposes. Further, the IPEDS organization has established standards and reporting mechanisms that make it highly conducive to this quantitative study.

The second data source was drawn from EDUCAUSE, "a nonprofit association whose mission is to advance higher education by promoting the intelligent use of information technology. EDUCAUSE helps those who lead, manage, and use information resources to shape strategic decisions at every level" (EDUCAUSE, 2011), and the

organization's main research arm, the EDUCAUSE Center for Applied Research (ECAR) has worked since 2001 to produce high quality research for the higher education sector.

According to the ECAR website:

“Developing a strong, forward-looking campus IT program is easier with ECAR’s well-timed, comprehensive research. ECAR simplifies complex issues, presents proven models, and reduces the risks involved in decision making....Recent research topics include student uses of technology, IT collaboration, identity management, and IT support for business continuity” (ECAR, 2011).

The rationale for using data from the research of Kvavik and Katz (2002) is to utilize data collected about ERP systems implementation and compare institutional resource allocations and dependences over time, rather than collect data about ERP systems implementation in the present day using similar techniques. This study was concerned with institutions that have and have not implemented ERP systems in order to examine resource and customer variables from a resource dependence perspective. Whereas Kvavik and Katz used a quantitative study, this study was a quantitative design that allowed for the examination of many variables.

### **Sample Institutions**

The population represented by Kvavik and Katz's research project included all 33 institutions of higher education utilized in the Kvavik and Katz 2002 ECAR study as discussed in the literature review. Further, 64 institutions that were known to have implemented ERP systems were selected after verification at the institutional level. In addition, 97 institutions were selected randomly from a population of institutions known not to have implemented ERP systems. Variables from the sample of 194 institutions were examined from a resource dependence perspective to understand whether or not ERP systems implementation affects IHEs ability to be effective in the environment. The

unit of analysis is each institution of higher education selected for examination.

Appendices 1 and 2 provide a complete list of institutions studied. The 194 institutions were chosen to represent a sample of 2-year and 4-year, public and private, American IHEs across the country from a variety of geographic regions in the United States.

The Kvavik and Katz 2002 ECAR study was qualitative research undertaken to study the “promise of performance of ERP systems.” A number of public and privately funded institutions were part of the study. According to Kvavik and Katz (2002), “Intensive telephone interviews were undertaken with more than 40 IT functional executives and managers at 33 institutions, selected based on the basis of peer nomination” (p. 19). The types of IHEs studied by Kvavik and Katz are public and private two and four-year degree granting institutions. The number of students enrolled at the institutions studied ranged from 5,000 to 30,000. Building upon the Kvavik and Katz 2002 study, this research expanded upon the notion of “the promise of performance” and examined the performance aspects of ERP systems.

### **Data Collection Procedures**

IPEDS data collected for FY 06 and FY 10 for the 194 institutions in the sample was analyzed for the following four categories of variables: institutional characteristics, financial resource variables, personnel variables, and customer variables. A combination of these two fiscal years of data was examined to evaluate the similarities or differences of resource allocations and/or impact on the primary customers of IHEs, the students, based on student enrollments and institutional support per student FTE because of ERP systems implementation, or not. A complete data set was created for analysis using the variables from Table 3.

Table 3.

*Details about Variables*

No.	Category of Variable	Description of Variable	Type of Variable	Measurement of Variable
1.	Institutional	ERP Status ①	Dichotomous	Numerical
2.	Institutional	Carnegie 2000 Classification	Categorical	Nominal
3.	Institutional	Geographic Region	Categorical	Nominal
4.	Institutional	Age ②	Continuous	Numerical
5.	Institutional	Age Group ③	Categorical	Nominal
6.	Institutional	Control	Categorical	Nominal
7.	Institutional	Level	Categorical	Nominal
8.	Institutional	Size	Categorical	Nominal
9.	Financial Input	Core revenues, total dollars	Continuous	Numerical
10.	Financial Input	Tuition and fees as a % of core revenues	Continuous	Numerical
11.	Financial Input	State appropriations as a % of core revenues	Continuous	Numerical
12.	Financial Input	Local appropriations as a % of core revenues	Continuous	Numerical
13.	Financial Input	Government grants and contracts as a % of core revenues	Continuous	Numerical
14.	Financial Input	Private gifts, grants, and contracts as a % of core revenues	Continuous	Numerical
15.	Financial Input	Investment return as a % of core revenues	Continuous	Numerical
16.	Financial Input	Other revenues as a % of core revenues	Continuous	Numerical
17.	Financial Output	Core expenses, total dollars	Continuous	Numerical
18.	Financial Output	Instruction expenses as a % of total core expenses	Continuous	Numerical
19.	Financial Output	Research expenses as a % of total core expenses	Continuous	Numerical
20.	Financial Output	Public service expenses as a % of total core expenses	Continuous	Numerical
21.	Financial Output	Academic support expenses as a % of total core expenses	Continuous	Numerical
22.	Financial Output	Student service expenses as a % of total core expenses	Continuous	Numerical
23.	Financial Output	Institutional support expenses as a % of total core expenses	Continuous	Numerical
24.	Financial Output	Other core expenses as a % of total core expenses	Continuous	Numerical
25.	Personnel	Total Staff FTE	Continuous	Numerical
26.	Personnel	Instruction-research-public service Staff FTE	Continuous	Numerical
27.	Personnel	Exec-Admin and managerial Staff FTE	Continuous	Numerical
28.	Personnel	Other professional Staff FTE	Continuous	Numerical
29.	Personnel	Non-professional Staff FTE	Continuous	Numerical
30.	Customer	Reported FTE Undergraduate Enrollment	Continuous	Numerical
31.	Customer	Reported FTE Graduate Enrollment	Continuous	Numerical
32.	Customer	Institutional support expenses per FTE	Continuous	Numerical

① Dependent variable, determined by institutional data.

② Calculated by subtracting year institution was founded by 2012.

③ Category established by the researcher for classification purposes.

IPEDS data is ideal for this study because it “provides basic data needed to describe – and analyze trends in – postsecondary education in the United States, in terms of numbers of students enrolled, staff employed, dollars expended, and degrees earned” (IPEDS New Keyholder Handbook, 2012, p. 3). The IPEDS data was used as a standard measure of institutional resources that were affected over time by the implementation of ERP systems because clear definitions exist for the data elements collected, and the data was reported via the annual survey; therefore, comparisons can be made over time to understand the possible similarities and/or differences that may exist with institutions that have or have not implemented ERP systems.

To reiterate, 97 IHEs studied were identified as having implemented ERP systems (Appendix 1), and 97 IHEs that have not implemented ERP systems were studied (Appendix 2). The IPEDS data for these 194 IHEs were gathered through the data extraction website provided by IPEDS. These steps were followed using the IPEDS Data Center: 1) look up each institution’s IPEDS Unit ID and create a list; 2) go to the IPEDS Data Center using the Internet site: <http://nces.ed.gov/ipeds/datacenter/Default.aspx>; 3) select the option to “Compare Individual Institutions;” 4) select the option to “use final release data” and click continue; 5) enter all 194 institution Unit ID separated by commas and click continue; 6) select “Continue” to Step 2 – Select Variables; 7) select each variable listed for each category of variable identified in Table 3, starting with the institutional category of variable (this step was repeated four additional times); 8) select the check boxes for the variables listed in Table 3 and click “Continue” to download a comma delimited file to the computer in use; 9) repeat steps 2 through 8 four more times to complete the data gathering; 10) create a final dataset including all variables listed in



Table 3 using Microsoft Excel, and 11) analyze the data using statistical computer software SPSS.

### **Independent Variables**

The 31 independent variables were grouped into four categories: institutional characteristics, financial resource variables, personnel variables, and customer variables.

**Institutional characteristics.** Regarding the institutional characteristics, the following seven variables were examined: Carnegie 2000 classification, geographic region of the institution, age and age group of the institution, control of the institution, level of the institution, and size of the institution. This data was collected through IPEDS. These characteristics were useful because they relate to the organizational environment referred to in resource dependency theory.

**Carnegie 2000 classification.** In 1973, the Carnegie Commission on Higher Education endeavored to determine a practical method of managing the various institutions of higher education in the United States, which resulted in classifying groups of institutions that would be “relatively homogeneous with respect to the functions of the institutions as well as with respect to characteristics of students and faculty members” (Carnegie Commission on Higher Education, 1973). For over 40 years, the Carnegie Classification “has proved to be a useful tool for researchers, policymakers, and institutional personnel interested in analyzing changes in the contours of the higher education system; analyzing the work, makeup, and activities of groups of institutions; and making sensible comparisons among institutions” (McCormick & Cox, 2003, p. 7).

Carnegie 2000 classification is a fundamental categorical variable because it provided standard classifications for the institutions selected for this study, and

represented whether implementing ERP systems was distinguishable based on a basic classification. The classification 2000 “includes all colleges and universities in the United States that are degree-granting and accredited by an agency recognized by the U.S. Secretary of Education” (IPEDS Glossary, 2011). It was necessary to distinguish the classification of institutions because it enhanced the study of similarities and/or differences between the various types of institutions.

The following codes were used to determine frequencies: 1 = Doctoral/Research Universities; 2 = Masters Colleges and Universities; 3 = Baccalaureate Colleges; and 4 = Associates Colleges. In addition, dummy variables were created for the categorical variables (e.g., 1 = Doctoral/Research Universities, 0 = Others; 1 = Masters Colleges and Universities, 0 = Others; 1 = Baccalaureate Colleges, 0 = Others; and 1 = Associates Colleges, 0 = Others). The use of dummy variables assisted with examining the effect of the IHE’s classification in the study.

**Geographic region.** The geographic region code is a representation of where the IHE is located within the United States. This categorical variable was coded as follows: 1 = New England and Mid-East; 2 = Great Lakes and Plains; 3 = Southeast; 4 = Southwest and Rocky Mountains; and 5 = Far West and Outlying areas. For data analysis, dummy variables were created for each option. This variable represented whether implementing ERP systems was distinguishable based on geographic region.

**Institutional age.** This was a continuous variable measured by numerical values (1-500). The age of the institution, in years, was calculated by subtracting the year the institution was established from the current year, 2012. This data was collected by

visiting the institutional website of each of the 194 institutions being examined. This variable was the basis of determining the institutional age group.

**Institutional age group.** This categorical variable was determined by the researcher based upon institutional age categorized into the following groupings in the dataset: 1 = Under 50 years old; 2 = 51 to 100 years old; 3 = 101 to 150 years old; 4 = 151 to 200 years old; 5 = 201 to 250 years old; and 6 = 251 years old and above. Dummy variables as previously described were created for data analysis using SPSS. This variable provided a method of classification for the age of an institution to represent if implementing ERP systems was distinguishable based on age group, and is an aspect of the organizational environment.

**Institutional control.** According to the IPEDS Glossary (2011), control is “a classification of whether an institution is operated by publicly elected or appointed officials or by privately elected or appointed officials and derives its major source of funds from private sources.” This categorical variable was coded with nominal values: 1 = Public; and 2 = Private (not-for-profit). A public institution is supported primarily by public funds and governed by publicly elected officials. A private not-for-profit institution is “a private institution in which the individual(s) or agency in control receives no compensation, other than wages, rent, or other expenses for the assumption of risk. These include both independent not-for-profit schools and those affiliated with a religious organization” (IPEDS Glossary, 2011). This variable represented whether implementing ERP systems was distinguishable based on if an institution is publicly or privately controlled, and it provided an understanding of the organizational environment.

**Institutional level.** The level of the institution is a classification of how many years an institution's programs take to complete. This is a categorical variable measured by nominal values. The following codes were used: 1 = At least two but less than four years; and 2 = four or more years. This variable represented whether implementing ERP systems was distinguishable based on the level of the institution.

**Institutional size.** Institutional size is a measure of total student enrollment at the institution. According to Tolbert (1985) "Size, measured here by total student enrollment has often been linked to administrative differentiation (Terriena & Mills, 1955; Blau, 1970; Hsu, Marsh, & Mannari, 1983)" (p. 7). This variable represented whether implementing ERP systems was distinguishable based on the size of an institution. This variable may have related to the amount funding received by various sources such as tuition and fees. The institution size category is based on total students enrolled for credit and contributes to the understanding of the organizational environment. This categorical variable was coded as follows: 1 = Under 1,000 students; 2 = 1,000 to 4,999 students; 3 = 5,000 to 9,999 students; 4 = 10,000 to 19,999 students; 5 = 20,000 students and above.

**Financial resource variables.** The inputs (revenues) and outputs (expenditures), of an organization are vital for it to be competitive because these are used to deliver services and/or create products. Resource dependency theory stipulates that inputs and outputs should be controlled by relatively few organizations (Bhyrovabhotla, 2012). Total revenues and expenses describe the total dollars received and used to support the institution's operations to fulfill its core mission, to serve students.

The following eight financial variables related to institutional inputs were gathered from IPEDS: core revenues, total dollars; tuition and fees as a percent of core

revenues; state appropriations as a percent of core revenues; local appropriations as a percent of core revenues; government grants and contracts as a percent of core revenues; private gifts, grants, and contracts as a percent of core revenues; investment return as a percent of core revenues; and other revenues as a percent of core revenues. Definitions for these variables from the IPEDS Glossary (2011) are listed in Appendix 3.

In addition, the following eight financial variables related to institutional outputs was gathered from IPEDS: core expenses, total dollars; instruction expenses as a percent of total core expenses; research expenses as a percent of total core expenses; public service expenses as a percent of total core expenses; academic support expenses as a percent of total core expenses; student service expenses as a percent of total core expenses; institutional support expenses as a percent of total core expenses; and other core expenses as a percent of total core expenses. The definitions of these variables from IPEDS Glossary (2011) are listed in Appendix 4.

In order to have a meaningful comparison of financial data and to account for inflation over the years, the variables examining revenues and expenses were based on a percentage of total revenues and total expenses reported. In order to give these percentages context, the total dollars of core revenues and core expenses were specified for each fiscal year studied. Having an understanding of the percent of core revenues and expenses that were examined added to the understanding of resource dependence because, as mentioned in Chapter 2, the amount and types of financial resources available to IHEs affect them. All of the 16 continuous variables about financial resources were measured using numerical values (1 to 100,000,000,000).

**Personnel variables.** The total number of faculty and support staff was measured by full-time equivalent (FTE) employees working at the institution to normalize the measurement. This continuous variable was measured by numerical values (1 to 100,000) that were retrieved from IPEDS data for each institution. Personnel variables were used to examine the resource allocations of IHEs that influence the operations of the institution. The counts of the following four groups of staff were examined: instruction/research/public service, executive/administrative/managerial, other professional, and non-professional. Inclusion of each of these groups is necessary because all employees affect the services delivered to the primary customers of IHEs, students. The definitions of these personnel variables from IPEDS Glossary (2011) are listed in Appendix 5. As previously discussed in Chapter 2, human resources are intertwined in the delivery of quality products and services of an organization, and contribute to its achievements.

**Customer variables.** The primary customers of IHEs are students; hence it was necessary to examine the effect of ERP systems implementation on its customers. The following three customer variables were collected from IPEDS: reported FTE for undergraduate enrollment, reported FTE for graduate enrollment, and institutional support expenses per FTE. These continuous variables are measured by numerical values (1 to 100,000), and these variables represented the effect of implementing ERP systems upon the institutional support provided to students. Definitions of these variables from IPEDS Glossary (2011) are listed in Appendix 6.

**Dependent variable.** The dependent variable is a dichotomous variable, describing whether an institution has or has not implemented ERP systems. The

dependent variable was coded “1” for having implemented ERP systems, and “0” if the institution has not implemented ERP systems. These institutions may or may not have participated in ERP systems implementation using a well-recognized product such as PeopleSoft, Banner, Jenzabar, or SAP (Swartz & Orgill, 2001).

### **Data Analyses**

Secondary institutional data drawn from IPEDS and EDUCAUSE was used for this study. Discriminant analysis (DISCRIM) was the statistical method utilized to answer research questions 1 and 2 outlined to study the two identified groups: institutions that have implemented ERP systems and institutions that have not implemented ERP systems (coded 1 = implemented and 0 = not implemented).

Klecka (1985) described, “Discriminant analysis is a statistical technique which allows the researcher to study the differences between two or more groups of objects with respect to several variables simultaneously” (p. 7). Further, Huberty (1994) related that in descriptive DISCRIM, “the basic question of interest pertains to grouping variable effects in the multiple outcome variables or, more specifically, to group separation or group differences with respect to the outcome variables” (p. 30). The groups in this study, institutions of higher education that have or have not implemented ERP systems were compared based on institutional characteristics, financial resource and personnel variables, and if institutions have or have not implemented ERP systems.

Interpretation and classification are the two main types of DISCRIM. This study employed the interpretation version of DISCRIM, which means that the researcher was able to describe and discriminate between the groups based upon some set of characteristics, and determine which characteristics are the most powerful discriminators

(Klecka, 1985). The analysis described the effects on the multiple outcome variables relating to institutions and ERP system implementation based upon the grouping variable; thus, descriptive DISCRIM explains the differences between the two groups (Huberty, 1994). The groups in this study, institutions of higher education that have or have not implemented ERP systems were compared by their institutional characteristics within those two groups.

Discriminant functional analysis was used to analyze these data, and was "...used to determine which continuous [independent and categorical] variables discriminate between two or more naturally occurring groups" (Poulson & French, 2011). For the purposes of this research, the groups under consideration are institutions of higher education that have and have not implemented ERP systems. Most resources will naturally fall into one of two categories: financial or personnel. Discriminant functional analysis was used to determine which variables were the best predictors of whether resources show dependences upon external sources. This information could be utilized to understand where resources are derived from, and where resources are allocated in order to maximize their use to enhance the institution's competitiveness in the environment. In addition, institutional characteristics such as control of the institution, level of the institution, size of the institution, geographic region of the institution, or Carnegie classification provided the researcher with the context of the organizational environment. For example, the analysis was designed to determine if ERP systems implementation is more closely associated with community colleges, colleges, or universities. Further, "discriminant analysis is a statistical technique which allows the researcher to study the



differences between two or more groups of objects with respect to several variables simultaneously” (Klecka, 1985, p. 7).

For analyzing research questions involving the examination of changes between FY 06 and FY 10, utilizing a paired samples t-tests allowed the researcher to measure whether or not there were changes due to implementing ERP systems. Zimmerman (1997) explains, “Many experimental designs in education, psychology, and social sciences employ paired or matched observations. A familiar example is repeated measures on the same subjects over a period of time” (p. 349). Making a comparison of observations using the same variables from one year to another may reveal differences between the means of variables being examined before and after ERP systems implementation. Further, Zimmerman (1997) states:

“Researchers typically analyze paired data using the paired-samples t-test. . . Applied statisticians generally are aware of the advantages and disadvantages of this test. First, the correlation associated with pairing or matching of observations reduces the standard error of the difference between means, so the error term differs from that of the independent-samples test” (p. 349).

Therefore, pairing the examination of variables from one year to another would be a good indicator of any effects of ERP implementation. However, a drawback of the paired samples t-test that Zimmerman (1997) describes is:

“...a loss of degrees of freedom. The one-sample t statistic based on n pairs is evaluated at  $n - 1$  degrees of freedom, while the two-sample t is evaluated at  $2n - 2$  degrees of freedom. Therefore, authors emphasize that the paired-samples test is preferable if the two groups are highly correlated, while the independent-samples test is the better choice if they are uncorrelated or only slightly correlated” (p. 350).

Hence, using a paired t-test was preferable for this study because there was a desire to study the correlation of financial and personnel resources to customers, and the two

groups are highly correlated because the same variables were being tested from FY 06 and FY 10.

A computer software program called Statistical Package for the Social Sciences (SPSS), version 20.0, released in August 2011, was used to perform the data analysis. This software is used by researchers at IHEs and industry to conduct statistical analyses; therefore, utilizing SPSS is an appropriate tool for this study to answer the four research questions proposed.

Previous research demonstrates the validity of the grouping and response variables used in this study. Most of these variables have been examined in several studies. The purpose of this national study was to utilize quantitative methods to examine institutional characteristics, financial resource variables, personnel variables, and customer variables of public and private institutions that have and have not implemented ERP systems, from a resource dependence perspective.

### **Research Questions**

The study used four research questions to examine many institutional, financial, personnel, and customer variables that relate to the organizational environment; acquiring, maintaining, and controlling resources; and the social context of external actors affecting resource dependence for IHEs that have and have not implemented ERP systems. The research questions are based on the dichotomous relationship between ERP systems implementation and resources. Each question addresses relevant themes from the literature and is guided by resource dependency theory. The following questions guided the study:

**Research question 1.** Are there differences in institutional characteristics of institutions that have and have not implemented ERP systems? This question was examined using IPEDS data. The purpose of this question was to examine the similarities and/or differences between institutions that have or have not implemented ERP systems. This question establishes a baseline assessment of which institutional characteristics predict membership in the two groups: IHEs that have and have not implemented ERP systems. Discriminant analysis was used to study this question in order to determine the variables that affect the organizational environment.

**Research question 2.** What resources best discriminate between institutions that have and have not implemented ERP systems? The purpose of this question was to examine the similarities and/or differences between institutions that have or have not implemented ERP systems. This question establishes a baseline assessment of which resources predict membership in the two groups: IHEs that have and have not implemented ERP systems. Discriminant analysis was used to study this question in order to determine the resource variables that affect the resource allocations, and as a result identify resource dependencies on external sources.

**Research question 3.** For institutions that have implemented ERP systems, are there differences in resource allocations, and/or student enrollment/institutional support per student from FY 06 to FY 10? This question used paired samples t-tests and the independent resource and customer variables collected for this study. The purpose of this question was to examine if there were changes, from one fiscal year to another, to student enrollments and or institutional support per student resulting from the implementation of

ERP systems. This question relates to the effect on autonomy and the ability of IHEs to pursue organizational interests based upon ERP systems implementation.

**Research question 4.** For institutions that have not implemented ERP systems, are there differences in resource allocations, and/or student enrollment/institutional support per student from FY 06 to FY 10? This question used paired samples t-tests and the independent resource and customer variables collected for this study. The purpose of this question was to examine if there were changes, from one fiscal year to another, to student enrollments and or institutional support per student resulting if IHEs have not implemented ERP systems. This question relates to the effect on autonomy and the ability of IHEs to pursue organizational interests based upon not implementing ERP systems.

### **Summary**

Utilizing the population, sample, data collection and data analysis, the focus of the study was to gain an understanding of the organizational environment based on institutional characteristics, and resource allocations and dependences relating to ERP systems implementation, or the absence thereof, in American IHEs over a five year period. Using a partial sample of institutions that have previously been studied aided the researcher with identifying institutions to study, and utilizing data from IPEDS supported the generalizability of the research for future studies.

This chapter has captured the following aspects of the study: research design, data sources, sample institutions, data collection procedures, data analyses, and research questions. The next chapter presents the results of the data collected and answers the research questions.

## CHAPTER 4: RESULTS

### Overview

The purpose of this national study was to utilize quantitative methods to examine institutional characteristics, financial resource variables, personnel variables, and customer variables of public and private institutions that have and have not implemented ERP systems, from a resource dependence perspective. The researcher collected and consolidated secondary institutional data from the U.S. Department of Education's Integrated Postsecondary Education Data System (IPEDS) which is collected through annual surveys of IHEs receiving federal funds.

The consolidated institutional data were imported into SPSS statistical software (Version 20, 2011). The statistical calculation, discriminant function analysis (DISCRM), was employed to examine how the institutional characteristics best discriminated (or classified) between institutions that have or have not implemented ERP systems. The researcher utilized a single DISCRM model containing all institutional characteristics to analyze these data. The grouping variable (or discriminating variable) used in the DISCRM was "ERP Status" (ERP not implemented or ERP implemented). In addition, paired samples t-tests were utilized to test pre and post ERP systems implementation, to compare continuous variables from FY 06 to FY 10. For institutions that did not implement ERP systems, paired samples t-tests were used to compare continuous variables from FY 06 to FY 10 to test if any discernible variances existed.

This chapter presents the results of the discriminant function analysis and paired samples t-test models. Further in this chapter, the results of the analysis classified by each of the six categorical variables, identified as institutional characteristics, and the four

research questions, will be presented. The chapter concludes with a summary of the results.

### **Discriminant Function Analysis Model**

A comprehensive DISCRM model was developed using the six categorical variables within the institutional characteristic category. This model correctly classified 80.4% of the original grouped cases. Thus, it provided a strong classification of the two group membership. Within the comprehensive model, institutions with ERP systems were accurately classified with 79.4% of the cases correct. The institutions without ERP systems classified 81.4% of the cases, which is also a favorable classification. The canonical correlation, which is “a measure of association which summarizes the degree of relatedness between the groups and the discriminant function analysis” (Klecka, 1985, p. 36), was high at 0.659. The function’s group centroids (means) displayed a good spread with the discriminating ERP status not implemented variable at -0.872, and the ERP status implemented variable at 0.872, institutions that did not implement ERP systems were coded as “0” and institutions that did implement ERP systems were coded as “1.” The Wilks’ Lambda, an intermediate statistic that provides a test of significance, showed statistically significant association between groups and predictors at 0.565. Considering the DISCRM’s strong correct classification of the two group membership (80.4%), the researcher was satisfied with the model.

### **Institutional Characteristics**

Institutional characteristics refer to social statistics, which are often used to strengthen social research designs (Hoover, 1995). The six profile, or demographic, characteristics used for this study were: Carnegie 2000 classification, geographic region,

institution age group, institution control, institution level, and institution size. First, descriptive statistics are provided as an overview of the institutional characteristics in the dataset, as well as to provide a more in-depth look at the sample. Using a significance level of .001, the results of the discriminant function analysis is provided to show which institutional characteristics best discriminate between institutions that have and have not implemented ERP systems.

**Descriptive statistics.** Descriptive statistics are presented in this section because they account for every case within sample drawn, thus providing an overall institutional profile for the study. However, DISCRM measures essentially report only the cases that were classified. The population studied consisted of 194 institutions, 97 that have implemented ERP systems and 97 that have not implemented ERP systems.

**Carnegie 2000 classification.** The Carnegie 2000 classification of the institution was categorized into groups in order to examine if this variable discriminates between institutions that have and have not implemented ERP systems. Carnegie 2000 classification was coded using four levels. For the overall sample, the Carnegie 2000 classifications were as follows: Doctoral/Research Universities (coded “1”) (86 institutions, 44.3%); Masters Colleges and Universities (coded “2”) (33 institutions, 17%); Baccalaureate Colleges (coded “3”) (45 institutions, 23.2%); and Associates Colleges (coded “4”) (30 institutions, 15.5%). For each Carnegie 2000 classification, the researcher dummy coded the four Carnegie 2000 classifications as “1” and the other Carnegie 2000 classifications as “0.”

**Geographic region.** The geographic region of the institution was categorized into five groups in order to examine if this variable discriminates between institutions that

have and have not implemented ERP systems. For the overall sample, geographic regions were coded as follows: New England and Mid-East (coded “1”) (65 institutions, 33.5%); Great Lakes and Plains (coded “2”) (47 institutions, 24.2%); Southeast (coded “3”) (48 institutions, 24.7%); Southwest and Rocky Mountains (coded “4”) (15 institutions, 7.7%), and Far West and Outlying Areas (coded “5”) (19 institutions, 9.8%). For each geographic region, the researcher dummy coded the geographic region as “1” and the other geographic regions as “0.”

**Institutional age/age group.** This study examined the current age of the institution, so the age range of the population was nine to 376. The median age of the institutions was 129, and the mean was 125.43. When examining the population by ERP status, the mean for institutions that have not implemented ERP systems was 104.91 (SD = 46.884) and the mean for institutions that have implemented ERP systems was 145.96 (SD = 59.842).

The age of the institution was categorized into groups in order to examine if this variable discriminates between institutions that have and have not implemented ERP systems. Age groups were coded using six levels. For the overall sample, the age groups were categorized as follows: Age 50 or less (coded “1”) (25 institutions, 12.9%); age between 51 and 100 (coded “2”) (36 institutions, 18.6%); age between 101 and 150 (coded “3”) (68 institutions, 35.1%); age between 151 and 200 (coded “4”) (52 institutions, 26.8%); age between 201 and 250 (coded “5”) (8 institutions, 4.1%); and age 251 or greater (coded “6”) (5 institutions, 2.6%). For each age group, the researcher dummy coded the age group as “1” and the other age groups as “0.”



**Institutional control.** This study examined institutions that are publicly and privately controlled. For the overall sample, 53% (102) of the institutions were publicly controlled, and 47% (92) were privately controlled. When examining the institutions by ERP status, 49.5% (48) of the institutions that have not implemented ERP systems were publicly controlled, and 50.5% (49) were privately controlled. For institutions that have implemented ERP systems, 55.7% (54) of the institutions were publicly controlled, and 44.3% (43) were privately controlled. These data were entered into SPSS coding public control as “1” and private control as “2.”

**Institutional level.** This study examined the level institutions that are described as “At least 2 but less than 4 years” and “Four or more years.” These data were entered into SPSS coding “At least 2 but less than 4 years” as “1” and “Four or more years” as “2.” For the overall sample, 11.3% (22) of the institutions were “At least 2 but less than 4 years,” and 88.7% (172) were “Four or more years.” When examining the institutions by ERP status, 17.5% (17) of the institutions that have not implemented ERP systems were at a level of “At least 2 but less than 4 years” and 82.5% (80) were at a level of “Four or more years.” For institutions that have implemented ERP systems 5.2% (5) were at a level of “At least 2 but less than 4 years,” and 94.8% (92) were at a level of “Four or more years.”

**Institutional size.** The size of the institution based on enrollment was categorized into groups in order to examine if this variable discriminates between institutions that have and have not implemented ERP systems. Size groups were coded using five levels. For the overall sample, the size groups were categorized as follows: Size under 1,000 (coded “1”) (14 institutions, 7.2%); size between 1,000 and 4,999 (coded “2”) (61

institutions, 31.4%); size between 5,000 and 9,999 (coded “3”) (28 institutions, 14.4%); size between 10,000 and 19,999 (coded “4”) (40 institutions, 20.6%); and 20,000 and above (coded “5”) (51 institutions, 26.3%). For each size group, the researcher dummy coded the size group as “1” and the other size groups as “0.”

**Research question 1.** The first research question was, “Are there differences in institutional characteristics of institutions that have and have not implemented ERP systems?” As previously mentioned, this question was analyzed using SPSS 20 (2011) statistical software. The entire data set of 194 institutions was used in a discriminant function analysis with the ERP status variable (not implemented or implemented) set as the discriminant (grouping) variable across all variables. The results of the institutional characteristics portion of the discriminant function analysis are displayed in Table 4.

Table 4.

*Predicted Group Membership Based on Institutional Characteristic*

Institutional Characteristic	Standardized Canonical Discriminant Function Coefficients <sup>④</sup>	Structure Coefficients <sup>⑤</sup>	Predicted Membership
Age Group Between 51 and 100	-0.113	-0.314	ERP Not Implemented
Size Between 1,000 and 4,999	0.058	-0.358	ERP Not Implemented
Size 20,000 and above	-0.009	0.512	ERP Implemented
Carnegie 2000 – Doctoral/ Research Universities	0.551	0.771	ERP Implemented
Carnegie 2000 – Masters Colleges and Universities	-0.051	-0.273	ERP Not Implemented
Carnegie 2000 – Associates Colleges	-0.162	-0.339	ERP Not Implemented

④ Standardized coefficients suggest the relative importance of each predictor in classifying characteristics after controlling for the effects of the other predictors.

⑤ Structure coefficients determine the correlation between each variable and the discriminant function.

Table 4 provides a statistical summary of the institutional characteristic predictors for group membership. The institutional characteristics are listed in the first column. The

second column displays the standardized canonical discriminant function coefficients, which display the relative importance of each predictor in classifying characteristics after controlling for the effects of the other predictors (Klecka, 1985). Structure coefficients over 0.05, whether positive or negative, were considered favorable. As shown in Table 4, all of the structure coefficients are greater than 0.05.

The third column in Table 4 displays the structure coefficients, which was the primary statistical measure to predict group membership used in this study. Structure coefficients simply suggest how closely the variable and function are related (Klecka, 1985). The higher the structure coefficient, the greater the correlation the variable has with group membership (ERP not implemented or ERP implemented). A favorable structure coefficient was considered to be greater than or equal to point one ( $\geq .1$ ). As shown in Table 4, Carnegie 2000 classification – Doctoral/ Research Universities received the highest structure coefficient of 0.771.

The fourth column, Predicted Membership, in Table 4 displays the specific group memberships that help answer research question 1. The six demographic characteristics that discriminated between institutions that have and have not implemented ERP systems were: age group between 51 and 100; size between 1,000 and 4,999; size 20,000 and above; Carnegie 2000 – Doctoral/ Research Universities; Carnegie 2000 – Masters Colleges and Universities; and Carnegie 2000 – Associates Colleges. These discriminating variables, which indicated group membership closest to the group centroid -0.872 were coded “0” = ERP not implemented, and membership closest to the group centroid 0.872 were coded “1” = ERP implemented, indicating the following:

- Institutions that are aged between 51 and 100 are more likely to have not implemented ERP systems (-0.314).
- Institutions that have size between 1,000 and 4,999 are more likely to have not implemented ERP systems (-0.358).
- Institutions that have size 20,000 and above are more likely to have implemented ERP systems (0.512).
- Institutions with Carnegie 2000 classification of Doctoral/Research Universities are more likely to have implemented ERP systems (0.771).
- Institutions with Carnegie 2000 classification of Masters Colleges and Universities are more likely to have not implemented ERP systems (-0.273).
- Institutions with Carnegie 2000 classification of Associates Colleges are more likely to have not implemented ERP systems (-0.339).

***Public and private institutions.*** Based on the six institutional characteristic predictors for group membership, Tables 5 and 6 provide descriptive statistics for IHEs that have and have not implemented ERP systems, respectively. These tables provide a statistical summary including the following nine columns: institutional characteristic predicting group membership; count of public and private IHEs with the discriminating characteristic; percent of public and private IHEs out of the total count of IHEs with the discriminating characteristic; total count of IHEs with the discriminating characteristic; percent of IHEs with the discriminating characteristic out of the sample group of 97 IHEs that have or have not implemented ERP systems, and percent of public and private IHEs for the discriminating characteristic out of the number of public and private IHEs in the sample groups.

The focus of these descriptive statistics is on public and private IHEs in each predicted member group (ERP status implemented or not implemented) that each discriminating characteristic is associated with. Since the discriminant analysis model

correctly classified 80.4% of the original grouped cases, the alternate group for each characteristic was not included in descriptive statistics because it was not deemed as significant for consideration.

Table 5.

*Discriminating Institutional Characteristics for Public and Private IHEs that Have Implemented ERP Systems*

<b>Institutional Char. Predicting Group Membership</b>	<b>Count of Pub. IHEs</b>	<b>Count of Priv. IHEs</b>	<b>% Public IHEs for Char.</b>	<b>% Private IHEs for Char.</b>	<b>Total Per Char.</b>	<b>% of IHEs in Sample of 97 for the Char.</b>	<b>% Public IHEs for Char. out of 54 Public IHEs</b>	<b>% Private IHEs for Char. out of 43 Private IHEs</b>
Size 20,000 and above	34	9	79%	21%	43	44%	63%	21%
Carnegie 2000 – Doctoral/ Research Universities	42	28	60%	40%	70	72%	78%	65%

There were 43 institutions in the category “Size 20,000 and above” that have implemented ERP systems. Of these, 34 (79%) were public IHEs and 9 (21%) were private IHEs. The 34 IHEs in this category represent 33% of the total (102) public IHEs in the study that have implemented ERP systems and 9 IHEs represent 10% of the total (92) private IHEs in the study that have implemented ERP systems.

There were 70 institutions in the category “Carnegie 2000 – Doctoral/ Research Universities” that have implemented ERP systems. Of these, 42 (60%) were public IHEs and 28 (40%) were private IHEs. In this category, 42 IHEs represent 41% of the total (102) public IHEs, and 28 IHEs represent 30% of the total (92) private IHEs in the study that have implemented ERP systems.

Table 6.

*Discriminating Institutional Characteristics for Public and Private IHEs that Have Not Implemented ERP Systems*

<b>Institutional Char. Predicting Group Membership</b>	<b>Count of Pub. IHEs</b>	<b>Count of Priv. IHEs</b>	<b>% Public IHEs for Char.</b>	<b>% Private IHEs for Char.</b>	<b>Total Per Char.</b>	<b>% of IHEs in Sample of 97 for the Char.</b>	<b>% Public IHEs for Char. out of 48 Public IHEs</b>	<b>% Private IHEs for Char. out of 49 Private IHEs</b>
Age group between 51 and 100	15	13	54%	46%	28	29%	31%	27%
Size between 1,000 and 4,999	16	28	36%	64%	44	45%	33%	57%
Carnegie 2000 – Masters Colleges and Universities	11	14	44%	56%	25	26%	23%	29%
Carnegie 2000 – Associates Colleges	22	3	88%	12%	25	26%	46%	6%

There were 28 institutions in the category “Age group between 51 and 100” that have not implemented ERP systems. Of these, 15 (54%) were public IHEs and 13 (46%) were private IHEs. In this category, 15 IHEs represent 15% of the total (102) public IHEs, and 13 IHEs represent 15% of the total (92) private IHEs in the study that have not implemented ERP systems.

There were 44 institutions in the category “Size between 1,000 and 4,999” that have not implemented ERP systems. Of these, 16 (36%) were public IHEs and 28 (64%) were private IHEs. In this category, 16 public IHEs represent 16% of the total (102) public IHEs, and 28 IHEs represent 30% of the total (92) private IHEs in the study that have not implemented ERP systems.

There were 25 institutions in the category “Carnegie 2000 – Masters Colleges and Universities” that have not implemented ERP systems. Of these, 11 (44%) were public IHEs and 14 (56%) were private IHEs. In this category, 11 IHEs represent 11% of the total (102) public IHEs, and 14 IHEs represent 15% of the total (92) private IHEs in the study that have not implemented ERP systems.

There were 25 institutions in the category “Carnegie 2000 – Associates Colleges” that have not implemented ERP systems. Of these, 22 (88%) were public IHEs and 3 (12%) were private IHEs. In this category, 22 IHEs represent 22% of the total (102) public IHEs, and 3 IHEs represent 3% of the total (92) private IHEs in the study that have not implemented ERP systems.

Of the population of 97 IHEs that have implemented ERP systems, the following statistics were calculated: 43 IHEs (44%) were in the category “Size 20,000 and above,” and 70 IHEs (72%) were in the category Carnegie 2000 – Doctoral/ Research Universities.

Descriptive statistics were calculated for the population of 97 IHEs that have not implemented ERP systems. 28 IHEs (29%) were in the category “Age group between 51 and 100.” 44 IHEs (45%) were in the category “Size between 1,000 and 4,999.” 25 IHEs (26%) were in the category “Carnegie 2000 – Masters Colleges and Universities.” 25 IHEs (26%) were in the category “Carnegie 2000 – Associates Colleges.”

In addition, descriptive statistics were computed for the total population of 194 IHEs in this study. For institutions that have implemented ERP systems, 43 IHEs (22%) were in the category “Size 20,000 and above” and 70 IHEs (36%) were in the category “Carnegie 2000 – Doctoral/ Research Universities.” For institutions that have not

implemented ERP systems, 28 IHEs (14%) were in the category “Age group between 51 and 100;” 44 IHEs (23%) were in the category “Size between 1,000 and 4,999;” 25 IHEs (13%) were in the category “Carnegie 2000 – Masters Colleges and Universities,” and 25 IHEs (13%) were in the category “Carnegie 2000 – Associates Colleges.”

### **Resource and Customer Variables**

Resource variables were examined to provide an understanding of the variety of financial and personnel resources such as revenues, expenses, and employees needed for institutional operations. In addition, information about the customers of IHEs was collected to ascertain the impact of implementing ERP systems on students. This section will first provide the descriptive statistics of the financial and personnel resource variables and customer variables examined in this study. The results of the discriminant function analysis will subsequently be discussed to understand which resource variables best discriminate between institutions that have and have not implemented ERP systems. Later in this chapter, the results of examining customer variables will be considered.

**Descriptive statistics.** A table for each category of resource variable (financial inputs, financial outputs, and personnel) is presented to display the descriptive statistics, including the sample size, status of ERP systems implementation, mean, and standard deviation for each variable under examination. For this section, the data for FY 10 are presented because this is the data used to study research question 2, which will be discussed later in this section.

**Financial input variables.** The average total dollars of core revenues for IHEs that have and have not implemented ERP systems ranged between \$135,302,619 and \$996,747,504 in FY 10. This data is presented in Table 7 below.



Table 7.

*Descriptive Statistics of FY 10 Revenue Variables*

Variable	ERP Status	N	Mean	Std. Deviation
Core revenues, total dollars	No ERP	97	135302618.90	210391234.30
	ERP	97	996747503.75	1046533454.96
	Total	194	566025061.32	867916691.38
Tuition and fees as a percent of core revenues	No ERP	97	44.30	25.33
	ERP	97	32.61	19.70
	Total	194	38.45	23.38
State appropriations as a percent of core revenues	No ERP	97	14.54	17.22
	ERP	97	12.52	13.42
	Total	194	13.53	15.43
Local appropriations as a percent of core revenues	No ERP	97	2.56	6.98
	ERP	97	1.53	9.26
	Total	194	2.04	8.19
Government grants and contracts as a percent of core revenues	No ERP	97	16.04	13.58
	ERP	97	19.11	10.79
	Total	194	17.58	12.33
Private gifts grants and contracts as a percent of core revenues	No ERP	97	7.82	9.34
	ERP	97	9.39	6.26
	Total	194	8.61	7.97
Investment return as a percent of core revenues	No ERP	97	7.00	12.00
	ERP	97	13.99	16.72
	Total	194	10.49	14.93
Other revenues as a percent of core revenues	No ERP	97	7.61	8.25
	ERP	97	10.89	8.74
	Total	194	9.25	8.63

The remaining seven financial input variables regarding institutional revenues (tuition and fees, state appropriations, local appropriations, government grants and contracts, private gift grants and contracts, investment return, and other revenues) were examined based upon a percentage of the total core revenues. The means of these variables were between 1.53 and 44.30.

**Financial output variables.** The average total dollars of core expenses for IHEs that have and have not implemented ERP systems ranged between \$123,742,850 and \$842,990,294 in FY 10. The remaining seven financial output variables relating to institutional expenses (instruction, research, public service, student service, academic

support, institutional support, and other expenses) were examined based upon a percentage of the total core expenses. The means of these variables were between 2.48 and 43.25. This data is presented in Table 8 below.

Table 8.

*Descriptive Statistics of FY 10 Expense Variables*

Variable	ERP Status	N	Mean	Std. Deviation
Core expenses, total dollars	No ERP	97	123742850.18	211464846.70
	ERP	97	842990293.56	854125727.99
	Total	194	483366571.87	717716912.79
Instruction expenses as a percent of total core expenses	No ERP	97	43.25	9.35
	ERP	97	40.70	10.15
	Total	194	41.97	9.83
Research expenses as a percent of total core expenses	No ERP	97	4.24	9.74
	ERP	97	16.91	14.04
	Total	194	10.57	13.63
Public service expenses as a percent of total core expenses	No ERP	97	2.48	4.21
	ERP	97	4.05	5.52
	Total	194	3.27	4.96
Student service expenses as a percent of total core expenses	No ERP	97	14.02	7.58
	ERP	97	8.12	5.37
	Total	194	11.07	7.19
Academic support expenses as a percent of total core expenses	No ERP	97	9.56	5.45
	ERP	97	11.46	5.95
	Total	194	10.51	5.77
Institutional support expenses as a percent of total core expenses	No ERP	97	19.16	7.95
	ERP	97	13.92	7.78
	Total	194	16.54	8.27
Other core expenses as a percent of total core expenses	No ERP	97	7.39	9.56
	ERP	97	4.91	5.51
	Total	194	6.15	7.86

**Personnel variables.** The total staff FTE is distinguished by a mean of 1,129 for institutions that have not implemented ERP systems, and 5,627 for institutions that have implemented ERP systems for FY 10. The remaining variables are the staff FTE for instruction/research/public service, executive/administrative/managerial, other professional, and non-professional. The means of the remaining variables were between 97 and 1,779. This data is presented in Table 9 below.

Table 9.

*Descriptive Statistics of FY 10 Personnel Variables*

Variable	ERP Status	N	Mean	Std. Deviation
Total FTE Staff	No ERP	97	1128.85	2436.29
	ERP	97	5626.47	5304.68
	Total	194	3377.66	4693.89
Instruction-Research-Public Service FTE Staff	No ERP	97	366.20	513.77
	ERP	97	1651.13	1435.86
	Total	194	1008.66	1253.68
Executive-Admin-Managerial FTE Staff	No ERP	97	96.74	228.00
	ERP	97	432.87	613.65
	Total	194	264.80	491.48
Other Professional FTE Staff	No ERP	97	279.35	760.51
	ERP	97	1763.96	1978.82
	Total	194	1021.65	1670.11
Non-professional FTE Staff	No ERP	97	386.56	1041.54
	ERP	97	1778.52	1760.52
	Total	194	1082.54	1602.55

**Customer variables.** Three customer variables were examined to gain an understanding of the reported FTE of undergraduate and graduate enrollment, and the instructional support expenses per FTE at the institution. The mean and standard deviation of each variable for FY 10 is presented in Table 10 below. The student enrollments are in a range between 811 and 13,494. The institutional support expenses per student FTE is between \$3,733 and \$8,128.

Table 10.

*Descriptive Statistics of FY 10 Customer Variables*

Variable	ERP Status	N	Mean	Std. Deviation
Reported FTE Undergraduate Enrollment	No ERP	97	4535.62	4365.78
	ERP	97	13493.90	11126.06
	Total	194	9014.76	9550.98
Reported FTE Graduate Enrollment	No ERP	97	810.74	1255.02
	ERP	97	5014.53	5008.62
	Total	194	2912.63	4207.43
Institutional support expenses per FTE	No ERP	97	3733.27	2642.71
	ERP	97	8127.95	19036.74
	Total	194	5930.61	13732.70

**Research question 2.** The second research question was, “What resources best discriminate between institutions that have and have not implemented ERP systems?” This question was analyzed using SPSS 20 (2011) statistical software. The entire data set of 194 institutions was used in a discriminant function analysis with the ERP status dependent variable (ERP not implemented or ERP implemented) set as the discriminant (grouping) variable across all independent variables. The results of the financial resource and personnel variables portion of the discriminant function analysis are displayed in Table 11. This table provides a statistical summary of the resource variable predictors for group membership. The resource characteristics are listed in the first column. The second and third columns display the standardized canonical discriminant function coefficients, and the structure coefficients, respectively; coefficients over 0.05, whether positive or negative, were considered favorable. The fourth column in Table 11, Predicted Membership, indicates that 11 variables helped to predict group membership using the DISCRM function.

Table 11.

*Predicted Group Membership Based on Resource Variable*

<b>Resource Variable</b>	<b>Standardized Canonical Discriminant Function Coefficients<sup>④</sup></b>	<b>Structure Coefficients<sup>⑤</sup></b>	<b>Predicted Membership</b>
Core revenues, total dollars	-0.300	0.654	ERP Implemented
Tuition and fees as a percent of core revenues	-0.155	-0.295	ERP Not Implemented
Investment return as a percent of core revenues	0.422	0.275	ERP Implemented
Core expenses, total dollars	0.760	0.662	ERP Implemented
Research expenses as a percent of total core expenses	-0.108	0.601	ERP Implemented
Student service expenses as a percent of total core expenses	-0.188	-0.515	ERP Not Implemented
Institutional support expenses as a percent of total core expenses	0.183	-0.382	ERP Not Implemented
Total FTE Staff	-0.917	0.624	ERP Implemented
Instruction-Research-Public Service FTE Staff	0.273	0.683	ERP Implemented
Executive-Admin-Managerial FTE Staff	-0.073	0.416	ERP Implemented
Other Professional FTE Staff	0.223	0.568	ERP Implemented

④ Standardized coefficients suggest the relative importance of each predictor in classifying characteristics after controlling for the effects of the other predictors.

⑤ Structure coefficients determine the correlation between each variable and the discriminant function.

There were three revenue related variables, four expense related variables, and four personnel related variables that discriminate between groups. These discriminating variables indicated that institutions, more likely to have implemented ERP systems are affected by the following:

- Core revenue, total dollars (0.654)
- Investment return as a percent of core revenues (0.275)
- Core expenses, total dollars (0.662)
- Research expenses as a percent of total core expenses (0.601)
- Total FTE Staff (0.624)

- Instruction-Research-Public Service FTE Staff (0.683)
- Executive-Admin-Managerial FTE Staff (0.416)
- Other Professional FTE Staff (0.568)

Institutions that are likely to have not implemented ERP systems are affected by the following:

- Tuition and fees as a percent of core revenues (-0.295)
- Student service expenses as a percent of total core expenses (-0.515)
- Institutional support expenses as a percent of total core expenses (-0.382)

### **Paired Samples t-test Model**

As previously discussed, resource variables refer to measurable financial and personnel resources of operating the institution to provide services to students (customers). There were 21 resource variables and three customer variables from FY 10 examined in this study, and these same 24 variables were collected for FY 06. This section will first provide the descriptive statistics of the financial and personnel resource variables, and customer variables for FY 06.

Subsequently, the results of the paired samples t-test model used to answer research questions 3 and 4 will be discussed. The goal is to use the paired samples t-test to compare the data from FY 06, which is pre-implementation, and data from FY 10 that is post-implementation. According to Zimmerman (1997), “the paired-samples test is preferable if the two groups are highly correlated” (p. 350). The data used for the study is highly correlated because it is collected using standard measures from year to year for the same individual institutions.

**Descriptive statistics.** A table for each category of resource variable (financial inputs, financial outputs, and personnel) and customer variables are presented in tables to display the descriptive statistics, including the sample size, status of ERP systems implementation, mean, and standard deviation for each variable under examination. For this section, the data for FY 06 are presented because this is part of the data used to study research questions 3 and 4 in comparison to data from FY 10 that was previously reviewed in this chapter.

**Financial input variables.** The average total dollars of core revenues for IHEs that have and have not implemented ERP systems ranged between \$118,024,976 and \$925,905,209 in FY 06. The remaining seven financial input variables regarding revenues of IHEs were examined based upon a percentage of the total core revenues. The means of these variables are between 1.54 and 41.85. This data is presented in Table 12 below.

Table 12.

*Descriptive Statistics of FY 06 Revenue Variables*

Variable	ERP Status	N	Mean	Std. Deviation
Core revenues, total dollars	No ERP	97	118024976.18	196024893.14
	ERP	97	925905208.57	1129744196.09
	Total	194	521965092.37	904422919.36
Tuition and fees as a percent of core revenues	No ERP	97	41.85	23.48
	ERP	97	29.97	18.89
	Total	194	35.91	22.07
State appropriations as a percent of core revenues	No ERP	97	15.12	18.26
	ERP	97	15.13	16.08
	Total	194	15.13	17.16
Local appropriations as a percent of core revenues	No ERP	97	2.42	6.85
	ERP	97	1.54	9.05
	Total	194	1.98	8.02
Government grants and contracts as a percent of core revenues	No ERP	97	14.34	13.05
	ERP	97	19.12	11.05
	Total	194	16.73	12.30
Private gifts grants and contracts as a percent of core revenues	No ERP	97	8.82	12.57
	ERP	97	6.89	10.17
	Total	194	7.86	11.45
Investment return as a percent of core revenues	No ERP	97	7.42	12.78
	ERP	97	13.58	20.58
	Total	194	10.50	17.36
Other revenues as a percent of core revenues	No ERP	97	8.96	8.32
	ERP	97	13.71	11.34
	Total	194	11.34	10.20

**Financial output variables.** The average total dollars of core expenses for IHEs that have and have not implemented ERP systems ranged between \$104,892,608 and \$691,904,768 in FY 06. The remaining seven financial output variables regarding institutional expenses (instruction, research, public service, student service, academic support, institutional support, and other expenses) were examined based upon a percentage of the total core expenses. The means of these variables are between 2.34 and 41.08. This data is presented in Table 13 below.



Table 13.

*Descriptive Statistics of FY 06 Expense Variables*

Variable	ERP Status	N	Mean	Std. Deviation
Core expenses, total dollars	No ERP	97	104892608.40	180571985.19
	ERP	97	691904768.10	690949118.16
	Total	194	398398688.25	583334677.34
Instruction expenses as a percent of total core expenses	No ERP	97	41.08	8.55
	ERP	97	37.25	10.17
	Total	194	39.16	9.56
Research expenses as a percent of total core expenses	No ERP	97	4.06	9.01
	ERP	97	15.51	13.44
	Total	194	9.78	12.77
Public service expenses as a percent of total core expenses	No ERP	97	2.34	3.94
	ERP	97	3.69	4.75
	Total	194	3.02	4.41
Student service expenses as a percent of total core expenses	No ERP	97	13.12	7.16
	ERP	97	7.26	5.24
	Total	194	10.19	6.91
Academic support expenses as a percent of total core expenses	No ERP	97	8.76	5.53
	ERP	97	10.26	5.56
	Total	194	9.51	5.58
Institutional support expenses as a percent of total core expenses	No ERP	97	18.53	8.31
	ERP	97	13.25	9.97
	Total	194	15.89	9.53
Other core expenses as a percent of total core expenses	No ERP	97	12.02	11.56
	ERP	97	12.78	11.20
	Total	194	12.40	11.36

**Personnel variables.** The total staff FTE for FY 06 is distinguished by a mean of 1,052 for institutions that have not implemented ERP systems, and 5,090 for institutions that have implemented ERP systems. The remaining variables are the staff FTE for instruction/research/public service, executive/administrative/managerial, other professional, and non-professional. The means of the remaining variables were between 84 and 1,737. This data is presented in Table 14 below.

Table 14.

*Descriptive Statistics of FY 06 Personnel Variables*

Variable	ERP Status	N	Mean	Std. Deviation
Total FTE Staff	No ERP	97	1051.80	2108.19
	ERP	97	5090.20	4641.16
	Total	194	3071.00	4125.94
Instruction-Research-Public Service FTE Staff	No ERP	97	341.15	481.52
	ERP	97	1509.31	1330.13
	Total	194	925.23	1156.84
Executive-Admin-Managerial FTE Staff	No ERP	97	84.34	185.73
	ERP	97	347.30	428.66
	Total	194	215.82	354.87
Other Professional FTE Staff	No ERP	97	251.37	618.28
	ERP	97	1496.55	1617.73
	Total	194	873.96	1371.68
Non-professional FTE Staff	No ERP	97	374.94	920.72
	ERP	97	1737.04	1671.31
	Total	194	1055.99	1509.07

**Customer variables.** Three customer variables were examined to gain an understanding of the reported FTE of undergraduate and graduate enrollment, and the instructional support expenses per FTE at the institution. The mean and standard deviation of these variables for FY 06 are presented in Table 15 below. The student enrollments are in a range between 603 and 12,509. The institutional support expenses per student FTE is between \$3,546 and \$13,278.

Table 15.

*Descriptive Statistics of FY 06 Customer Variables*

Variable	ERP Status	N	Mean	Std. Deviation
Reported FTE Undergraduate Enrollment	No ERP	97	3962.16	3822.37
	ERP	97	12509.38	10148.10
	Total	194	8235.77	8766.47
Reported FTE Graduate Enrollment	No ERP	97	602.58	968.72
	ERP	97	3660.03	3617.80
	Total	194	2131.30	3053.88
Institutional support expenses per FTE	No ERP	97	3545.89	2707.89
	ERP	97	13277.90	78101.45
	Total	194	8411.89	55331.40

**Research question 3.** The third research question was, “For institutions that have implemented ERP systems, are there differences in resource allocations, and/or student enrollment/institutional support per student from fiscal year 2005-2006 to fiscal year 2009-2010?” This question was analyzed using SPSS 20 (2011) statistical software. The partial dataset of 97 institutions that have implemented ERP systems were used in a paired samples t-test analysis. The results of these paired tests of financial input variables, financial expense variables, personnel variables, and customer variables are presented in tables 16 through 19, respectively.

Using a significance of .001, Table 16 displays the following two financial input variables are significant when pairs are compared between FY 06 and FY 10: tuition and fees as a percent of core revenues, and state appropriations as percent of core revenues. All other variables in the paired samples t-test are non-significant.

Table 16.

*Paired Samples t-test – Institutions with ERP Systems – Revenues*

		T	df	Sig. (2- tailed)	Effect Size (Cohen's <i>d</i> )	Effect Size ( <i>r</i> -based)
Pair 1	FY 06 Core revenues total dollars - FY 10 Core revenues total dollars	-1.848	96	0.068	-0.27	-0.13
Pair 2	FY 06 Tuition and fees as a percent of core revenues - FY 10 Tuition and fees as a percent of core revenues	-4.595	96	0.000	-0.66	-0.31
Pair 3	FY 06 State appropriations as a percent of core revenues - FY 10 State appropriations as a percent of core revenues	5.759	96	0.000	0.83	0.38
Pair 4	FY 06 Local appropriations as a percent of core revenues - FY 10 Local appropriations as a percent of core revenues	0.217	96	0.829	0.03	0.02
Pair 5	FY 06 Government grants and contracts as a percent of core revenues - FY 10 Government grants and contracts as a percent of core revenues	0.017	96	0.986	0.002	0.001
Pair 6	FY 06 Private gifts grants and contracts as a percent of core revenues - FY 10 Private gifts grants and contracts as a percent of core revenues	-2.724	96	0.008	-0.39	-0.19
Pair 7	FY 06 Investment return as a percent of core revenues - FY 10 Investment return as a percent of core revenues	-0.417	96	0.678	-0.06	-0.03
Pair 8	FY 06 Other revenues as a percent of core revenues - FY 10 Other revenues as a percent of core revenues	3.137	96	0.002	0.45	0.22

Using a significance of .001, Table 17 displays the following six financial output variables as significant when pairs are compared between FY 06 and FY 10: core expenses, total dollars; instruction expenses as a percent of total core expenses; research expenses as a percent of total core expenses; student service expenses as a percent of total core expenses; academic support expenses as a percent of total core expenses, and other core expenses as a percent of total core expenses. All other variables in the paired samples t-test were non-significant.

Table 17.

*Paired Samples t-test – Institutions with ERP Systems – Expenses*

		T	df	Sig. (2- tailed)	Effect Size (Cohen's <i>d</i> )	Effect Size ( <i>r</i> -based)
Pair 9	FY 06 Core expenses total dollars - FY 10 Core expenses total dollars	-7.877	96	0.000	-1.14	-0.49
Pair 10	FY 06 Instruction expenses as a percent of total core expenses - FY 10 Instruction expenses as a percent of total core expenses	-6.536	96	0.000	-0.94	-0.43
Pair 11	FY 06 Research expenses as a percent of total core expenses - FY 10 Research expenses as a percent of total core expenses	-4.733	96	0.000	-0.68	-0.32
Pair 12	FY 06 Public service expenses as a percent of total core expenses - FY 10 Public service expenses as a percent of total core expenses	-2.265	96	0.026	-0.33	-0.16
Pair 13	FY 06 Student service expenses as a percent of total core expenses - FY 10 Student service expenses as a percent of total core expenses	-4.913	96	0.000	-0.71	-0.33
Pair 14	FY 06 Academic support expenses as a percent of total core expenses - FY 10 Academic support expenses as a percent of total core expenses	-4.809	96	0.000	-0.69	-0.33
Pair 15	FY 06 Institutional support expenses as a percent of total core expenses - FY 10 Institutional support expenses as a percent of total core expenses	-1.443	96	0.152	-0.21	-0.10
Pair 16	FY 06 Other core expenses as a percent of total core expenses - FY 10 Other core expenses as a percent of total core expenses	8.63	96	0.000	1.25	0.53

Using a significance of .001, Table 18 presents the following three personnel variables as significant when pairs are compared between FY 06 and FY 10: total FTE staff, Instruction-Research-Public Service FTE Staff, and other professional FTE staff. All other variables in the paired samples t-test were non-significant.

Table 18.

*Paired Samples t-test – Institutions with ERP Systems – Personnel*

		T	df	Sig. (2- tailed)	Effect Size (Cohen's <i>d</i> )	Effect Size ( <i>r</i> -based)
Pair 17	FY 06 Total FTE Staff - FY 10 Total FTE Staff	-4.320	96	.000	-0.62	-0.30
Pair 18	FY 06 Instruction-Research-Public Service FTE Staff - FY 10 Instruction-Research-Public Service FTE Staff	-3.680	96	.000	-0.53	-0.26
Pair 19	FY 06 Executive-Admin-Managerial FTE Staff - FY 10 Executive-Admin-Managerial FTE Staff	-3.176	96	.002	-0.46	-0.22
Pair 20	FY 06 Other Professional FTE Staff - FY 10 Other Professional FTE Staff	-3.594	96	.001	-0.52	-0.25
Pair 21	FY 06 Non-professional FTE Staff - FY 10 Non-professional FTE Staff	-.868	96	.388	-0.13	-0.06

Using a significance of .001, Table 19 displays the following two customer variables as significant when pairs are compared between FY 06 and FY 10: reported FTE undergraduate enrollment and reported FTE graduate enrollment. All other variables in the paired samples t-test were non-significant.

Table 19.

*Paired Samples t-test – Institutions with ERP Systems – Customers*

		T	df	Sig. (2- tailed)	Effect Size (Cohen's <i>d</i> )	Effect Size ( <i>r</i> -based)
Pair 22	FY 06 Reported FTE Undergraduate Enrollment - FY 10 Reported FTE Undergraduate Enrollment	-4.727	96	.000	-0.68	-0.32
Pair 23	FY 06 Reported FTE Graduate Enrollment - FY 10 Reported FTE Graduate Enrollment	-7.376	96	.000	-1.06	-0.47
Pair 24	FY 06 Institutional support expenses per FTE - FY 10 Institutional support expenses per FTE	.845	96	.400	0.12	0.06

In summary, to determine whether there was a statistically significant difference between FY 06 and FY 10, a two-tailed paired samples t-test was performed, and the confidence level was set at 0.001. The results show that the following 13 resource allocations were significant:

- Pair 2 - Tuition and fees as a percent of core revenues
- Pair 3 - State appropriations as percent of core revenues
- Pair 9 - Core expenses, total dollars
- Pair 10 - Instruction expenses as a percent of total core expenses
- Pair 11- Research expenses as a percent of total core expenses
- Pair 13 - Student service expenses as a percent of total core expenses
- Pair 14 - Academic support expenses as a percent of total core expenses
- Pair 16 - Other core expenses as a percent of total core expenses
- Pair 17 - Total FTE Staff
- Pair 18 - Instruction-Research-Public Service FTE Staff
- Pair 20 - Other Professional FTE Staff
- Pair 22 - Reported FTE Undergraduate Enrollment
- Pair 23 - Reported FTE Graduate Enrollment

**Research question 4.** The fourth research question was, “For institutions that have not implemented ERP systems, are there differences in resource allocations, and/or student enrollment/institutional support per student from FY 06 to fiscal year 2009-2010?” This question was analyzed using SPSS 20 (2011) statistical software. The partial data set of 97 institutions that have not implemented ERP systems were used in a paired samples t-test analysis. The results of these paired samples t-tests of financial input

variables, financial expense variables, personnel variables, and customer variables are presented in tables 20 through 24, respectively. Each table lists the pair number, description of the variable tested, t-factor, degrees of freedom, significance of the two-tailed t-test, effect size using Cohen's *d*, and *r*-based effect size. The variables with noteworthy effect size are described later in this section.

Using a significance of .001, Table 20 displays one financial input variable is significant when pairs are compared between FY 06 and FY 10: core revenue total dollars. All other variables in the paired samples t-test were non-significant.

Table 20. *Paired Samples t-test – Institutions without ERP Systems – Revenues*

		T	df	Sig. (2- tailed)	Effect Size (Cohen's <i>d</i> )	Effect Size ( <i>r</i> - based)
Pair 1	FY 06 Core revenues total dollars - FY 10 Core revenues total dollars	-5.498	96	.000	-0.79	-0.37
Pair 2	FY 06 Tuition and fees as a percent of core revenues - FY 10 Tuition and fees as a percent of core revenues	-2.491	96	.014	-0.36	-0.18
Pair 3	FY 06 State appropriations as a percent of core revenues - FY 10 State appropriations as a percent of core revenues	.622	96	.535	0.09	0.04
Pair 4	FY 06 Local appropriations as a percent of core revenues - FY 10 Local appropriations as a percent of core revenues	-.492	96	.624	-0.07	-0.04
Pair 5	FY 06 Government grants and contracts as a percent of core revenues - FY 10 Government grants and contracts as a percent of core revenues	-2.650	96	.009	-0.38	-0.19
Pair 6	FY 06 Private gifts grants and contracts as a percent of core revenues - FY 10 Private gifts grants and contracts as a percent of core revenues	1.361	96	.177	0.20	0.10
Pair 7	FY 06 Investment return as a percent of core revenues - FY 10 Investment return as a percent of core revenues	.790	96	.431	0.11	0.06
Pair 8	FY 06 Other revenues as a percent of core revenues - FY 10 Other revenues as a percent of core revenues	1.756	96	.082	0.25	0.13



Using a significance of .001, Table 21 presents three financial output variables as significant when pairs are compared between FY 06 and FY 10: core expenses, total dollars; instruction expenses as a percent of total core expenses; and other core expenses as a percent of total core expenses. All other variables in the paired samples t-test were non-significant.

Table 21.

*Paired Samples t-test – Institutions without ERP Systems – Expenses*

		T	df	Sig. (2- tailed)	Effect Size (Cohen's <i>d</i> )	Effect Size ( <i>r</i> -based)
Pair 9	FY 06 Core expenses total dollars - FY 10 Core expenses total dollars	-4.965	96	.000	-0.72	-0.34
Pair 10	FY 06 Instruction expenses as a percent of total core expenses - FY 10 Instruction expenses as a percent of total core expenses	-3.488	96	.001	-0.50	-0.24
Pair 11	FY 06 Research expenses as a percent of total core expenses - FY 10 Research expenses as a percent of total core expenses	-1.074	96	.286	-0.16	-0.08
Pair 12	FY 06 Public service expenses as a percent of total core expenses - FY 10 Public service expenses as a percent of total core expenses	-.597	96	.552	-0.09	-0.04
Pair 13	FY 06 Student service expenses as a percent of total core expenses - FY 10 Student service expenses as a percent of total core expenses	-1.641	96	.104	-0.24	-0.12
Pair 14	FY 06 Academic support expenses as a percent of total core expenses - FY 10 Academic support expenses as a percent of total core expenses	-2.942	96	.004	-0.42	-0.21
Pair 15	FY 06 Institutional support expenses as a percent of total core expenses- FY 10 Institutional support expenses as a percent of total core expenses	-1.774	96	.079	-0.26	-0.13
Pair 16	FY 06 Other core expenses as a percent of total core expenses - FY 10 Other core expenses as a percent of total core expenses	4.716	96	.000	0.68	0.32

Using a significance of .001, Table 22 displays one personnel variable as significant when pairs are compared between FY 06 and FY 10: Instruction-Research-Public Service FTE Staff. All other variables in the paired samples t-test were non-significant.

Table 22.

*Paired Samples t-test – Institutions without ERP Systems – Personnel*

		<b>T</b>	<b>df</b>	<b>Sig. (2-tailed)</b>	<b>Effect Size (Cohen's d)</b>	<b>Effect Size (r-based)</b>
Pair 17	FY 06 Total FTE Staff - FY 10 Total FTE Staff	-1.928	96	0.057	-0.28	-0.14
Pair 18	FY 06 Instruction-Research-Public Service FTE Staff - FY 10 Instruction-Research-Public Service FTE Staff	-3.519	96	0.001	-0.51	-0.25
Pair 19	FY 06 Executive-Admin-Managerial FTE Staff - FY 10 Executive-Admin-Managerial FTE Staff	-2.376	96	0.019	-0.34	-0.17
Pair 20	FY 06 Other Professional FTE Staff - FY 10 Other Professional FTE Staff	-1.578	96	0.118	-0.23	-0.11
Pair 21	FY 06 Non-professional FTE Staff - FY 10 Non-professional FTE Staff	-0.824	96	0.412	-0.12	-0.06

Using a significance of .001, Table 23 displays the following two customer variables as significant when pairs are compared between FY 06 and FY 10: reported FTE undergraduate enrollment and reported FTE graduate enrollment. All other variables in the paired samples t-test were non-significant.

Table 23.

*Paired Samples t-test – Institutions without ERP Systems – Customers*

		T	df	Sig. (2- tailed)	Effect Size (Cohen's <i>d</i> )	Effect Size ( <i>r</i> -based)
Pair 22	FY 06 Reported FTE Undergraduate Enrollment - FY 10 Reported FTE Undergraduate Enrollment	-4.602	96	0.000	-0.66	-0.32
Pair 23	FY 06 Reported FTE Graduate Enrollment - FY 10 Reported FTE Graduate Enrollment	-4.188	96	0.000	-0.60	-0.29
Pair 24	FY 06 Institutional support expenses per FTE - FY 10 Institutional support expenses per FTE	-1.394	96	0.166	-0.20	-0.10

In summary, to determine whether there was a statistically significant difference between FY 06 and FY 10, a two-tailed paired samples t-test was performed, and the confidence level was set at 0.001. The results show that the following seven resource allocations were significant:

- Pair 1 - Core revenues total dollars
- Pair 9 - Core expenses total dollars
- Pair 10 - Instruction expenses as a percent of total core expenses
- Pair 16 - Other core expenses as a percent of total core expenses
- Pair 18 - Instruction-Research-Public Service FTE Staff
- Pair 22 - Reported FTE Undergraduate Enrollment
- Pair 23 - Reported FTE Graduate Enrollment

**Effect size.** The effect size based on the paired t-tests provided useful information regarding the effect of the analysis. Two formulas were used to calculate the effect size, Cohen's *d* and *r*-based because they compute effect size based on standardized mean difference using the sample size and correlation, respectively. Table 24 describes the

thresholds for interpreting effect size (Ellis, 2009a). A calculator developed by Ellis (2009b) was used to compute the Cohen’s  $d$  and  $r$ -based values for each paired t-test. In addition, a calculator developed by Cepeda (2008) was used to calculate the Cohen’s  $d$  value for each paired t-test, and the results were similar, if not exactly the same as the results from the Ellis calculator. Tables 16 through 23 listed the Cohen’s  $d$  and  $r$ -based effect size values using the Ellis (2009b) calculator for each paired t-test for groups of IHEs that have and have not implemented ERP systems, a total of 48 pairs.

Table 24.

*Cohen’s Thresholds for Interpreting Effect Size*

Test	Relevant Effect Size	Effect Size Threshold			
		Small	Medium	Large	Very Large
Standardized mean difference	$d, \Delta,$ Hedges’ $g$	0.20	0.50	0.80	1.30
Correlation	$r$	0.10	0.30	0.50	0.70

Based on these thresholds, the 24 independent variables were categorized into groupings of “Small to Medium,” “Medium to Large,” and “Large to Very Large” for each group of IHEs examined, institutions that have and have not implemented ERP systems. Variables that did not meet the minimum standard of small threshold were considered trivial and too small to be noteworthy. Tables 25 and 26 present the variables with noticeable effect size for institutions that have and have not implemented ERP systems, respectively.

Table 25.

*Noteworthy Effect Size for Paired t-tests – IHEs with ERP Systems*

Effect Size	Pair	Cohen's <i>d</i> Value	<i>r</i> -based Value
<b>Small to Medium</b>	Financial Inputs – Revenues		
	• Core revenues total dollars	0.27	0.13
	• Private gifts grants and contracts	0.39	0.19
	• Other revenues	0.45	0.22
	Financial Outputs – Expenses		
	• Institutional support expenses	0.21	0.1
• Public service expenses	0.33	0.16	
	Personnel		
	• Executive-Admin-Managerial FTE Staff	0.46	0.22
<b>Medium to Large</b>	Financial Inputs – Revenues		
	• Tuition and fees	0.66	0.31
	• State appropriations	0.83	0.38
	Financial Outputs – Expenses		
	• Research expenses	0.68	0.32
	• Student service expenses	0.71	0.33
	• Academic support expenses	0.69	0.33
	Personnel		
	• Total FTE Staff	0.62	0.3
	• Instruction-Research-Public Service FTE Staff	0.53	0.26
• Other Professional FTE Staff	0.52	0.25	
	Customer		
	• Reported FTE Undergraduate Enrollment	0.68	0.32
<b>Large to Very Large</b>	Financial Outputs – Expenses		
	• Core expenses total dollars	1.14	0.49
	• Instruction expenses	0.94	0.43
	• Other core expenses	1.25	0.53
	Customer		
	• Reported FTE Graduate Enrollment	1.06	0.47

For institutions that have implemented ERP systems, Table 25 presents six financial input and output, and personnel variables with a small to medium effect size. These were: core revenues total dollars, private gifts grants and contracts, other revenues,

institutional support expenses, public service expenses, and executive-admin-managerial FTE staff. There were nine variables with a medium to large effect size: tuition and fees, state appropriations, research expenses, student service expenses, academic support expenses, total FTE staff, instruction-research-public service FTE staff, other professional FTE staff and reported FTE undergraduate enrollment. Lastly, there were four variables with a large to very large effect size: core expenses total dollars, instruction expenses, other core expenses and reported FTE graduate enrollment. The remaining five variables had an effect size that was insignificant.

For institutions that have not implemented ERP systems, Table 26 presents 13 financial input and output, personnel, and customer variables with a small to medium effect size. These were: tuition and fees, government grants and contracts, private gifts grants and contracts, other revenues, instruction expenses, student service support expenses, academic support expenses, institutional support expenses, total FTE staff, instruction-research-public service FTE staff, executive-admin-managerial FTE staff, other professional FTE staff, and institutional support expenses per FTE. There were five variables with a medium to large effect size: core revenues total dollars, core expenses total dollars, other core expenses, reported FTE undergraduate enrollment, and reported FTE graduate enrollment. Six variables had an effect size that was trivial, and none of the variables had a large to very large effect size.

Table 26.

*Noteworthy Effect Size for Paired t-tests – IHEs without ERP Systems*

Effect Size	Pair	Cohen's d Value	r-based Value
<b>Small to Medium</b>	Financial Inputs – Revenues		
	• Tuition and fees	0.36	0.18
	• Government grants and contracts	0.38	0.19
	• Private gifts grants and contracts	0.20	0.10
	• Other revenues	0.25	0.13
	Financial Outputs – Expenses		
	• Instruction expenses	0.50	0.24
	• Student service expenses	0.24	0.12
	• Academic support expenses	0.42	0.21
	• Institutional support expenses	0.26	0.13
	Personnel		
	• Total FTE Staff	0.28	0.14
	• Instruction-Research-Public Service FTE Staff	0.51	0.25
• Executive-Admin-Managerial FTE Staff	0.34	0.17	
• Other Professional FTE Staff	0.23	0.11	
Customer			
• Institutional support expenses per FTE	0.20	0.10	
<b>Medium to Large</b>	Financial Inputs – Revenues		
	• Core revenues total dollars	0.79	0.37
	Financial Outputs – Expenses		
	• Core expenses total dollars	0.72	0.34
	• Other core expenses	0.68	0.32
	Customer		
• Reported FTE Undergraduate Enrollment	0.66	0.32	
• Reported FTE Graduate Enrollment	0.60	0.29	
<b>Large to Very Large</b>	No variables were within this threshold.		

Overall, there were four more variables with a medium to large effect size for IHEs that have implemented ERP systems (80% more) than those that have not. One variable, reported FTE undergraduate enrollment, had a similar effect size for both

groups of IHEs studied; a Cohen's d value of 0.68 for IHEs that have implemented ERP systems, and 0.66 for IHEs that have not implemented ERP systems, and the r-based value was the same at 0.32.

**Variance between FY 06 and FY 10.** Since research questions 3 and 4 compared IHEs that have and have not implemented ERP systems between FY 06 and FY 10, the researcher will present tables to illustrate the FY 10 mean, FY 06 mean, the variance between these two fiscal years, and the percent change from FY 06 to FY 10 for financial variables, revenues and expenses; personnel variables; and customer variables in Tables 27 through 30, respectively.

There are no conclusive results regarding revenues for IHEs that have and have not implemented ERP systems presented in Table 27. In general, IHEs that have not implemented ERP systems have a higher percentage (14.64%) of variance in total core revenues, and lower percent variance in state appropriations (-3.84%) between FY 06 and FY 10 than IHEs that have implemented ERP systems.



Table 27.

*Variance of Revenues between FY 06 and FY 10*

Variable	ERP Status	N	FY 10 Mean	FY 06 Mean	Variance (FY 10 - FY 06)	% Change from FY 06
Core revenues total dollars	No ERP	97	135302618.90	118024976.18	17277642.72	14.64%
	ERP	97	996747503.75	925905208.57	70842295.18	7.65%
	Total	194	566025061.32	521965092.37	44059968.95	8.44%
Tuition and fees as a percent of core revenues	No ERP	97	44.30	41.85	2.45	5.85%
	ERP	97	32.61	29.97	2.64	8.81%
	Total	194	38.45	35.91	2.54	7.07%
State appropriations as a percent of core revenues	No ERP	97	14.54	15.12	-0.58	-3.84%
	ERP	97	12.52	15.13	-2.61	-17.25%
	Total	194	13.53	15.13	-1.60	-10.58%
Local appropriations as a percent of core revenues	No ERP	97	2.56	2.42	0.14	5.79%
	ERP	97	1.53	1.54	-0.01	-0.65%
	Total	194	2.04	1.98	0.06	3.03%
Government grants and contracts as a percent of core revenues	No ERP	97	16.04	14.34	1.70	11.85%
	ERP	97	19.11	19.12	-0.01	-0.05%
	Total	194	17.58	16.73	0.85	5.08%
Private gifts grants and contracts as a percent of core revenues	No ERP	97	7.82	8.82	-1.00	-11.34%
	ERP	97	9.39	6.89	2.50	36.28%
	Total	194	8.61	7.86	0.75	9.54%
Investment return as a percent of core revenues	No ERP	97	7.00	7.42	-0.42	-5.66%
	ERP	97	13.99	13.58	0.41	3.02%
	Total	194	10.49	10.50	-0.01	-0.10%
Other revenues as a percent of core revenues	No ERP	97	7.61	8.96	-1.35	-15.07%
	ERP	97	10.89	13.71	-2.82	-20.57%
	Total	194	9.25	11.34	-2.09	-18.43%

Overall, Table 28 presents data which illustrates that expenses have increased for both IHEs that have and have not implemented ERP systems, except for the variable “other core expenses as a percent of total core expenses,” which shows that IHEs that have not implemented ERP systems have a lower percentage (-38.52%) of variance between FY 06 and FY 10 than IHEs that have implemented ERP systems.

Table 28.

*Variance of Expenses between FY 06 and FY 10*

Variable	ERP Status	N	FY 10 Mean	FY 06 Mean	Variance (FY 10 - FY 06)	% Change from FY 06
Core expenses total dollars	No ERP	97	123742850.18	104892608.40	18850241.78	17.97%
	ERP	97	842990293.56	691904768.10	151085525.46	21.84%
	Total	194	483366571.87	398398688.25	84967883.62	21.33%
Instruction expenses as a percent of total core expenses	No ERP	97	43.25	41.08	2.17	5.28%
	ERP	97	40.70	37.25	3.45	9.26%
	Total	194	41.97	39.16	2.81	7.18%
Research expenses as a percent of total core expenses	No ERP	97	4.24	4.06	0.18	4.43%
	ERP	97	16.91	15.51	1.40	9.03%
	Total	194	10.57	9.78	0.79	8.08%
Public service expenses as a percent of total core expenses	No ERP	97	2.48	2.34	0.14	5.98%
	ERP	97	4.05	3.69	0.36	9.76%
	Total	194	3.27	3.02	0.25	8.28%
Student service expenses as a percent of total core expenses	No ERP	97	14.02	13.12	0.90	6.86%
	ERP	97	8.12	7.26	0.86	11.85%
	Total	194	11.07	10.19	0.88	8.64%
Academic support expenses as a percent of total core expenses	No ERP	97	9.56	8.76	0.80	9.13%
	ERP	97	11.46	10.26	1.20	11.70%
	Total	194	10.51	9.51	1.00	10.52%
Institutional support expenses as a percent of total core expenses	No ERP	97	19.16	18.53	0.63	3.40%
	ERP	97	13.92	13.25	0.67	5.06%
	Total	194	16.54	15.89	0.65	4.09%
Other core expenses as a percent of total core expenses	No ERP	97	7.39	12.02	-4.63	-38.52%
	ERP	97	4.91	12.78	-7.87	-61.58%
	Total	194	6.15	12.40	-6.25	-50.40%

Table 29 displays data which illustrates that personnel has increased between FY 06 and FY 10 for both IHEs that have and have not implemented ERP systems. There is a distinction that for all personnel variables, except non-professional FTE staff, IHEs that have implemented ERP systems have higher percentages of variance than those that have not implemented ERP systems.

Table 29.

*Variance of Personnel between FY 06 and FY 10*

Variable	ERP Status	N	FY 10 Mean	FY 06 Mean	Variance (FY 10 - FY 06)	% Change from FY 06
Total FTE Staff	No ERP	97	1128.85	1051.80	77.05	7.33%
	ERP	97	5626.47	5090.20	536.27	10.54%
	Total	194	3377.66	3071.00	306.66	9.99%
Instruction-Research-Public Service FTE Staff	No ERP	97	366.20	341.15	25.05	7.34%
	ERP	97	1651.13	1509.31	141.82	9.40%
	Total	194	1008.66	925.23	83.43	9.02%
Executive-Admin-Managerial FTE Staff	No ERP	97	96.74	84.34	12.40	14.70%
	ERP	97	432.87	347.30	85.57	24.64%
	Total	194	264.80	215.82	48.98	22.69%
Other Professional FTE Staff	No ERP	97	279.35	251.37	27.98	11.13%
	ERP	97	1763.96	1496.55	267.41	17.87%
	Total	194	1021.65	873.96	147.69	16.90%
Non-professional FTE Staff	No ERP	97	386.56	374.94	11.62	3.10%
	ERP	97	1778.52	1737.04	41.48	2.39%
	Total	194	1082.54	1055.99	26.55	2.51%

Table 30 presents data which illustrates that between FY 06 and FY 10 the number of customers, or student enrollments, has increased overall for both IHEs that have and have not implemented ERP systems. However, there is a distinction that institutional support expenses per FTE have decreased significantly, by \$5,150 (-38.79%) for IHEs that have implemented ERP systems.

Table 30.

*Variance of Customers between FY 06 and FY 10*

Variable	ERP Status	N	FY 10 Mean	FY 06 Mean	Variance (FY 10 - FY 06)	% Change from FY 06
Reported FTE Undergraduate Enrollment	No ERP	97	4535.62	3962.16	573.46	14.47%
	ERP	97	13493.90	12509.38	984.52	7.87%
	Total	194	9014.76	8235.77	778.99	9.46%
Reported FTE Graduate Enrollment	No ERP	97	810.74	602.58	208.16	34.54%
	ERP	97	5014.53	3660.03	1354.50	37.01%
	Total	194	2912.63	2131.30	781.33	36.66%
Institutional support expenses per FTE	No ERP	97	3733.27	3545.89	187.38	5.28%
	ERP	97	8127.95	13277.90	-5149.95	-38.79%
	Total	194	5930.61	8411.89	-2481.28	-29.50%

In summary, between FY 06 and FY 10, the percent of variance is mixed for revenues received for both IHEs that have and have not implemented ERP systems, some variables increase and some decrease depending upon ERP system implementation status. However, expenses, personnel, and customers consistently increased for all institutions between FY 06 and FY 10, except for the significant decrease in overall institutional support per student FTE for IHEs that have implemented ERP systems.

**Summary**

The purpose of this chapter was to present the results of the study. The six institutional characteristics that discriminated between institutions that have and have not implemented ERP systems were: age group between 51 and 100 (ERP not implemented); size between 1,000 and 4,999 (ERP not implemented); size 20,000 and above (ERP implemented); Carnegie 2000 – Doctoral/ Research Universities (ERP implemented);

Carnegie 2000 – Masters Colleges and Universities (ERP not implemented); and Carnegie 2000 – Associates Colleges (ERP not implemented).

The 11 resource allocations that discriminated between the two institutional groups were: core revenues, total dollars (ERP implemented); tuition and fees as a percent of core revenues (ERP not implemented); investment return as a percent of core revenues (ERP implemented); core expenses, total dollars (ERP implemented); research expenses as a percent of total core expenses (ERP implemented); student service expenses as a percent of total core expenses (ERP not implemented); institutional support expenses as a percent of total core expenses (ERP not implemented); total FTE staff (ERP implemented); instruction-research-public service FTE staff (ERP implemented); executive-admin-managerial FTE staff (ERP implemented); and other professional FTE staff (ERP implemented).

When institutions that have and have not implemented ERP systems were compared from FY 06 and FY 10, there were similarities and differences. The five resource variables which were similar between institutions that have and have not implemented ERP systems are core expenses, total dollars; instruction expenses as a percent of total core expenses; other core expenses as a percent of total core expenses; instruction-research-public service FTE staff; and reported FTE undergraduate enrollment. For institutions that have implemented ERP systems, the following eight resource variables are significant, in addition to the five discussed previously: tuition and fees as a percent of core revenues; state appropriations as percent of core revenues; research expenses as a percent of total core expenses; student service expenses as a percent of total core expenses; academic support expenses as a percent of total core

expenses; total FTE staff; other professional FTE staff; and reported FTE graduate enrollment. Lastly, for institutions that have not implemented ERP systems, the following two resource variables are significant, in addition to the five previously discussed: core revenue total dollars and reported FTE graduate enrollment. In Chapter 5, a discussion of findings, implications for theory, and implications for practice will be presented in more detail.

## **CHAPTER 5: INTERPRETATIONS AND RECOMMENDATIONS**

### **Introduction**

This study examined institutional profile characteristics, financial variables, personnel variables, and customer variables between a select group of institutions across the United States that have and have not implemented enterprise resource planning (ERP) systems. The institutional characteristics were: institution control, age and age group, Carnegie 2000, institution level (i.e., 2 year or 4 year), institution size, and geographic region. There were a variety of financial variables, personnel variables, and customer variables utilized to examine the resource allocations of institutions that affect services to an institution's customer (students). The focus of this chapter is to summarize the study and discuss the results and findings presented in Chapter 4. This chapter is organized into the following sections: overview of the study, discussion of the findings, implications for theory, implications for practice, and suggestions for future research.

### **Overview of the Study**

The purpose of this national study was to utilize quantitative methods to examine institutional characteristics, financial resource variables, personnel variables, and customer variables of public and private institutions that have and have not implemented ERP systems, from a resource dependence perspective. The institutional characteristics were selected to examine the similarities and/or differences in the institutions being studied to establish a baseline of information about IHEs that have or have not implemented ERP systems. Financial and personnel variables were selected to examine which resources best discriminate by implementing ERP systems or not, in order to maintain or improve organizational efficiency and effectiveness. Further, efficiency and

effectiveness is impacted by factors such as identifying and minimizing dependence on external resources, using information systems to the organization's advantage, and addressing the needs of external actors that can influence an organization's ability to acquire and maintain resources. Customer variables were selected to examine changes in student enrollments and institutional support cost per student for those institutions that have or have not implemented ERP systems. The organizational concept of resource dependency theory (RDT) served as the theoretical framework for this study. The four research questions utilized for this study were as follows:

1. Are there differences in institutional characteristics of institutions that have and have not implemented ERP systems?
2. What resources best discriminate between institutions that have and have not implemented ERP systems?
3. For institutions that have implemented ERP systems, are there differences in resource allocations, and/or student enrollment/institutional support per student from fiscal year 2005-2006 to fiscal year 2009-2010?
4. For institutions that have not implemented ERP systems, are there differences in resource allocations, and/or student enrollment/institutional support per student from fiscal year 2005-2006 to fiscal year 2009-2010?

The researcher utilized a comprehensive discriminant function analysis model (DISCRM) to examine questions 1 and 2. DISCRM was chosen as the appropriate procedure because of its statistical sophistication to categorize large amounts of variables into two (or more) distinguished groups (Klecka, 1985). DISCRM is an analytical tool to determine "a linear combination of variables that maximizes the differences between



groups” (Rosser, 2003, p. 75). Using national secondary institutional data, the sample for examination was 194 institutions of higher education. In order to compare similarities and/or differences of resource allocations for institutions that have and have not implemented ERP systems, data from the IPEDS database was extracted for fiscal year 2005-2006 (FY 06) and fiscal year 2009-2010 (FY 10), and paired samples t-tests were used to compare financial, personnel, and customer variables from one year to another in order to answer research questions 3 and 4.

### **Discussion of the Findings**

This study examined institutional characteristics and many resources that best discriminate between institutions that have and have not implemented ERP systems. The study’s results and findings showed that several institutional characteristics were statistically classified as either an institution that has or has not implemented ERP systems, thus designating group membership. The discussion will be separated into four sections addressing each research question, paying specific attention to the variables that best discriminates between ERP group membership (implemented versus not implemented), and variables that are statistically significant when comparing one fiscal year (FY 06) to another (FY 10), in order to consider similarities and/or differences of institutions that have or have not implemented ERP systems.

**Research question 1: Institutional characteristics.** The first research question asked “Are there differences in institutional characteristics of institutions that have and have not implemented ERP systems?” Six institutional characteristics, or variables, discriminated between institutions that have and have not implemented ERP systems. Of these, two variables suggested that institutions implemented ERP systems: size 20,000

and above, and Carnegie 2000 – Doctoral/ Research Universities. Four variables suggested that institutions have not implemented ERP systems: age group between 51 and 100; size between 1,000 and 4,999; Carnegie 2000 – Masters Colleges and Universities; and Carnegie 2000 – Associates Colleges.

*Institutions that have implemented ERP systems.* There were 43 IHEs that have implemented ERP systems in the category “Size 20,000 and above,” presented in Table 5. When comparing public and private IHEs, it was notable that 79% (34 of 43) of IHEs in this category were publicly controlled. Within the context of 54 publicly controlled IHEs that have implemented ERP systems, 63% were in the category “Size 20,000 and above.” Out of the population of 97 IHEs that have implemented ERP systems in the study, 44% were in the category “Size 20,000 and above.” Private institutions represented a smaller portion (9 out of 43, 21%) of IHEs that have implemented ERP systems. These results indicate that public IHEs, larger in size, are likely to have implemented ERP systems.

As previously mentioned in Table 5, there were 70 IHEs that have implemented ERP systems in the category “Carnegie 2000 – Doctoral/ Research Universities.” When comparing public and private IHEs, it was notable that 60% (42 of 70) of IHEs in the category were publicly controlled. Within the context of 54 publicly controlled IHEs that have implemented ERP systems, 78% were in the category “Carnegie 2000 – Doctoral/ Research Universities.” Out of the population of 97 IHEs that have implemented ERP systems in the study, 72% were in this category. Private institutions represented a slightly smaller portion (28 out of 43, 65%) of IHEs that have implemented ERP systems. These results indicate that both public and public IHEs, classified as Doctoral/ Research Universities, are likely to have implemented ERP systems.

These results indicate those larger sized institutions and those that are classified as doctoral/research universities are more likely to implement ERP systems. This is not a surprise because these institutions are driven by their large customer base to be effective and efficient. According to Pfeffer and Salancik (1978), “We have argued that the effective organization is one which responds to the demands from its environment according to its dependence on the various components of the environment” (p. 84). Therefore, implementing ERP systems is in line with their goals. Pfeffer and Salancik (1978) posit, “It is reasonable to argue that organizational growth occurs because size fosters the achievement of either organizational goals or the goals of some members of the organization (McGuire, 1963)” (p. 132). Thus, larger institutions strive toward centralization, which is a motivating factor to implement ERP systems (Hirschheim & Sabherwal, 2001; Goldstein & Pirani, 2008).

***Institutions that have not implemented ERP systems.*** There were 28 IHEs that have not implemented ERP systems in the category “Age group between 51 and 100” presented in Table 6. When comparing public and private IHEs, it was notable that 54% (15 of 28) of IHEs in this category were publicly controlled. Within the context of 48 publicly controlled IHEs that have not implemented ERP systems, 31% were in the category “Age group between 51 and 100.” Out of the population of 97 IHEs that have not implemented ERP systems in the study, 29% were in the category “Age group between 51 and 100.” Private institutions represented a slightly smaller portion (13 out of 28, 46%) of IHEs that have not implemented ERP systems. These results indicate that both public and private IHEs that are younger are not likely to have implemented ERP systems.

There were 44 IHEs that have not implemented ERP systems in the category “Size between 1,000 and 4,999” presented in Table 6. When comparing public and private IHEs, it was notable that 64% (28 of 44) of IHEs in this category were privately controlled. Within the context of 49 privately controlled IHEs that have not implemented ERP systems, 57% were in the category “Size between 1,000 and 4,999.” Out of the population of 97 IHEs that have not implemented ERP systems in the study, 45% were in the category “Size between 1,000 and 4,999.” Public institutions represented a smaller portion (16 out of 44, 36%) of IHEs that have not implemented ERP systems. These results indicate that private IHEs that are of smaller size are not likely to have implemented ERP systems.

There were 25 IHEs that have not implemented ERP systems in the categories “Carnegie 2000 – Masters Colleges and Universities” and “Carnegie 2000 – Associates Colleges” presented in Table 6. When comparing public and private IHEs, it was notable that 56% (14 of 25) of IHEs in the category “Carnegie 2000 – Masters Colleges and Universities” were privately controlled, and 88% (22 of 25) of IHEs in the category “Carnegie 2000 – Associates Colleges” were publicly controlled. It was not surprising that private institutions represented a much smaller portion (3 out of 25, 6%) of IHEs that have not implemented ERP systems and classified as “Carnegie 2000 – Associates Colleges” because these colleges are primarily funded by state appropriations. These results indicate that private IHEs classified as “Carnegie 2000 – Masters Colleges and Universities” are not likely to have implemented ERP systems.

Moreover, the results indicate that younger institutions, those that are smaller in size, and those that are classified as master’s colleges and universities, or associates

colleges are likely to have not implemented ERP systems. This is also not surprising because these institutions typically have fewer available resources and fewer avenues to obtain additional resources to implement ERP systems. According to Pfeffer and Salancik (1978), “The establishment of departments and the development of information systems are both partly guided by considerations of adaptation....Those that do not develop new, appropriate information systems are less likely to survive” (p. 78). This is consistent with the challenges that public master’s colleges and universities face because of a lack of resources available to meet the demands of serving more students as they pursue becoming research universities (Hauptman, 2001). There are opportunities for younger and smaller institutions to cater to their customer bases of students to serve their needs in a targeted way to increase the likelihood that they are effective in their environment.

**Research question 2: Resource variables.** The second research question was “What resources best discriminate between institutions that have and have not implemented ERP systems?” This question was answered using the statistical function DISCRIM. Four discriminating financial variables that indicate institutions more likely to have implemented ERP systems are affected by the following: total dollars of core revenue, investment return as a percent of core revenues, core expenses total dollars, and research expenses as a percent of total core expenses. These variables indicate that the total dollars of revenue input into the organization is a key indicator of group membership. This is not surprising because larger institutions, classified as doctoral/research universities bring in more revenue than other classifications of institutions. Investment returns as a percent of core revenue indicate that there is an external source of funds that IHEs depend on to bring funds into the institution. This

variable is defined to include income from assets consisting of dividends, interest earnings, royalties, rent, and gains/losses (IPEDS Glossary, 2011). Therefore, being informed of asset allocations, having a solid spending policy, and managing risk (Yoder, 2001) are key aspects of investing for IHEs to have a relatively predictable and steady stream of revenue.

The next two variables are outputs of IHEs and where the funds are allocated. It is not surprising that total dollars of core expenses emerged as a key indicator of group membership. If institutions bring in significant revenue, there is a direct relationship to the core expenses to which IHEs allocate resources. Again, not surprising is that research expenses were a key indicator of group membership because IHEs classified as doctoral/research intensive universities perform a significant amount of research. Given the indication that expenses for research was a predictor of membership in the group of IHEs that have implemented ERP systems, these institutions could develop processes using ERP systems to address information needs of the federal government to manage the dependence on this resource.

In addition, three discriminating financial variables that indicate IHEs more likely not to have implemented ERP systems are: tuition and fees as a percent of core revenues, student service expenses as a percent of total core expenses, and institutional support expenses as a percent of total core expenses. In contrast to doctoral/research intensive universities, those IHEs classified as masters or associates level colleges and universities receive a significant amount of revenues from tuition and fees, and allocate resources to serve students and provide institutional support. In these cases, IHEs of the lower classification may not have resources to allocate to ERP systems implementation. The

variable tuition and fees as a resource that predicted IHEs that have not implemented ERP systems means, not surprisingly, that these IHEs depend upon students and parents who provide revenue to the institutions. Therefore, students and parents are powerful external actors to be aware of to provide excellent services to improve the college experience. If students are a key contributor of tuition and fees, it stands to reason that they receive the benefit of student services, and funds they provide are allocated toward supporting the institution.

Further, there are four discriminating personnel variables that indicate institutions that are more likely to have implemented ERP systems: total FTE staff, instruction-research-public service FTE staff, executive-admin-managerial FTE staff, and other professional FTE staff. All personnel variables except non-professional FTE staff were predictors of membership in the group of institutions that have implemented ERP systems. This finding is in line with traditional thoughts of organizational theory, that human resources are an essential factor in an enterprise. What is notable is the variable non-professional FTE staff did not discriminate group membership for institutions that have implemented ERP systems. This variable is defined as “Employees of an institution whose primary function or occupational activity is classified as one of the following: technical and paraprofessional; clerical and secretarial; skilled crafts; or service/maintenance” (IPEDS Glossary, 2011), and this category of employee “Includes persons who perform some of the duties of a professional in a supportive role, which usually requires less formal training and/or experience than normally required for professional status” (IPEDS Glossary, 2011). Therefore, these supportive roles are not necessarily ones that are affected by implementing ERP systems.

Subsequently, the results indicate that for institutions that have implemented ERP systems, dependence on resources exists based on funds coming into and allocated throughout the institution, and available personnel to deliver services and operate the institution. According to Pfeffer and Salancik (1978, p 46):

“An organization’s vulnerability to extraorganizational influence is partly determined by the extent to which the organization has come to depend on certain types of exchanges for its operation... The relative magnitude of an exchange as a determinant of the importance of the resource is measureable by assessing the proportion of inputs or the proportion of total outputs accounted for by the exchange.”

Therefore, IHEs that have implemented ERP systems rely upon a variety of external actors that contribute total core revenue to the institution, especially investment return, and as expected, these funds are used for the provision of a variety of services, especially research, by a number of staff in the categories of instruction-research-public service, executive-admin-managerial, and other professionals.

In contrast, for institutions that have not implemented ERP systems, one revenue variable, tuition and fees, and two expense variables, student services and institutional support, are predictors of membership. This finding indicates that a primary input, funding through tuition and fees, directly impacts the institution’s provision, or outputs, of student services and institutional support. Therefore, IHEs that have not implemented ERP systems are potentially at risk of extraorganizational influences, or influences outside their organization from students and parents. If there is not an adequate supply of funds from these sources, support for the institution could be adversely affected.

**Research question 3: Institutions with ERP systems.** The third research question inquired “For institutions that have implemented ERP systems, are there differences in resource allocations, and/or student enrollment/institutional support per



student from fiscal year 2005-2006 to fiscal year 2009-2010?” There were a total of 13 variables that were statistically significant, eight relating to financial resources, three relating to human resource allocation, and two relating to customer variables of IHEs that have implemented ERP systems.

The following eight financial variables are statistically significant when compared one year to the other: tuition and fees as a percent of core revenues, state appropriations as a percent of core revenues, core expenses total dollars, instruction expenses as a percent of total core expenses, research expenses as a percent of total core expenses, student service expenses as a percent of total core expenses, academic support expenses as a percent of total core expenses, and other core expenses as a percent of total core expenses. This finding indicates that when compared from one fiscal year to another, IHEs that have implemented ERP systems are likely to benefit from using technology to maximize use of their inputs and outputs. Both public and private institutions also depend upon the external sources of tuition and fees from students, parents, and public intuitions rely upon state appropriations. As previously mentioned, these funds are utilized in the provision of instruction, research, student services, and academic support at public and private IHEs; although, public IHEs are dependent upon state government more than private institutions.

Based on the variance of revenues between FY 06 and FY 10 (Table 27), there is an 8.81% increase in tuition and fees, and state appropriations decreased significantly by -17.25%. This is consistent with the line of thinking that implementing ERP systems could increase fees assessed to students to pay for the implementation and maintenance. Oberlin (1996) and Ringle (1992) discuss the funding for ERP systems implementation

through a variety of mechanisms, including student fees, and Kvavik and Katz (2002) comment on the funding of post-implementation costs that need to be considered. An argument could also be made that implementing ERP systems has allowed IHEs to manage with a decrease in state support. On the other hand, there has been a decline in funding for higher education since 2007, and this could account for the marked decrease in state appropriations due to the economic downturn in the United States.

Based on the variance of expenses between FY 06 and FY 10 (Table 28), total core expenses increased by 21.84% while total core revenues did not increase as proportionately with a change of 7.65% (Table 27) for institutions that have implemented ERP systems. Further, expenses for instruction, research, student service, and academic support increased in the range of 9 to 11% from FY 06 to FY 10. Notably, other core expenses decreased significantly by -61.58%. It is reasonable to posit that implementing ERP systems provided IHEs the opportunity to make strategic changes to reallocate resources to support the core mission of instruction, academic support, and student services.

In addition, the following three personnel variables are statistically significant when compared from FY 06 to FY 10: total FTE staff, instruction-research-public service FTE staff, and other professional FTE staff. Based on Table 29, total staff FTE increased by 10.54%, instruction-research-public service FTE increased by 9.40%, and other professional FTE increased by 17.87% for institutions that have implemented ERP systems. This finding was inconclusive because as student enrollments increase, there is a direct relationship with increases in personnel providing instructional, research, and student services. However, this was consistent with the literature that an increased

number of other professional personnel are needed after ERP systems implementation to address technology support and coordination, training, and management. In this study, the definition of the variable “other professional staff FTE” (Appendix 5) includes:

“...employees holding titles such as business operations specialists;...human resources, training, and labor relations specialists; management analysts; financial specialists; budget analysts; computer specialists; computer and information scientists; computer programmers; computer software engineers; computer support specialists; computer systems analysts; database administrators; network and computer systems administrators; network systems and data communication analysts...” (IPEDS Glossary, 2011).

In contrast, these are the particular types of employees that should decrease as a result of implementing ERP systems, according to ERP vendors.

Lastly, the following two customer variables are statistically significant when compared from FY 06 to FY 10: reported FTE undergraduate enrollment and reported FTE graduate enrollment. There was an increase in undergraduate and graduate enrollment, of 7.87% and 37.01% respectively, while institutional support expenses per FTE decreased by -38.79% between FY 06 and FY 10 (Table 30). This demonstrates that implementation of ERP systems could have had a material effect on IHEs to modestly increase tuition and fees along with increased student enrollments, especially in graduate students, and a significant decrease in support per student FTE. This finding also indicates that implementing ERP systems could increase the enrollment at these institutions, even though there was a decrease in state appropriations, because of the possibility that having information systems to manage customers leads to an increase in serving those customers.

**Research question 4: Institutions without ERP systems.** The fourth research question was “For institutions that have not implemented ERP systems, are there

differences in resource allocations, and/or student enrollment/institutional support per student from fiscal year 2005-2006 to fiscal year 2009-2010?” There were a total of seven variables that are statistically significant.

Four financial variables were statistically significant: core revenues total dollars, core expenses total dollars, instruction expenses as a percent of total core expenses, and other core expenses as a percent of total core expenses. Based on the variance of revenues between FY 06 and FY 10 (Table 27), there is a 14.64% change in total core revenues for IHEs that have not implemented ERP systems. This finding indicates that implementing ERP systems does not have an effect on the inputs of IHEs. There may be other factors for revenues to increase from one year to another, most likely an increase in student enrollments resulting in an increase of student tuition and fees.

Regarding total core expenses and instruction expenses, these variables are likely to have a direct relationship to the change in student enrollment, rather than having implemented ERP systems. Based on the variance of expenses between FY 06 and FY 10 (Table 28), total core expenses increased by 17.97%, and instruction expenses increased by 5.28%. The variable other core expenses decreased by -38.52%, and this is noteworthy because IHEs could have implemented other strategies to address resource allocations and maintain operations to serve an increased number of students.

One personnel variable that is statistically significant from FY 06 to FY 10 is Instruction-Research-Public Service FTE Staff; there was an increase of 7.34% (Table 29) for IHEs that have not implemented ERP systems. This finding is not surprising because it indicates that a change in personnel that provide instruction, research, and public services is due to a direct relationship between student enrollment and the human

resources necessary to deliver the core service of IHEs, to teach students and fulfill the academic mission of institutions.

Two customer variables statistically significant for institutions that have implemented ERP systems and those that have not implemented ERP systems, when compared from FY 06 to FY 10, are reported FTE undergraduate enrollment and reported FTE graduate enrollment. Based on Table 30, undergraduate enrollment increased by 14.47% and graduate enrollment increased by 34.54%. This finding suggests that regardless of implementing ERP systems, student enrollment changes often occur due to other factors, and IHEs are successful in managing operations without commercial ERP systems. The next section will present the implications for theory.

### **Implications for Theory**

Pfeffer and Salancik (1978) discuss the following themes of resource dependency theory: using strategies to enhance autonomy and pursue organizational interests; acquiring, maintaining, and controlling critical resources from the environment using information systems; and understanding that social context matters in relationships between organizations and their external environment. These aspects of RDT were applicable to this study and will be discussed in this section.

**Enhancing autonomy and pursuing interests.** A theme of RDT is, within their environment, organizations strive to enhance their autonomy to pursue organizational interests. Using information systems in this context can allow organizations to better utilize scarce resources and pursue organizational interests. According to Pfeffer and Salancik (1978), “Organizational environments are not given realities; they are created through a process of attention and interpretation. Organizations have information systems

for gathering, screening, selecting, and retaining information” (p. 13). An ERP system is one such information system which IHEs can utilize to gather, screen, select, and retain information about finances, personnel, and students to influence an organization’s response to the environment. If ERP systems can improve operational efficiencies to address dependencies on external actors, then organizations have the ability to pursue their other organizational interests such as student services or research. The results of this study were inconclusive regarding the effect of implementing ERP systems because of the uncertainty of other environmental factors that could have influenced an institution’s ability to primarily serve students, and then pursue other interests.

**Acquiring, maintaining and controlling resources.** There are hurdles to acquiring resources because they could be scarce; then, maintaining resources once acquired is difficult because suppliers may be inconsistent; therefore, controlling resources within the organization once they are received is essential to be effective and efficient. Allocating resources effectively is a component of control, and managing dependence upon resources impacts the ability of IHEs to be successful. The two most vital resources for any organization are its financial and human resources. Therefore, allocating financial resources such as the funds coming into the IHE, its revenues, and identifying where the funds are used, its expenses, are critical to the success of IHEs. According to Pfeffer and Salancik (1978),

“Achieving stability in the supply of a resource or in the absorption of an output is problematic for an organization that requires steady resource exchanges to operate...Instability with respect to an important resource means the organization’s survival has become more uncertain” (p. 47).

In this study, financial resources flowing into the IHE are directly related to the stability of the output of the institution. Therefore, the stability of resources flowing from entities

such as students, parents, government, and donors can be uncertain for both public and private IHEs due to periods of economic instability, or declining enrollments, such as the recession starting in 2008. Subsequently, “Dependence can then be defined as the product of the importance of a given input or output to the organization and the extent to which it is controlled by a relatively few organizations” (Pfeffer & Salancik, 1978, p. 51). This study determined that the external actors which influence resource dependences for public and private IHEs that have and have not implemented ERP systems are students and parents, state and federal government, and private donors. External actors associated with investment returns for IHEs that have implemented ERP systems were indistinguishable if they were associated with either public or private IHEs.

**Social context and the external environment.** Understanding the context of the external organizational environment is essential for institutional leaders to manage their relationships with external actors. According to Pfeffer and Salancik (1978), “There are many forms of discretion over a resource, which is the capacity to determine the allocation or use of the resource. Such discretion is a major source of power and is more important when the resource is more scarce” (p. 48). Therefore, obtaining scarce resources from external actors is a delicate balancing act of appealing to their needs. This study determined that IHEs need to understand the social context of students, parents, government entities, and donors in the environment in order to procure resources (funding) from them. Mechanisms to do this are to use ERP systems to enhance higher education and to provide information to state and federal government to receive state appropriations, and grants and contracts. The next section presents implications for practice.

## **Implications for Practice**

Practitioners need concrete information upon which to base decisions. This study demonstrated that institutional leaders can benefit from recognizing the sources of resource dependence and the importance of understanding the social context of external actors in the organizational environment, in order to manage or avoid dependence upon them. This study revealed that implementing ERP systems increases external dependence on financial and human resources for IHEs. However, even with recognizing this, implementing ERP systems could be a strategy for IHEs to retain autonomy in order to focus on institutional interests.

Through implementation of ERP systems, IHEs can achieve organizational benefits of streamlining processes and enhancing the coordinating efforts of various operational activities. Then, once implemented, ERP systems are able to supply timely and coordinated information to support institutional decision making, thereby allowing IHEs to provide information to address concerns of external actors when attempting to obtain resources. According to Kvavik and Katz (2002),

“...information systems provide the foundation on which the business of the higher education enterprise sits. Higher education’s business practices and processes, and the information that guides decision making in large areas of the academy, interact with and derive from these information systems” (p. 5).

Next, leaders can improve organizational success by understanding that acquiring, maintaining, and controlling critical resources from the environment are related to the social context of external actors in the environment. Understanding the needs of external actors and addressing their needs is a fundamental aspect of acquiring resources, and allocating resources is directly influenced by the source of acquisition.



Further, leaders, or practitioners have challenges to deal with on a daily basis. They need to be cognizant of the variety of options available to them to manage and lead their organizations successfully, within the context of the utilizing strengths and opportunities, and minimizing weaknesses and threats in the organizational environment. What may work for one institution may not be a good fit for another. As institutions respond to the current economic crisis, it will be challenging for them to operate successfully now and into the future. Therefore, IHEs, which are constrained by the financial resources available to them, have an opportunity to transform the way they do business, especially by utilizing information and technology to their advantage in strategic and cost conscious ways. It is incumbent upon leaders to utilize the information and resources available to make the best decisions for the institution. ERP systems are a technological avenue for leaders of public or private IHEs to utilize information and resources to their fullest, if the institution can afford it.

Understanding the context of the organizational environment is essential for institutional leaders to manage their relationships with external actors. Having an understanding of institutional characteristics and resource allocations that predict membership in groups of IHEs that have or have not implemented ERP systems will educate institutional leaders about where they fit in the landscape of higher education and understand their competition somewhat better in the context of ERP systems implementation. The next section provides suggestions for future research.

## **Suggestions for Future Research**

There was dissonance in the results that needs further investigation. A few suggestions for future research are: utilize regression analysis in a longitudinal study of each year between FY 06 and FY 10 to determine if any variables are significant for IHEs that have and have not implemented ERP systems; analyze the specifics of ERP implementation for each of the 97 institutions that have implemented ERP systems to determine if factors such as project scope, cost of implementation, and resources used for implementation affect revenues, expenses, personnel or customer; and implement a qualitative study to examine the organizational structure of institutions before and after ERP system implementation.

This study utilized quantitative methods to examine many financial, personnel, and customer variables to study public and private institutions of higher education that have and have not implemented ERP systems. Undertaking a longitudinal study of variables for five consecutive years would provide insight into the subtle changes that may occur from one year to the next. Also, studying groups of exclusively public and private IHEs that have and have not implemented ERP systems would add depth to the study. Further, using another quantitative design involving the analysis of each ERP systems implementation for the 97 IHEs in the study for this group to provide additional details regarding the project scope, resources used for implementation, and cost of implementation to order to compare against financial, personnel, and customer variables each year after implementation for five to 10 years. This would help determine the nature of resource dependence over time given additional elements for ERP systems implementation. To take it one step further, a comparison of these 97 IHEs based on

public or private control would provide added detail to the examination. When using longitudinal data for future research, it can account for the ebb and flow of financial pressures from one year to another.

In contrast, a qualitative study would provide the researcher opportunities to understand in-depth, using primary sources, how and why IHEs undertake specific actions to strengthen their positions in the landscape of higher education. Additionally, a qualitative study would focus on a smaller sample from which to extract detailed information for analysis. An aspect of RDT is organizational structure, and this study did not allow for an opportunity to study the organizational structure of institutions before and after ERP systems implementation. Determining if IHEs have opportunities for organizational change through the implementation of ERP systems would assist institutional leaders in being effective and efficient in utilizing their scarce resources. Subsequently, information systems are a mechanism for leaders to understand the external factors that influence resource allocation and resource dependence. As RDT theorizes, understanding resource allocation and dependence affects the ability of leaders to take measures to ensure their organizations are efficient and effective.

## **Conclusion**

For the past 20 years, the decision whether or not to implement ERP systems has challenged leaders in higher education. Empirical research that has incorporated the study of ERP systems in the sectors of higher education or information technology was limited. Therefore, there was a need for empirical research comparing institutions that have and have not implemented ERP systems. Accordingly, this study compared the institutional profile characteristics, financial variables, personnel variables, and customer variables at

public and private IHEs in the United States. The researcher used resource dependency theory as the theoretical framework for this comparative study. By using secondary institutional data drawn from the national IPEDS database, the researcher employed a comprehensive discriminant function analysis model to examine which institutional characteristics and resource variables best discriminated (classified) between the two groups of institutions, those that have and have not implemented ERP systems. In addition, paired samples t-tests were used to compare financial, personnel, and customer variables from one year to another.

This study discussed many aspects of using information systems, such as modern day ERP systems, as a possible dimension for ease of processing information that would place a premium on information that is quantifiable and easily measurable (Pfeffer & Salancik, 1978). This would allow IHEs to identify the sources of resource dependence and to make business decisions about acquiring, maintaining, and controlling resources, in order to improve the institution's performance in a competitive industry. The results were mixed as to whether the implementation of ERP systems had a material effect on IHEs. A consideration is that some IHEs that were identified as not having implemented ERP systems could have other legacy systems that fulfill their information management needs.

As leaders in higher education continue to face economic turbulence, they need to make informed decisions to best utilize scarce resources. By examining institutional profile characteristics, and a selection of financial, personnel, and customer variables, this study provided several implications for practitioners and future researchers. In addition, the findings of this study suggested that a few institutional profile characteristics, and

some financial, personnel, and customer variables best discriminates group membership in the categories of IHEs that have and have not implemented ERP systems. The combination of understanding the external environment, identifying and acquiring scarce resources, being aware of resource dependence, and using information systems are factors that determine an organization's efficiency.

## APPENDIX 1

### Institutions with ERP Systems

No.	Institution Name	IPEDS Unit ID	Geographic Region	Carnegie Classification
1.	Arizona State University	104151	Southwest and Rocky Mountains	Doctoral/Research
2.	Baylor University	223232	Southwest and Rocky Mountains	Doctoral/Research
3.	Boston College	164924	New England and Mid-East	Doctoral/Research
4.	Boston University	164988	New England and Mid-East	Doctoral/Research
5.	Brandeis University	165015	New England and Mid-East	Doctoral/Research
6.	Caldwell College	183910	New England and Mid-East	Baccalaureate
7.	California Institute of Technology	110404	Far West and Outlying Areas	Doctoral/Research
8.	Carnegie Mellon University	211440	New England and Mid-East	Doctoral/Research
9.	Clemson University	217882	Southeast	Doctoral/Research
10.	Coe College	153144	Great Lakes and Plains	Baccalaureate
11.	Columbia University in the City of New York	190150	New England and Mid-East	Doctoral/Research
12.	Cornell University	190415	New England and Mid-East	Doctoral/Research
13.	Dartmouth College	182670	New England and Mid-East	Doctoral/Research
14.	DePaul University	144740	Great Lakes and Plains	Doctoral/Research
15.	Dillard University	158802	Southeast	Baccalaureate
16.	Duke University	198419	Southeast	Doctoral/Research
17.	Emory University	139658	Southeast	Doctoral/Research
18.	Florida Agricultural and Mechanical University	133650	Southeast	Masters
19.	Florida State University	134097	Southeast	Doctoral/Research
20.	Franklin Pierce University	182795	New England and Mid-East	Baccalaureate
21.	George Washington University	131469	New England and Mid-East	Doctoral/Research
22.	Harvard University	166027	New England and Mid-East	Doctoral/Research
23.	Illinois College	145691	Great Lakes and Plains	Baccalaureate
24.	Illinois Wesleyan University	145646	Great Lakes and Plains	Baccalaureate
25.	Indiana State University	151324	Great Lakes and Plains	Doctoral/Research
26.	Johns Hopkins University	162928	New England and Mid-East	Doctoral/Research
27.	Massachusetts Institute of Technology	166683	New England and Mid-East	Doctoral/Research
28.	Miami University-Oxford	204024	Great Lakes and Plains	Doctoral/Research
29.	Michigan State University	171100	Great Lakes and Plains	Doctoral/Research
30.	Middle Tennessee State University	220978	Southeast	Doctoral/Research
31.	MiraCosta College	118912	Far West and Outlying Areas	Associates

32.	Montana State University	180461	Southwest and Rocky Mountains	Doctoral/Research
33.	New York University	193900	New England and Mid-East	Doctoral/Research
34.	Northern Kentucky University	157447	Southeast	Masters
35.	Northwestern University	147767	Great Lakes and Plains	Doctoral/Research
36.	Oberlin College	204501	Great Lakes and Plains	Baccalaureate
37.	Ohio State University-Main Campus	204796	Great Lakes and Plains	Doctoral/Research
38.	Ohio University-Main Campus	204857	Great Lakes and Plains	Doctoral/Research
39.	Pace University-New York	194310	New England and Mid-East	Doctoral/Research
40.	Pennsylvania State University-Main Campus	214777	New England and Mid-East	Doctoral/Research
41.	Pima Community College	105525	Southwest and Rocky Mountains	Associates
42.	Princeton University	186131	New England and Mid-East	Doctoral/Research
43.	Purdue University-Main Campus	243780	Great Lakes and Plains	Doctoral/Research
44.	Rockefeller University	195049	New England and Mid-East	Doctoral/Research
45.	Rutgers University-New Brunswick	186380	New England and Mid-East	Doctoral/Research
46.	San Juan College	188100	Southwest and Rocky Mountains	Associates
47.	Smith College	167835	New England and Mid-East	Baccalaureate
48.	Southern Maine Community College	161545	New England and Mid-East	Associates
49.	Stanford University	243744	Far West and Outlying Areas	Doctoral/Research
50.	Talladega College	102298	Southeast	Baccalaureate
51.	Texas Lutheran University	228981	Southwest and Rocky Mountains	Baccalaureate
52.	The University of Alabama	100751	Southeast	Doctoral/Research
53.	The University of Tennessee	221759	Southeast	Doctoral/Research
54.	The University of Texas at Austin	228778	Southwest and Rocky Mountains	Doctoral/Research
55.	The University of Texas at San Antonio	229027	Southwest and Rocky Mountains	Masters
56.	The University of Virginia's College at Wise	233897	Southeast	Baccalaureate
57.	Trinity University	229267	Southwest and Rocky Mountains	Masters
58.	Tufts University	168148	New England and Mid-East	Doctoral/Research
59.	Union Institute & University	206279	Great Lakes and Plains	Doctoral/Research
60.	University of Cincinnati-Main Campus	201885	Great Lakes and Plains	Doctoral/Research
61.	University of Connecticut	129020	New England and Mid-East	Doctoral/Research
62.	University of Delaware	130943	New England and Mid-East	Doctoral/Research
63.	University of Florida	134130	Southeast	Doctoral/Research

64.	University of Georgia	139959	Southeast	Doctoral/Research
65.	University of Illinois at Urbana-Champaign	145637	Great Lakes and Plains	Doctoral/Research
66.	University of Kansas	155317	Great Lakes and Plains	Doctoral/Research
67.	University of Massachusetts Amherst	166629	New England and Mid-East	Doctoral/Research
68.	University of Massachusetts-Boston	166638	New England and Mid-East	Doctoral/Research
69.	University of Massachusetts-Dartmouth	167987	New England and Mid-East	Masters
70.	University of Massachusetts-Lowell	166513	New England and Mid-East	Doctoral/Research
71.	University of Michigan-Ann Arbor	170976	Great Lakes and Plains	Doctoral/Research
72.	University of Minnesota-Twin Cities	174066	Great Lakes and Plains	Doctoral/Research
73.	University of Mississippi Main Campus	176017	Southeast	Doctoral/Research
74.	University of Missouri-Columbia	178396	Great Lakes and Plains	Doctoral/Research
75.	University of North Carolina at Charlotte	199139	Southeast	Masters
76.	University of North Dakota	200280	Great Lakes and Plains	Doctoral/Research
77.	University of Notre Dame	152080	Great Lakes and Plains	Doctoral/Research
78.	University of Portland	209825	Far West and Outlying Areas	Masters
79.	University of Rhode Island	217484	New England and Mid-East	Doctoral/Research
80.	University of Utah	230764	Southwest and Rocky Mountains	Doctoral/Research
81.	University of Vermont	231174	New England and Mid-East	Doctoral/Research
82.	University of Virginia-Main Campus	234076	Southeast	Doctoral/Research
83.	University of Washington-Seattle Campus	236948	Far West and Outlying Areas	Doctoral/Research
84.	University of Wisconsin-Madison	240444	Great Lakes and Plains	Doctoral/Research
85.	University of Wisconsin-Milwaukee	240453	Great Lakes and Plains	Doctoral/Research
86.	University of Wisconsin-Oshkosh	240365	Great Lakes and Plains	Masters
87.	Virginia Commonwealth University	234030	Southeast	Doctoral/Research
88.	Virginia Union University	234164	Southeast	Baccalaureate
89.	Wake Forest University	199847	Southeast	Doctoral/Research
90.	Washington State Community College	206446	Great Lakes and Plains	Associates
91.	Wayne State University	172644	Great Lakes and Plains	Doctoral/Research
92.	West Virginia University	238032	Southeast	Doctoral/Research
93.	Westminster College	216807	New England and Mid-East	Baccalaureate
94.	Whitman College	237057	Far West and Outlying Areas	Baccalaureate



95.	Wichita State University	156125	Great Lakes and Plains	Doctoral/Research
96.	Yale University	130794	New England and Mid-East	Doctoral/Research
97.	Yeshiva University	197708	New England and Mid-East	Doctoral/Research

## APPENDIX 2

### Institutions without ERP Systems

No.	Institution Name	IPEDS Unit ID	Geographic Region	Carnegie Classification
1.	Agnes Scott College	138600	Southeast	Baccalaureate
2.	Allegany College of Maryland	161688	New England and Mid-East	Associates
3.	Baltimore International College	161882	New England and Mid-East	Associates
4.	Bard College	189088	New England and Mid-East	Baccalaureate
5.	Barry University	132471	Southeast	Masters
6.	Bellevue College	234669	Far West and Outlying Areas	Associates
7.	Beloit College	238333	Great Lakes and Plains	Baccalaureate
8.	Bennington College	230816	New England and Mid-East	Baccalaureate
9.	Black Hills State University	219046	Great Lakes and Plains	Baccalaureate
10.	Brevard College	198066	Southeast	Baccalaureate
11.	Brewton-Parker College	139205	Southeast	Baccalaureate
12.	Cabrini College	211352	New England and Mid-East	Masters
13.	Carlow University	211431	New England and Mid-East	Masters
14.	Carroll University	238458	Great Lakes and Plains	Baccalaureate
15.	Case Western Reserve University	201645	Great Lakes and Plains	Doctoral/Research
16.	Catholic University of America	131283	New England and Mid-East	Doctoral/Research
17.	Chesapeake College	162168	New England and Mid-East	Associates
18.	Chicago State University	144005	Great Lakes and Plains	Masters
19.	Clarion University of Pennsylvania	211644	New England and Mid-East	Masters
20.	Clarke University	153126	Great Lakes and Plains	Baccalaureate
21.	College of Alameda	108667	Far West and Outlying Areas	Associates
22.	College of the Holy Cross	166124	New England and Mid-East	Baccalaureate
23.	Concord University	237330	Southeast	Baccalaureate
24.	Concordia University	180984	Great Lakes and Plains	Masters
25.	Concordia University-Saint Paul	173328	Great Lakes and Plains	Baccalaureate
26.	CUNY Lehman College	190637	New England and Mid-East	Masters
27.	Drake University	153269	Great Lakes and Plains	Masters
28.	Excelsior College	196680	New England and Mid-East	Baccalaureate
29.	Farmingdale State College	196042	New England and Mid-East	Baccalaureate
30.	Faulkner University	101189	Southeast	Baccalaureate
31.	Fisher College	165802	New England and Mid-East	Associates
32.	Fort Lewis College	127185	Southwest and Rocky Mountains	Baccalaureate

33.	Framingham State University	165866	New England and Mid-East	Masters
34.	Goucher College	162654	New England and Mid-East	Baccalaureate
35.	Graceland University-Lamoni	153366	Great Lakes and Plains	Baccalaureate
36.	Grossmont College	115296	Far West and Outlying Areas	Associates
37.	Hastings College	181127	Great Lakes and Plains	Baccalaureate
38.	Hofstra University	191649	New England and Mid-East	Doctoral/Research
39.	Indiana University-East	151388	Great Lakes and Plains	Baccalaureate
40.	Iowa Western Community College	153630	Great Lakes and Plains	Associates
41.	Johnson State College	230913	New England and Mid-East	Masters
42.	Judson College	101541	Southeast	Baccalaureate
43.	La Sierra University	117627	Far West and Outlying Areas	Masters
44.	Lane College	220598	Southeast	Baccalaureate
45.	Lincoln University of Pennsylvania	213598	New England and Mid-East	Masters
46.	Los Angeles Mission College	117867	Far West and Outlying Areas	Associates
47.	Los Angeles Valley College	117733	Far West and Outlying Areas	Associates
48.	Louisiana State University at Alexandria	159382	Southeast	Associates
49.	Louisiana State University-Shreveport	159416	Southeast	Masters
50.	Lyndon State College	230931	New England and Mid-East	Baccalaureate
51.	Manchester Community College	183132	New England and Mid-East	Associates
52.	Marion Military Institute	101648	Southeast	Associates
53.	Mesa State College	127556	Southwest and Rocky Mountains	Baccalaureate
54.	Michigan Technological University	171128	Great Lakes and Plains	Doctoral/Research
55.	Middle Georgia College	140483	Southeast	Associates
56.	Middlebury College	230959	New England and Mid-East	Baccalaureate
57.	Middlesex Community College	129756	New England and Mid-East	Associates
58.	Mount Saint Mary College	193353	New England and Mid-East	Masters
59.	North Central College	147660	Great Lakes and Plains	Masters
60.	Ohio Valley University	237640	Southeast	Baccalaureate
61.	Olympic College	236188	Far West and Outlying Areas	Associates
62.	Oregon State University	209542	Far West and Outlying Areas	Doctoral/Research
63.	Our Lady of the Lake University-San Antonio	227331	Southwest and Rocky Mountains	Masters
64.	Queens University of Charlotte	199412	Southeast	Masters
65.	Roger Williams University	217518	New England and Mid-East	Baccalaureate
66.	Salisbury University	163851	New England and Mid-East	Masters
67.	Santa Ana College	121619	Far West and Outlying Areas	Associates

68.	Santa Fe College	137096	Southeast	Associates
69.	Santa Rosa Junior College	123013	Far West and Outlying Areas	Associates
70.	Simmons College	167783	New England and Mid-East	Masters
71.	South Dakota State University	219356	Great Lakes and Plains	Doctoral/Research
72.	Southern Connecticut State University	130493	New England and Mid-East	Masters
73.	Spoon River College	148991	Great Lakes and Plains	Associates
74.	St Vincent's College	130448	New England and Mid-East	Associates
75.	Swarthmore College	216287	New England and Mid-East	Baccalaureate
76.	Tennessee State University	221838	Southeast	Doctoral/Research
77.	Tennessee Wesleyan College	221731	Southeast	Baccalaureate
78.	Toccoa Falls College	141185	Southeast	Baccalaureate
79.	Treasure Valley Community College	210234	Far West and Outlying Areas	Associates
80.	Tulane University of Louisiana	160755	Southeast	Doctoral/Research
81.	Union University	221971	Southeast	Masters
82.	University of Arkansas-Fort Smith	108092	Southeast	Associates
83.	University of Charleston	237312	Southeast	Baccalaureate
84.	University of Great Falls	180258	Southwest and Rocky Mountains	Masters
85.	University of Hartford	129525	New England and Mid-East	Doctoral/Research
86.	University of Memphis	220862	Southeast	Doctoral/Research
87.	University of Nebraska-Lincoln	181464	Great Lakes and Plains	Doctoral/Research
88.	University of North Florida	136172	Southeast	Masters
89.	University of Rochester	195030	New England and Mid-East	Doctoral/Research
90.	University of Sioux Falls	219383	Great Lakes and Plains	Masters
91.	University of Southern Mississippi	176372	Southeast	Doctoral/Research
92.	University of the Pacific	120883	Far West and Outlying Areas	Doctoral/Research
93.	Vanderbilt University	221999	Southeast	Doctoral/Research
94.	Washington State University	236939	Far West and Outlying Areas	Doctoral/Research
95.	Weatherford College	229799	Southwest and Rocky Mountains	Associates
96.	West Kentucky Community and Technical College	157483	Southeast	Associates
97.	Youngstown State University	206695	Great Lakes and Plains	Masters

### APPENDIX 3

#### Definitions of Financial Input Variables from IPEDS

Variable	Definition from IPEDS (2011)
Core revenues, total dollars	<p>Variable Statistics            Minimum: 1            Maximum: 6,270,528,000            Mean: 51,715,654.38            Standard Deviation: 217,256,493.46</p> <p>Core revenues, total dollars is derived for all institutions as follows:</p> <p>For public institutions using the new GASB 34/35 standard</p> <ol style="list-style-type: none"> <li>1. Tuition and fees revenues (F1B01)</li> <li>2. State government appropriation revenues (F1B11)</li> <li>3. Local government appropriation revenues (F1B12)</li> <li>4. Federal operating grants and contracts (F1B02)</li> <li>5. State operating grants and contracts (F1B03)</li> <li>6. Local operating grants and contracts (F1B04)</li> <li>7. Other operating sources (F1B08)</li> <li>8. Federal appropriations (F1B10)</li> <li>9. Federal non-operating grants (F1B13)</li> <li>10. State non-operating grants (F1B14)</li> <li>11. Local non-operating grants (F1B15)</li> <li>12. Gifts, including contributions from affiliated organizations (F1B16)</li> <li>13. Investment income (F1B17)</li> <li>14. Other non-operating revenues (F1B18)</li> <li>15. Total other revenues and additions (F1B24)</li> </ol> <p>For public and private-not-for profit institutions using the FASB standards.</p> <ol style="list-style-type: none"> <li>1. Tuition and fees revenues (F2D01)</li> <li>2. Federal appropriations (F2D02)</li> <li>3. State appropriations (F2D03)</li> <li>4. Local appropriations (F2D04)</li> <li>5. Federal grants and contracts (F2D05)</li> <li>6. State grants and contracts (F2D06)</li> <li>7. Local grants and contracts (F2D07)</li> <li>8. Private gifts, grants, and contracts (F2D08)</li> <li>9. Contributions from affiliated entities (F2D09)</li> <li>10. Investment return (F2D10)</li> <li>11. Sales and services of educational activities (F2D11)</li> <li>12. Other revenues (F2D15)</li> </ol>
Tuition and fees as a percent of core revenues	<p>Variable Statistics            Minimum: 1            Maximum: 100            Mean: 53.87            Standard Deviation: 32.99</p> <p>Tuition and fees divided by total core revenues.</p> <p>Tuition and fees (revenues) (F1B01, F2D01, F3D01) - Revenues from all tuition and fees assessed against students (net of refunds and discounts and allowances) for educational purposes. If tuition or fees are remitted to the</p>

Variable	Definition from IPEDS (2011)
	<p>state as an offset to the state appropriation, the total of such tuition or fees are deducted from the total state appropriation and added to the total for tuition and fees.</p>
<p>State appropriations as percent of core revenues</p>	<p>Variable Statistics  Minimum: 1  Maximum: 99  Mean: 36.17  Standard Deviation: 14.68</p> <p>State appropriations as a percent of core revenues is derived for public institutions (GASB) only.</p> <p>State appropriations is divided by total core revenues.</p> <p>This variable is not applicable for private not-for-profit and for-profit institutions.</p> <p>State appropriations are amounts received by the institution through acts of a state legislative body, except grants and contracts and capital appropriations. Funds reported in this category are for meeting current operating expenses, not for specific projects or programs.</p>
<p>Local appropriations as a percent of core revenues</p>	<p>Variable Statistics  Minimum: 1  Maximum: 95  Mean: 24.15  Standard Deviation: 17.43</p> <p>Local appropriations as a percent of core revenues is derived for public institutions (GASB) only.</p> <p>Local appropriations is divided by total core revenues</p> <p>This variable is not applicable for private not-for-profit and for-profit institutions.</p> <p>Local appropriations, education district taxes, and similar support - Local appropriations are government appropriations made by a governmental entity below the state level. Education district taxes include all tax revenues assessed directly by an institution or on behalf of an institution when the institution will receive the exact amount collected. These revenues also include similar revenues that result from actions of local governments or citizens (such as through a referendum) that result in receipt by the institution of revenues based on collections of other taxes or resources (sales taxes, gambling taxes, etc.).</p>

Variable	Definition from IPEDS (2011)
Government grants and contracts as a percent of core revenues	<p>Variable Statistics  Minimum: 1  Maximum: 100  Mean: 20.22  Standard Deviation: 18.14</p> <p>Government grants and contracts as a percent of core revenues</p> <p>Government grants and contracts is equal to:</p> <p>For public institutions using GASB (34/35) standards:</p> <ul style="list-style-type: none"> <li>• Federal operating grants and contracts (F1B02)</li> <li>• State operating grants and contracts (F1B03)</li> <li>• Local operating grants and contracts (F1B04)</li> <li>• Federal non-operating grants (F1B13)</li> <li>• State non-operating grants (F1B14)</li> <li>• Local nonoperating grants (F1B15)</li> </ul> <p>For private-not-for-profit institutions using FASB standards:  (Note some public institutions use the FASB standard).</p> <ul style="list-style-type: none"> <li>• Federal grants and contracts (F2D05)</li> <li>• State grants and contracts (F2D06)</li> <li>• Local grants and contracts (F2D07)</li> </ul> <p>Government grants and contract revenues is divided by total core revenues.</p> <p>Government grants and contracts (revenues) - Revenues from governmental agencies that are for specific research projects, other types of programs, or for general institutional operations (if not government appropriations). Examples are research projects, training programs, student financial assistance, and similar activities for which amounts are received or expenses are reimbursable under the terms of a grant or contract, including amounts to cover both direct and indirect expenses. Includes Pell Grants and reimbursement for costs of administering federal financial aid programs. Grants and contracts should be classified to identify the governmental level - federal, state, or local - funding the grant or contract to the institution; grants and contracts from other sources are classified as nongovernmental grants and contracts. GASB institutions are required to classify in financial reports such grants and contracts as either operating or non-operating.</p> <p>Operating - GASB requires that revenues and expenses be separated between operating and non-operating. Operating revenues and expenses result from providing goods and services. Operating transactions are incurred in the course of the operating activities of the institution</p> <p>Non-operating - GASB requires that revenues and expenses be separated between operating and non-operating. Operating revenues and expenses result from providing goods and services. Non-operating activities are those outside the activities that are part of the operating activities of the institution. Investment income is non-operating in most instances because institutions are not engaged in investing as an operating activity. Gifts are defined as non-operating. Nonexchange transactions generate non-operating revenues.</p>

Variable	Definition from IPEDS (2011)
Private gifts, grants, and contracts as a percent of core revenues	<p>Variable Statistics  Minimum: 1  Maximum: 99  Mean: 19.47  Standard Deviation: 17.37</p> <p>Private gifts, grants, and contracts as a percent of core revenues (FASB only).</p> <p>Private gifts, grants, and contract revenues is divided by total core revenues.</p> <p>Private gifts, grants and contracts (revenues) Revenues from private donors for which no legal consideration is involved and from private contracts for specific goods and services provided to the funder as stipulation for receipt of the funds. Includes only those gifts, grants, and contracts that are directly related to instruction, research, public service, or other institutional purposes. Includes monies received as a result of gifts, grants, or contracts from a foreign government. Also includes the estimated dollar amount of contributed services.</p>
Investment return as a percent of core revenues	<p>Variable Statistics  Minimum: 1  Maximum: 91  Mean: 11.74  Standard Deviation: 13.87</p> <p>Investment return as a percent of core revenues (FASB only).</p> <p>Investment return revenues is equal to F2D10 for public and private-not-for profit institutions using FASB standards.</p> <p>Investment return revenues is divided by total core revenues.</p> <p>Investment return - Income from assets including dividends, interest earnings, royalties, rent, gains (losses) etc.  Assets - Physical items (tangible) or rights (intangible) that have value and that are owned by the institution. Assets are useful to the institution because they are a source of future services or because they can be used to secure future benefits  Interest - The price paid (or received) for the use of money over a period of time. Interest income is one component of investment income. Interest paid by the institution is interest expense.  Gains - Increases in the institution's net assets from peripheral or incidental transactions. This is in contrast to revenues, which occur from the institution's ongoing major or central operations. Whether a transaction generates revenue or a gain depends on the relationship of the transaction to the institution's activities. For example, the sale of computers by a college store might be part of ongoing central activities, while the sale of surplus computers from administrative offices might be considered otherwise.  Losses - Decreases in net assets from an organization's peripheral or incidental transactions and other events affecting the organization, other than those that result from expenses</p>



Variable	Definition from IPEDS (2011)
Other revenues as a percent of core revenues	<p>Variable Statistics  Minimum: 1  Maximum: 100  Mean: 19.74  Standard Deviation: 22.65</p> <p>For public institutions using the new GASB 34/35 standard  Other operating sources (F1B08)  Federal appropriations (F1B10)  Gifts, including contributions from affiliated organizations (F1B16)  Investment income (F1B17)  Other non-operating revenues (F1B18)  Total other revenues and additions (F1B24)</p> <p>For public and private-not-for profit institutions using the FASB standards.  Federal appropriations (F2D02)  State appropriations (F2D03)  Local appropriations (F2D04)  Contributions from affiliated entities (F2D09)  Sales and services of educational activities (F2D11)  Other revenues (F2D15)</p> <p>Other Core revenues is divided by total core revenues.</p>

## APPENDIX 4

### Definitions of Financial Output Variables from IPEDS

Variable	Definition from IPEDS (2011)
Core expenses, total dollars	<p>Core expenses, total dollars for public institutions using GASB 34/35 standard are derived by adding expenses for the following functions:</p> <ul style="list-style-type: none"> <li>Instruction (F1C011)</li> <li>Research (F1C021)</li> <li>Public service (F1C031)</li> <li>Academic support (F1C051)</li> <li>Student services (F1C061)</li> <li>Institutional support (F1C071)</li> <li>Operation maintenance of plant (F1C081)</li> <li>Depreciation (F1C091)</li> <li>Scholarships and fellowships expenses (F1C101)</li> <li>Other expenses and deductions (F1C141)</li> <li>Total non-operating expenses and deductions (F1C181)</li> </ul> <p>Core expenses, total dollars for public and private-not-for-profit institutions using FASB standards are derived by adding expenses for the following functions:</p> <ul style="list-style-type: none"> <li>Instruction (F2E011)</li> <li>Research (F2E021)</li> <li>Public service (F2E031)</li> <li>Academic support (F2E041)</li> <li>Student services (F2E051)</li> <li>Institutional support (F2E061)</li> <li>Net grant aid to students (F2E081)</li> <li>Other expenses (F2E121)</li> </ul>
Instruction expenses as a percent of total core expenses	<p>Instruction expenses as a percent of total core expenses for public institutions using GASB 34/35 standards is derived as follows:</p> <p>Instruction expenses (F1C011) divided by total core expenses (F1COREXP)</p> <p>Instruction - A functional expense category that includes expenses of the colleges, schools, departments, and other instructional divisions of the institution and expenses for departmental research and public service that are not separately budgeted. Includes general academic instruction, occupational and vocational instruction, community education, preparatory and adult basic education, and regular, special, and extension sessions. Also includes expenses for both credit and non-credit activities. Excludes expenses for academic administration where the primary function is administration (e.g., academic deans). Information technology expenses related to instructional activities if the institution separately budgets and expenses information technology resources are included (otherwise these expenses are included in academic support). FASB institutions include actual or allocated costs for operation and maintenance of plant, interest, and depreciation. GASB institutions do not include operation and maintenance of plant or interest, but may, as an option, distribute depreciation expense.</p>

Variable	Definition from IPEDS (2011)
<p>Research expenses as a percent of total core expenses</p>	<p>Research expenses as a percent of total core expenses for public institutions using GASB 34/35 standards is derived as follows:</p> <p>Research expenses (F1C021) divided by total core expenses (F1COREXP)</p> <p>Research (expense) - A functional expense category that includes expenses for activities specifically organized to produce research outcomes and commissioned by an agency either external to the institution or separately budgeted by an organizational unit within the institution. The category includes institutes and research centers, and individual and project research. This function does not include non-research sponsored programs (e.g., training programs). Also included are information technology expenses related to research activities if the institution separately budgets and expenses information technology resources (otherwise these expenses are included in academic support.) FASB institutions include actual or allocated costs for operation &amp; maintenance of plant, interest, and depreciation. GASB institutions do not include operation &amp; maintenance of plant or interest but may, as an option, distribute depreciation expense.</p>
<p>Public service expenses as a percent of total core expenses</p>	<p>Public service expenses as a percent of total core expenses for public institutions using GASB 34/35 standards is derived as follows:</p> <p>Public service expenses (F1C031) divided by total core expenses (F1COREXP)</p> <p>Public service (expense) - A functional expense category that includes expenses for activities established primarily to provide noninstructional services beneficial to individuals and groups external to the institution. Examples are conferences, institutes, general advisory service, reference bureaus, and similar services provided to particular sectors of the community. This function includes expenses for community services, cooperative extension services, and public broadcasting services. Also includes information technology expenses related to the public service activities if the institution separately budgets and expenses information technology resources (otherwise these expenses are included in academic support). FASB institutions include actual or allocated costs for operation and maintenance of plant, interest, and depreciation. GASB institutions do not include operation and maintenance of plant or interest, but may, as an option, distribute depreciation expense.</p>
<p>Academic support expenses as a percent of total core expenses</p>	<p>Academic support expenses as a percent of total core expenses for public institutions using GASB 34/35 standards is derived as follows:</p> <p>Academic support (F1C051) expenses divided by 12-month FTE enrollment (F1COREXP)</p> <p>Academic support A functional expense category that includes expenses of activities and services that support the institution's primary missions of instruction, research, and public service. It includes the retention, preservation, and display of educational materials (for example, libraries, museums, and galleries); organized activities that provide support services to the academic functions of the institution (such as a demonstration school associated with a college of education or veterinary and dental clinics if their primary purpose is to support the instructional program); media such as</p>

Variable	Definition from IPEDS (2011)
	<p>audiovisual services; academic administration (including academic deans but not department chairpersons); and formally organized and separately budgeted academic personnel development and course and curriculum development expenses. Also included are information technology expenses related to academic support activities; if an institution does not separately budget and expense information technology resources, the costs associated with the three primary programs will be applied to this function and the remainder to institutional support. Under FASB standards this includes actual or allocated costs for operation and maintenance of plant, interest, and depreciation. Under GASB standards this does not include operation and maintenance of plant or interest but may include depreciation expense.</p>
<p>Student service expenses as a percent of total core expenses</p>	<p>Student services expenses as a percent of total core expenses for public institutions using GASB 34/35 standards is derived as follows:</p> <p>Student service expenses divided by total core expenses.</p> <p>Student services (expenses) - A functional expense category that includes expenses for admissions, registrar activities, and activities whose primary purpose is to contribute to students emotional and physical well - being and to their intellectual, cultural, and social development outside the context of the formal instructional program. Examples include student activities, cultural events, student newspapers, intramural athletics, student organizations, supplemental instruction outside the normal administration, and student records. Intercollegiate athletics and student health services may also be included except when operated as self - supporting auxiliary enterprises. Also may include information technology expenses related to student service activities if the institution separately budgets and expenses information technology resources (otherwise these expenses are included in institutional support.) FASB institutions include actual or allocated costs for operation and maintenance of plant, interest, and depreciation. GASB institutions do not include operation and maintenance of plant or interest but may, as an option, distribute depreciation expense.</p>
<p>Institutional support expenses as a percent of total core expenses</p>	<p>Institutional support expenses as a percent of total core expenses for public institutions using GASB 34/35 standards is derived as follows:</p> <p>Institutional support expenses divided by total core expenses.</p> <p>Institutional support - A functional expense category that includes expenses for the day-to-day operational support of the institution. Includes expenses for general administrative services, central executive-level activities concerned with management and long range planning, legal and fiscal operations, space management, employee personnel and records, logistical services such as purchasing and printing, and public relations and development. Also includes information technology expenses related to institutional support activities. If an institution does not separately budget and expense information technology resources, the costs associated with student services and operation and maintenance of plant will also be applied to this function. FASB institutions include actual or allocated costs for operation and maintenance of plant, interest and depreciation. GASB institutions do not include operation and maintenance of plant or interest, but may, as an option, distribute depreciation expense.</p>

Variable	Definition from IPEDS (2011)
Other core expenses as a percent of total core expenses	<p>All other core expenses as a percent of total core expenses for public institutions using GASB 34/35 standards is derived as follows:</p> <p>Other core expenses is equal to the sum of expenses for the following functions:</p> <ul style="list-style-type: none"> <li>Operation maintenance of plant (F1C081)</li> <li>Depreciation (F1C091)</li> <li>Scholarships and fellowships expenses (F1C101)</li> <li>Other expenses and deductions (F1C141)</li> <li>Total non-operating expenses and deductions (F1C181)</li> </ul> <p>Other core expenses is then divided by total core expenses (F1COREXP)</p>

## APPENDIX 5

### Definitions of Personnel Variables from IPEDS

Variable	Definition from IPEDS (2011)
Total Staff FTE	The full-time-equivalent (FTE) of staff is calculated by summing the total number of full-time staff from the Employees by Assigned Position (EAP) component and adding one-third of the total number of part-time staff.
Instruction-Research-Public Service Staff FTE	<p>The full-time-equivalent (FTE) of professional staff is calculated by summing the total number of full-time professional staff from the Employees by Assigned Position (EAP) component and adding one-third of the total number of part-time professional staff.</p> <p>Primarily instruction - A primary function or occupational activity category used to classify persons whose specific assignments customarily are made for the purpose of conducting instruction or teaching and who hold academic titles of professor, associate professor, assistant professor, instructor, lecturer or the equivalent. Includes deans, directors, or the equivalent, as well as associate deans, assistant deans, and executive officers of academic departments (chairpersons, heads, or equivalent) if their principal activity is instruction.</p> <p>Primarily public service - A primary function or occupational activity category used to classify persons whose specific assignments customarily are made for the purpose of carrying out public service activities such as agricultural extension services, clinical services, or continuing education and who may hold academic titles of professor, associate professor, assistant professor. Includes deans, directors, or the equivalent, as well as associate deans, assistant deans, and executive officers of academic departments (chairpersons, heads, or equivalent) if their principal activity is public service.</p> <p>Primarily research - A primary function or occupational activity category used to classify persons whose specific assignments customarily are made for the purpose of conducting research and who hold academic titles of professor, associate professor, assistant professor, or titles such as research associate or postdoctoral fellow. Includes deans, directors, or the equivalent, as well as associate deans, assistant deans, and executive officers of academic departments (chairpersons, heads, or equivalent) if their principal activity is research.</p>
Exec-Admin-Managerial Staff FTE	<p>The full-time-equivalent (FTE) of professional staff is calculated by summing the total number of full-time professional staff from the Employees by Assigned Position (EAP) component and adding one-third of the total number of part-time professional staff.</p> <p>Executive, administrative, and managerial - A primary function or occupational activity category used to classify persons whose assignments require management of the institution, or a customarily recognized department or subdivision thereof. Assignments require the performance of work directly related to management policies or general business operations of the institution, department or subdivision. Assignments in this category customarily and regularly require the incumbent to exercise discretion and independent judgment. Included in this category are employees holding titles</p>

Variable	Definition from IPEDS (2011)
	<p>such as: top executives; chief executives; general and operations managers; advertising, marketing, promotions, public relations, and sales managers; operations specialties managers; administrative services managers; <b>computer and information systems managers</b>; financial managers; human resources managers; purchasing managers; postsecondary education administrators such as: presidents, vice presidents (including assistants and associates), deans (including assistants and associates) if their principal activity is administrative and not primarily instruction, research or public service, directors (including assistants and associates), department heads (including assistants and associates) if their principal activity is administrative and not primarily instruction, research or public service, assistant and associate managers (including first-line managers of service, production and sales workers who spend more than 80 percent of their time performing supervisory activities); engineering managers; food service managers; lodging managers; and medical and health services managers.</p>
Other professional Staff FTE	<p>The full-time-equivalent (FTE) of professional staff is calculated by summing the total number of full-time professional staff from the Employees by Assigned Position (EAP) component and adding one-third of the total number of part-time professional staff.</p> <p>Other professional (support/service) - A primary function or occupational activity category used to classify persons employed for the primary purpose of performing academic support, student service, and institutional support, whose assignments would require either a baccalaureate degree or higher or experience of such kind and amount as to provide a comparable background. Included in this category are all employees holding titles such as business operations specialists; buyers and purchasing agents; human resources, training, and labor relations specialists; management analysts; meeting and convention planners; miscellaneous business operations specialists; financial specialists; accountants and auditors; budget analysts; financial analysts and advisors; financial examiners; loan counselors and officers; computer specialists; computer and information scientists, research; computer programmers; computer software engineers; computer support specialists; computer systems analysts; database administrators; network and computer systems administrators; network systems and data communication analysts; counselors, social workers, and other community and social service specialists; counselors; social workers; health educators; clergy; directors, religious activities and education; lawyers; librarians, curators, and archivists; museum technicians and conservators; librarians; artists and related workers; designers; athletes, coaches, umpires; dancers and choreographers; music directors and composers; chiropractors; dentists; dietitians and nutritionists; optometrists; pharmacists; physicians and surgeons; podiatrists; registered nurses; therapists; and veterinarians</p>
Non-professional Staff FTE	<p>The full-time-equivalent (FTE) of staff is calculated by summing the total number of full-time staff from the Employees by Assigned Position (EAP) component and adding one-third of the total number of part-time staff.</p> <p>Non-professional staff - Employees of an institution whose primary function or occupational activity is classified as one of the following: technical and paraprofessional; clerical and secretarial; skilled crafts; or service/maintenance</p>

Variable	Definition from IPEDS (2011)
	<p>Technical and paraprofessional - A primary function or occupational activity category used to classify persons whose assignments require specialized knowledge or skills which may be acquired through experience, apprenticeship, on-the-job-training, or academic work in occupationally specific programs that result in a 2-year degree or other certificate or diploma. Includes persons who perform some of the duties of a professional in a supportive role, which usually requires less formal training and/or experience than normally required for professional status. Includes mathematical technicians; life, physical, and social science technicians; agricultural and food science technicians; chemical technicians; geological and petroleum technicians; nuclear technicians; paralegals and legal assistants; miscellaneous legal support workers; health technologists and technicians; dietetic technicians; pharmacy technicians; licensed practical and licensed vocational nurses; medical records and health information technicians; opticians, dispensing; healthcare support occupations; nursing aides, orderlies, and attendants; physical therapist assistants and aides; massage therapists; dental assistants; medical assistants; and pharmacy aides.</p> <p>Clerical and secretarial - A primary function or occupational activity category used to classify persons whose assignments typically are associated with clerical activities or are specifically of a secretarial nature. Includes personnel who are responsible for internal and external communications, recording and retrieval of data (other than computer programmer) and/or information and other paperwork required in an office. Also includes such occupational titles such as switchboard operators, including answering service; telephone operators; bill and account collectors; billing and posting clerks and machine operators; bookkeeping, accounting, and auditing clerks; payroll and timekeeping clerks; procurement clerks; file clerks; clerical library assistants; human resources assistants, except payroll and timekeeping; shipping, receiving, and traffic clerks; secretaries and administrative assistants; computer operators; data entry and information processing workers; desktop publishers; mail clerks and mail machine operators (except postal service); office clerks (general); office machine operators (except computer); and proofreaders and copy markers.</p> <p>Skilled crafts - A primary function or occupational activity category used to classify persons whose assignments typically require special manual skills and a thorough and comprehensive knowledge of the processes involved in the work, acquired through on-the-job-training and experience or through apprenticeship or other formal training programs . Includes occupational titles such as welders, cutters, solderers and brazers; bookbinders and bindery workers; printers; cabinetmakers and bench carpenters; plant and system operators; stationary engineers and boiler operators; water and liquid waste treatment plant and system operators; crushing, grinding, polishing, mixing, and blending workers; medical, dental, and ophthalmic laboratory technicians; painting workers; photographic process workers and processing machine operators; and etchers and engravers.</p> <p>Service/maintenance - A primary function or occupational activity category used to classify persons whose assignments require limited degrees of previously acquired skills and knowledge and in which workers perform duties that result in or contribute to the comfort, convenience, and hygiene of personnel and the student body or that contribute to the upkeep of the institutional property. Includes titles such as fire fighters; law enforcement</p>



Variable	Definition from IPEDS (2011)
	workers; parking enforcement workers; police officers; security guards; lifeguards; ski patrol; cooks and food preparation workers; food and beverage serving workers; fast food and counter workers; waiters and waitresses; other food preparation and serving related workers; building cleaning and pest control workers; grounds maintenance workers; electrical and electronic equipment mechanics; installers and repairers; radio and telecommunications equipment installers and repairers; avionics technicians; electric motor, power tool, and related repairers; vehicle and mobile equipment mechanics, installers, and repairers; control and valve installers and repairers; heating, air conditioning, and refrigeration mechanics and installers; air transportation workers; motor vehicle operators; and parking lot attendants.

## APPENDIX 6

### Definitions of Customer Variables from IPEDS

Variable	Definition from IPEDS (2011)
Reported FTE Undergraduate Enrollment	<p>Reported full-time equivalent (FTE) undergraduate enrollment, academic year 2005-06, and academic year 2009-2010</p> <p>NCES uses estimated FTE undergraduate enrollment to calculate expenses by function per FTE and core revenues per FTE as reported in the IPEDS Data Feedback Report.</p> <p>If the generated estimate was not reasonable, the institution provided their best estimate for undergraduate FTE. If the institution did not provide an FTE, then the reported FTE was set to the estimated FTE.</p>
Reported FTE Graduate Enrollment	<p>Reported full-time equivalent (FTE) graduate enrollment, academic year 2005-06, and academic year 2009-2010</p> <p>NCES uses estimated FTE graduate enrollment to calculate expenses by function per FTE and core revenues per FTE as reported in the IPEDS Data Feedback Report.</p> <p>If the generated estimate was not reasonable, the institution provided their best estimate for graduate FTE. If the institution did not provide an FTE then the reported FTE was set to the estimated FTE.</p>
Institutional support expenses per FTE	<p>Institutional support expenses per FTE enrollment for public institutions using GASB 34/35 standards is derived as follows:</p> <p>Institutional support expenses (F1C071) divided by 12-month FTE enrollment (FTE12MN)</p> <p>Institutional support - A functional expense category that includes expenses for the day-to-day operational support of the institution. Includes expenses for general administrative services, central executive-level activities concerned with management and long range planning, legal and fiscal operations, space management, employee personnel and records, logistical services such as purchasing and printing, and public relations and development. Also includes information technology expenses related to institutional support activities. If an institution does not separately budget and expense information technology resources, the costs associated with student services and operation and maintenance of plant will also be applied to this function. FASB institutions include actual or allocated costs for operation and maintenance of plant, interest and depreciation. GASB institutions do not include operation and maintenance of plant or interest, but may, as an option, distribute depreciation expense.</p> <p>The full-time-equivalent (FTE) enrollment used is the sum of the institutions' FTE undergraduate enrollment and FTE graduate enrollment (as calculated from or reported on the 12-month Enrollment component) plus the estimated FTE of first-professional students. Undergraduate and graduate FTE are estimated using 12-month instructional activity (credit and/or contact hours).</p>

Variable	Definition from IPEDS (2011)
	<p>For more information see the variable description for 12-month full-time equivalent enrollment (info link) under frequently used\ 12-month enrollment.</p> <p>Institutional support expenses per FTE enrollment for public and private not-for-profit institutions using FASB standards is derived as follows:</p> <p>Institutional support expenses (F2E061) divided by 12-month FTE enrollment (FTE12MN)</p> <p>Institutional support - A functional expense category that includes expenses for the day-to-day operational support of the institution. Includes expenses for general administrative services, central executive-level activities concerned with management and long range planning, legal and fiscal operations, space management, employee personnel and records, logistical services such as purchasing and printing, and public relations and development. Also includes information technology expenses related to institutional support activities. If an institution does not separately budget and expense information technology resources, the costs associated with student services and operation and maintenance of plant will also be applied to this function. FASB institutions include actual or allocated costs for operation and maintenance of plant, interest and depreciation. GASB institutions do not include operation and maintenance of plant or interest, but may, as an option, distribute depreciation expense.</p> <p>The full-time-equivalent (FTE) enrollment used is the sum of the institutions' FTE undergraduate enrollment and FTE graduate enrollment (as calculated from or reported on the 12-month Enrollment component) plus the estimated FTE of first-professional students. Undergraduate and graduate FTE are estimated using 12-month instructional activity (credit and/or contact hours).</p> <p>For more information see the variable description for 12-month full-time equivalent enrollment (info link) under frequently used\ 12-month enrollment.</p>

## REFERENCES

- Aloini, D., Dulmin, R., & Mininno, V. (2007). Risk management in ERP project introduction: Review of the literature. *Information & Management*, 44(6), 547-567.
- Andriole, S. J. (2006). The collaborate/integrate business technology strategy. *Communication of the Association of Computing Machinery (ACM)*, 49, 85-90.
- Arindam, S., & Bhattacharya, R. (2009). Analysis of fitment of ERP and conceptualization of its substitute in small segment – A strategic approach. *Business Strategy Series*, 10(1), 28-39.
- Ash, C., & Burn, J. (2003). A strategic framework for the management of ERP enabled e-business change. *European Journal of Operational Research*. 146(2), 374-394.
- Babey, E. R. (2006). Costs of enterprise resource planning system implementation – And then some. *New Directions for Higher Education*, 136(Winter), 21-33.
- Bhyrovabhotla, Narayana V. L. (2012). Resource dependency theory: Renaissance and extensions – A conceptual basis. Retrieved October 22, 2012, from <http://ssrn.com/abstract=2015273>.
- Bieberstein, N., Bose, S., Walker, L., & Lynch, A. (2005). Impact of service-oriented architecture on enterprise systems, organizational structure, and individuals. *IBM System Journal*, 44, 691-707.
- Breneman, D. W., & Finney, J. E. (2001). The changing landscape: Higher education finance in the 1990s. In J. L. Yeager, G. M. Nelson, E. A. Potter, J. C. Weidman & T. G. Zullo (Eds.), *ASHE reader on finance in higher education* (2<sup>nd</sup> ed.) (pp. 161-178). Boston, MA: Pearson Custom Publishing.

- Callen, J. L., Klein, A., & Tinkelman, D. (2010). The contextual impact of nonprofit board composition and structure on organizational performance: Agency and resource dependence perspectives. *VOLUNTAS: International Journal of Voluntary and Nonprofit Organizations*, 21(1), 101-125.
- Carnegie Commission on Higher Education. (1973). *A classification of institutions of higher education*. Berkeley, CA: Carnegie Commission on Higher Education.
- Carnegie Foundation for the Advancement of Teaching. (2011). Classification description. Retrieved December 22, 2011, from <http://classifications.carnegiefoundation.org/>.
- Carnevale, A. P., Smith, N., & Strohl, J. (2010). *Help wanted: Projections of job and education requirements through 2018*. Indianapolis, IN: Lumina Foundation.
- Casciaro, T., & Piskorski, M. J. (2005). Power imbalance, mutual dependence, and constraint absorption: A closer look at resource dependence theory. *Administrative Science Quarterly*, 50(2), 167-199. Retrieved March 15, 2011, from <http://www.jstor.org/stable/30037190>.
- Cepeda, N. (2008). Effect size calculator. Retrieved November 27, 2012, from <http://www.cognitiveflexibility.org/effectsize/>.
- Chan, Y. E., & Reich, B. H. (2007). IT alignment: What have we learned?. *Journal of Information Technology*, 22, 297-315.
- Chillingworth, M. (2006). Library automation market is tracking big it vendors. *Information World Review*, 220(1), 4.
- Cooper, R. B., & Zmud, R. W. (1990). Information technology implementation research: A technological diffusion approach. *Management Science*, 36(2), 123-139.

- Davenport, T. H. (1998). Putting the enterprise into the enterprise system. *Harvard Business Review*, 76(4), 121-31.
- Davis, G. F., & Cobb, J. A. (2010). Resource dependence theory: Past and future. *Research in the Sociology of Organizations*, 28, 21-42.
- Devadoss, P., & Pan, S. (2007). Enterprise systems use: Towards a structural analysis of enterprise systems induced organizational transformation. *Communications of the Association for Information Systems*, 19, 352-385.
- ECAR. (2011). EDUCAUSE Center for Applied Research. Retrieved June 1, 2011, from <http://www.educause.edu/ecar>.
- EDUCAUSE. (2011). About EDUCAUSE. Retrieved June 1, 2011, from <http://www.educause.edu/about>.
- Ehie, I. C., & Madsen, M. (2005). Identifying critical issues in enterprise resource planning (ERP) implementation. *Computers in Industry*, 56(6), 545-557.
- Elbertsen, L., Benders, J., & Nijssen, E. (2006). ERP use: Exclusive or complemented?. *Industrial Management & Data Systems*, 106(6), 811-824.
- Ellis, P. D. (2009a). Thresholds for interpreting effect sizes. Retrieved November 27, 2012, from [http://www.polyu.edu.hk/mm/effectsizefaqs/thresholds\\_for\\_interpreting\\_effect\\_sizes2.html](http://www.polyu.edu.hk/mm/effectsizefaqs/thresholds_for_interpreting_effect_sizes2.html).
- Ellis, P. D. (2009b). Effect size calculator. Retrieved November 27, 2012, from <http://www.polyu.edu.hk/mm/effectsizefaqs/calculator/calculator.html>.
- Ellis, P. D. (2009c). Effect size equations. Retrieved November 27, 2012, from [http://www.polyu.edu.hk/mm/effectsizefaqs/effect\\_size\\_equations2.html](http://www.polyu.edu.hk/mm/effectsizefaqs/effect_size_equations2.html).

- Froelich, K. A. (1999). Diversification of revenue strategies: Evolving resource dependence in nonprofit organizations. *Nonprofit and Voluntary Sector Quarterly*, 28, 246-268.
- Gattiker, T. F., & Goodhue, D. L. (2005). What happens after ERP implementation: Understanding the impact of interdependence and differentiation on plant-level outcomes. *MIS Quarterly*, 29(3), 559-585.
- Glick, M. D., & Kupiec, J. (2001). E=MC2: The answer is still technology – Strategic technology. *Educause Review*, 36(6), 32-44.
- Goldstein, P. J. (2004). Information technology funding in higher education. Research Study from the Educause Center for Applied Research. Retrieved March 15, 2011, from <http://www.educause.edu/ECAR/InformationTechnologyFundingin/158577>.
- Goldstein, P. J. (2010). Responding to recession: IT funding and cost management in higher education. Research Study from the Educause Center for Applied Research. Retrieved March 15, 2011, from <http://www.educause.edu/Resources/RespondingtoRecessionITFunding/208239>.
- Goldstein, P. J., & Pirani, J. A. (2008). Leading the IT workforce in higher education. Research Study from the Educause Center for Applied Research. Retrieved March 15, 2011, from <http://www.educause.edu/ECAR/LeadingtheITWorkforceinHigherE/163201>.
- Gorr, W., & Hossler, D. (2006). Why all the fuss about information systems? or information systems as golden anchors in higher education. *New Directions for Higher Education*, 2006, 7-20.
- Green, K. C. (2005). Digital Tweed/Commentary: ROI is dead!. *Campus Technology*,

Retrieved March 1, 2011, from

<http://campustechnology.com/articles/2005/08/digital-tweedcommentary-roi-is-dead.aspx>

Green, K. C., & Gilbert, S. W. (1995). Great expectations: Content, communications, productivity, and the role of information technology in higher education. *Change*, 27(2), 8-18.

Hauptman, A. M. (2001). Financing American higher education in the 1990s. In J. L. Yeager, G. M. Nelson, E. A. Potter, J. C. Weidman & T. G. Zullo (Eds.), *ASHE reader on finance in higher education* (2<sup>nd</sup> ed.) (pp. 115-126). Boston, MA: Pearson Custom Publishing.

Hawkins, B. (1989). Managing a revolution – Turning a paradox into a paradigm. In B. Hawkins (Ed.), *Organizing and managing information resources on campus*. McKinney, TX: Academic Computing Publications.

Hillman, A. J., Withers, M. C., & Collins, B. J. (2009). Resource dependence theory: A review. *Journal of Management*, 35, 1404-1427.

Hirschheim, R., & Sabherwal, R. (2001). Detours in the path toward strategic information systems alignment. *California Management Review*, 44, 87-108.

Hoover, K. R. (1995). *The elements of social scientific thinking* (6<sup>th</sup> ed.). New York, NY: St. Martin's Press.

Hossler, D. (2007). *Building a student information system: Strategies for success and implications for campus policy makers*. San Francisco, CA: Josey-Bass.

Hossler, D., & Pape, S. (2006), Editors' notes. *New directions for higher education* (pp. 1-6).



- Huberty, C. J. (1994). *Applied discriminant analysis*. New York, NY: Wiley.
- IPEDS. (2011). About IPEDS. Retrieved April 28, 2011, from <http://nces.ed.gov/ipeds/about/>.
- IPEDS Glossary. (2011). IPEDS glossary search. Retrieved December 28, 2011, from <http://nces.ed.gov/ipeds/glossary>.
- IPEDS New Keyholder Handbook. (2012). Retrieved September 2, 2012, from [https://surveys.nces.ed.gov/ipeds/downloads/New\\_Keyholder\\_Handbook\\_2012\\_all.pdf](https://surveys.nces.ed.gov/ipeds/downloads/New_Keyholder_Handbook_2012_all.pdf).
- Johnstone, D. B. (2001). Financing higher education: Who should pay?. In J. L. Yeager, G. M. Nelson, E. A. Potter, J. C. Weidman & T. G. Zullo (Eds.), *ASHE reader on finance in higher education* (2<sup>nd</sup> ed.) (pp. 3-16). Boston, MA: Pearson Custom Publishing.
- Katz, D., & Kahn, R. L. (1966). *The social psychology of organizations*. New York, NY: Wiley.
- Katz, R. N., Kvavik, R. B., Penrod, J. I., Pirani, J. A., Nelson, M. R., National Association of College Stores, & Salaway, G. (2004). Information technology leadership in higher education: The condition of the community. Research Study from the Educause Center for Applied Research. Retrieved March 15, 2011, from <http://www.educause.edu/ECAR/InformationTechnologyLeadershi/158568>.
- Klecka, W. R. (1985). *Discriminant analysis*. Beverley Hills, CA: Sage Publications, Inc.
- Koch, C. (2006). The ABCs of ERP: getting started with enterprise resource planning. Retrieved February 18, 2011, from <http://www.cio.com/research/erp/edit/erpbasics.html>.

- Kogetsidis, H., Kokkinaki, A., & Soteriou, V. (2008). Enterprise resource planning implementation in the retail sector: A case study on the effects of the implementation of an ERP system in Cyprus. *Journal of International Business and Entrepreneurship Development*, 3(3/4), 270-283.
- Koh, S. C. L., Simpson, M., Padmore, J., Dimitriadis, N., & Misopoulos, F. (2006). An exploratory study of enterprise resource planning adoption in Greek companies. *Industrial Management and Data Systems*, 106(7), 1033-1059.
- Kohli, R., & Grover, V. (2008, January). Business value of IT: An essay on expanding research directions to keep up with the times. *Journal of the Association for Information Systems*, 9, 23-39.
- Kvavik, R. B., & Katz, R. N. (2002). The promise and performance of enterprise systems. Research Study from the EDUCAUSE Center for Applied Research. Retrieved March 15, 2011, from <http://www.educause.edu/ECAR/ThePromiseandPerformanceofEnte/158557>.
- Lackey, J., & Brown, S. (2002). Why informal information technology management models do not work. *User Services Conference*, 9, 60-63.
- Lambert, H. D. (2008). Managing risk and exploiting opportunity. *Educause Review*, 43(6), 36-37.
- Langenwaller, G. A. (2000). *Enterprise resource planning and beyond – Integrating your entire organisation*. Boca Raton, FL: St. Lucie Press.
- Leslie, L., & Rhoades, G. (1995). Rising administrative costs: Seeking explanations. *The Journal of Higher Education*, 66(2), 187-212.
- Mark, A. (2008). Educational technology funding models. *Association for the*

*Advancement of Computing In Education Journal*, 16(4), 405-424.

- Markus, M. L., & Tanis, C. (2000). The enterprise systems experience from adoption to success. Retrieved March 18, 2011, from <http://pro.unibz.it/staff/ascime/documents/ERP%20paper.pdf>.
- McClure, P. A. (2003). *Organizing and managing information resources on your campus*. San Francisco, CA: Jossey-Bass Inc.
- McCormick, A. C., & Cox, R. D. (2003). Classifying two-year colleges: Purposes, possibilities, and pitfalls. *New Directions for Community Colleges*, 122, 7-15.
- Momoh, A., Roy, R., & Shehab, E. (2010). Challenges in enterprise resource planning implementation: State-of-the-art. *Business Process Management Journal*, 16(4), 537-565.
- Morris, M. G., & Venkatesh, V. (2010). Job characteristics and job satisfaction: Understanding the role of enterprise resource planning system implementation. *MIS Quarterly*, 34(1), 143-161.
- Muscatello, J. R., Small, M. H., & Chen, I. J. (2003). Implementing enterprise resource planning (ERP) systems in small and midsize manufacturing firms. *International Journal of Operations & Production Management*, (23)8, 850-871.
- Nah, F. F., Lau, J. L., & Kuang, J. (2001). Critical factors for successful implementation of enterprise systems. *Business Process Management Journal*, 7(3), 285-296.
- Nash, K. (2000). Companies don't learn from previous IT snafus. *Computerworld*, October 30.
- Ndede-Amadi, A. A. (2004). What strategic alignment, process redesign, enterprise resource planning, and e-commerce have in common: Enterprise-wide computing.

*Business Process Management Journal*, (10)2, 184-199.

Nworie, J. (2006). Academic technology in higher education: Organizing for better results. *Journal of Educational Technology Systems*, 35(1), 105-128.

Oberlin, J. L. (1996). The financial mythology of information technology: Developing a new game plan. *Cause/Effect*, 19(2), 10-17. Retrieved April 2, 2011 from <http://net.educause.edu/ir/library/html/cem/cem96/cem9624.html>.

Orlikowski, W. J., & Barley, S. R. (2001). Technology and institutions: What can research on information technology and research on organizations learn from each other?. *MIS Quarterly*, (25)2, 145-165.

Peterson, R. (2004). Crafting information technology governance. *Information Systems Management*, 21(2), 7-22.

Pfeffer, J. (1981). *Power in organizations*. Marshfield, MA: Pitman.

Pfeffer, J., & Salancik, G. R. (1974). Organizational decision making as a political process: The case of a university budget. *Administrative Science Quarterly*, 19, 135-151.

Pfeffer, J., & Salancik, G. R. (1978). *The external control of organizations: A resource dependence perspective*. New York, NY: Harper and Row.

Pfeffer, J., & Salancik, G. R. (2003). *The external control of organizations: A resource dependence perspective*. Stanford, CA: Stanford University Press.

Phipps, R., & Wellman, J. (2001). Funding the “infostructure”: A guide to financing technology infrastructure in higher education. *New Agenda Series*, 3(2).

Indianapolis, IN: Lumina Foundation.

Pirani, J. A., & Spicer, D. Z. (2006). A collaborative IT support model for research at

- Georgetown University. Retrieved March 20, 2011, from <http://net.educause.edu/ir/library/pdf/ers0605/cs/ECS0603.pdf>.
- Poulson, J., & French, A. (2011). Discriminant analysis. Retrieved June 14, 2011, from <http://userwww.sfsu.edu/~efc/classes/biol710/discrim/discrim.pdf>
- Powel, W. D., & Barry, J. (2005). An ERP post-implementation review: Planning for the future by looking back. *Educause Quarterly*, 3, 40-46.
- Ramcharan, H. (2006). *Information technology integration in higher education: A case study of a historically black university*. Doctoral dissertation. Capella University.
- Ramirez, R. V. (2003). *The influence of information technology and organizational improvement efforts on the performance of firms*. Doctoral dissertation. University of California, Irvine.
- Ringle, M. D. (2001). Forecasting financial priorities for technology. In J. L. Yeager, G. M. Nelson, E. A. Potter, J. C. Weidman & T. G. Zullo (Eds.), *ASHE reader on finance in higher education* (2<sup>nd</sup> ed.) (pp. 353-361). Boston, MA: Pearson Custom Publishing.
- Rosser, V. J. (2003). Faculty and staff members' perceptions of effective leadership: Are there differences between women and men leaders?. *Equity & Excellence in Education*, 36(1), 71-81.
- Salancik, G. R. (1979). Interorganizational dependence and responsiveness to affirmative action: The case of women and defense contractors. *Academy of Management Journal*, 22(2), 375-394.
- Soh, C., Kien, S. S., & Tay-Yap, J. (2000). Cultural fits and misfits: Is ERP a universal solution?. *Communication of the ACM*, (43)4, 47-51.

- Straub, D., Weill, P., & Schwaig, K. S. (2008). Strategic dependence on the IT resource and outsourcing: A test of the strategic control model. *Information Systems Frontiers, 10*(2), 195-210.
- Swaminathan, S. (2011). *Critical success factors of ERP implementation*. Doctoral dissertation. University of Toledo.
- Swartz, D., & Orgill, K. (2001). Higher education ERP: Lessons learned. *Educause Quarterly, 20*(2), 20-27.
- Teo, T. S. H., & King, W. R. (1997). Integration between business planning and information systems planning: An evolutionary-contingency perspective. *Journal of Management Information Systems, 14*, 185-214.
- Themistocleus, M. & Irani, Z. (2001). Benchmarking the benefits and barriers of application integration. *Benchmarking: An International Journal, (8)*4, 317-331.
- Tillquist, J., King, J. L., & Woo, C. (2002). A representational scheme for analyzing information technology and organizational dependency. *MIS Quarterly, 26*(2), 91-118.
- Tolbert, P. S. (1985). Institutional environments and resource dependence: Sources of administrative structure in institutions of higher education. *Administrative Science Quarterly, 30*, 1-13.
- Ulrich, D., & Barney, J. B. (1984). Perspectives in organizations: Resource dependence, efficiency, and population. *The Academy of Management Review, 9*(3), 471-481.
- Venkatesh, V. (2006). Where to go from here? Thoughts for future directions for research on individual-level technology adoption with a focus on decision-making. *Decision Sciences, 37*, 497-518.

- Venkatesh, V., Davis, F. D., & Morris, M. G. (2007). Dead or alive? The evolution, trajectory, and future of technology adoption research. *Journal of the AIS*, 8(4), 267-286.
- Viswadoss, A. (1999). *Chief information officers in higher education: Role, leadership and career reflections*. Doctoral dissertation. University of Virginia.
- Waggaman, J. (2001). Strategies and consequences: Managing the costs in higher education. In J. L. Yeager, G. M. Nelson, E. A. Potter, J. C. Weidman & T. G. Zullo (Eds.), *ASHE reader on finance in higher education* (2<sup>nd</sup> ed.) (pp. 301-315). Boston, MA: Pearson Custom Publishing.
- West, R., & Daigle, S. L. (2004). Total cost of ownership: A strategic tool for ERP planning and implementation. Research Study from the EDUCAUSE Center for Applied Research. Retrieved March 1, 2011, from <http://net.educause.edu/ir/library/pdf/ERB0401.pdf>.
- Wulf, V., & Rohde, M. (1995). Towards an integrated organization and technology development. In *Proceedings of the 1st conference on designing interactive systems: Processes, practices, methods, and techniques*. New York: Association for Computing Machinery (ACM).
- Yakovlev, I. V. (2002). An ERP implementation and business process reengineering at a small university. *Educause Quarterly*, 4, 52-57.
- Yoder, J. A. (2001). Investing planned gifts: Proper management yields big dividends. In J. L. Yeager, G. M. Nelson, E. A. Potter, J. C. Weidman & T. G. Zullo (Eds.), *ASHE reader on finance in higher education* (2<sup>nd</sup> ed.) (pp. 271-274). Boston, MA: Pearson Custom Publishing.

- Youngberg, E., Olsen, D., & Hauser, K. (2009). Determinants of professionally autonomous end user acceptance in an enterprise resource planning system environment. *International Journal of Information Management*, 29, 138-144.
- Yusuf, Y., Gunasekaran, A., & Abthorpe, M. S. (2004). Enterprise information systems project implementation: A case study of ERP in Rolls-Royce. *International Journal Production Economics*, 87(3), 251-66.
- Zehir, C., & Keskin, H. (2003). A field research on the effects of MIS on organizational restructuring. *Journal of American Academy of Business*, 3(1/2), 270-279.
- Zimmerman, D. W. (1997). A note on interpretation of the paired samples t-test. *Journal of Educational and Behavioral Statistics*, 22(3), 349-360.
- Zusman, A. (2005). Challenges facing higher education in the twenty-first century. In P. G. Altbach, R. O. Berdahl & P. J. Gumport (Eds.), *American higher education in the twenty-first century: Social, political, and economic challenges* (pp. 115-160). Baltimore, MD: Johns Hopkins University Press.



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