Factors related to the adoption of IT emerging technologies by research and non-research based higher education institutions

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ABSTRACT

This study examined the adoption of information technology (IT) emerging technology by higher education institutions with a focus on non-research and research based institutions categorized by Carnegie Mellon classifications that are members of EDUCAUSE, a higher education non-profit organization, whose mission is the use of IT in higher education. Publicly available archival information was used to survey a selected population from EDUCAUSE's member institutions. The study results indicate that research and non-research based higher education institutions mostly considered in their decision making process for adopting IT emerging technologies the cost of IT adoption, return on investment, total cost of ownership, competition, strategic and academic goals, comparable or competitor's use of IT emerging technologies, use of existing physical infrastructure, integration with existing legacy equipment, perceived worker skill sets, productivity, attracting quality students, faculty and staff, and quality of computing services. Staff training levels and academic standing with comparable schools and competitors were least considered in the decision making process for adopting IT emerging technologies. This research provides a better understanding of what factors are viewed by non-research based higher education institutions as reasons to adopt IT emerging technologies.

Keywords: IT emerging technologies, Carnegie Mellon classifications, EDUCAUSE, innovation

INTRODUCTION

Adoption of emerging technologies prior to their proven value is both acceptable and normal in today's globalized economy. Firms that refuse to change their approach face declining sales, obsolescence, and potential bankruptcy. In this regard, academic institutions are no different. IT is a critical asset for higher education institutions and can aid and support institutional strategic objectives such as recruitment of students and faculty (Oblinger, 2008; Tanner, 2011). The adoption of emerging technology in business is broadly studied but the resulting research has produced inconsistent results (Brandyberry, 2003). Moreover, the research associated with the study of the adoption of emerging technologies by higher education is very limited. Accordingly, this study will focus on adoption of emerging technology by higher education institutions with a focus on research and non-researched based institutions categorized by Carnegie Mellon classifications (2007). It will offer a quantitative analysis of the factors related to the adoption of emerging technology by non-researched based institutions with a comparison to research institutions.

Problem Background

There are existing studies that evaluate the rate, cause, or sustainability of adopting IT emerging technologies by higher educational institutions in very specific settings such as the use of data warehousing for decision making; use in student services and registration processes; and the impact of technology on community college libraries (Heise, 2006; Ball, 2002; Moore, 2006). Those studies that focus on factors related to adoption of IT emerging technologies after the fact, offer the practitioner little support in determining which variables are best at determining why emerging technologies are adopted at all. Russell (2008) specifically researched higher educational institution chief information officers' behavior related to adoption of emerging technology before the technology had a proven utility. Russell's key findings indicate more technology is diffused than infused, misalignment of technologies and goals, lower levels of innovation adoption produce better alignment, technologies are used for recruiting, students push for technological innovation, and using technology as a differentiator.

Day and Schoemaker (2000) state that retrospective studies of emerging technologies inherently suffer from selection bias in that they focus on widely known successes or failures but rarely emphasize the hundreds of lesser known cases where progress or fall-back may be less noticeable. This is seen in "Emerging Technology Disappointments" (eWeek, 2007), an annual report that focuses on technologies that did not perform as expected which in the past has included residential voice over Internet Protocol (VOIP) services, Blu-Ray vs. HD DVD video viewing media, and municipal wireless Internet services. Utterback (1994) states that firms that have successfully mastered several waves of technological change balance development of innovation with core competencies of the business.

Nworie (2011) discusses the impact and resulting change of digital technology on society. He states that there are number of factors that have prevented the use of technology in higher education. Among them are adoption and integration approaches, resistance, budgets, priorities, student demographics, institutional cultures, leadership, and adoption failures (Nworie).

Very little research, however, has been completed to determine factors of adoption by non-research based higher education institutions perhaps due to the perception that non-research

based institutions have limited funding to experiment ahead of their better funded research counterparts. Another reason may be perceptions that non-research based institutions have little to no drivers to adopt emerging technologies ahead of the curve when cost of adoption is generally at a premium.

Although numerous studies evaluate the use or rate of adoption of IT emerging technologies little of the research to date addresses the factors related to adoption of IT emerging technologies by higher education institutions. There are also no known completed research studies which offer information related to non-research based higher education institutions. This research effort will add to the body of academic literature in the areas of research and non-research based higher education institutions, emerging technology, and information technology.

Variables related to adoption of emerging technologies by research and non-research based higher education institutions will illuminate factors beyond the obvious, such as cost or perceived value, and offer other, perhaps more subtle pro-active reasons for adoption of IT emerging technologies that may go unnoticed. This research will also provide a better understanding of what variables are viewed as the factors research and non-research based higher education institutions adopt IT emerging technologies. This research will also evaluate the rate at which research and non-research based institutions adopt IT emerging technologies and provide evidence to support the theory that non-research higher education institutions adopt IT emerging technologies based on variables that are unrelated to cost. Why do non-research based institutions adopt IT emerging technologies. Are these factors different than research based institutions?

PURPOSE OF THE STUDY

The adoption of IT emerging technologies is an important area of study that can assist both academic institutions and businesses in allocating limited resources and prioritizing research and development budgets based on current use and future needs. It will also identify factors related to the adoption of emerging technologies by research and non-research based higher education institutions. Most of the research on the use or adoption of IT emerging technologies focuses on the private business sector and no known research of academic institutions. This study will investigate the factors that may distinguish the rate, cause, or reasons for adoption of IT emerging technologies by research and non-research based institutions categorized by Carnegie Mellon classification (2007).

This study will also evaluate factors used by non-research based higher education institutions and research based higher education institutions prior to adoption of IT emerging technologies to evaluate the rate, cause, or reason IT emerging technologies are adopted at all. The comparison of data may identify different variables between the two groups for reasons of adoption and is intended to add to the existing body of research on adoption of emerging technologies.

RESEARCH QUESTIONS

What internal and external factors cause a research and non-research based higher education institution to adopt IT emerging technologies?

Factors this study considered are: cost of IT adoption, return on investment, total cost of ownership, staff training levels, competition, strategic goals, competitor's use of IT emerging

technologies, use of existing physical infrastructure, integration with existing legacy equipment, perceived worker skill sets, productivity, attracting quality students, faculty, and staff, quality of computing services, and academic standing with comparable schools and competitors.

LIMITATIONS AND DELIMITATIONS

This study was conducted using a sample of the population of higher education institution that are members of EDUCAUSE and did not consider institutions that are not members of this organization. This may lead to sample bias as non-members of EDUCAUSE were not surveyed. Initial survey instrument was assessed via a pilot study of a smaller number of higher education EDUCAUSE information technology experts. The pilot study included an assessment of content validity to ensure the eventual study will measure the appropriate areas as related to IT, emerging technologies, and the rate, cause, and reason for adoption by research and non-research based higher education institutions.

This study will not attempt to define specific IT emerging technologies for survey participants but rather the rate, cause, and reason for adoption as research institutions may consider a specific technology as late technology whereas a non-research institution may consider it advanced or the reverse is also possible. It will however provide specific details in order to answer the question why they are adopted at all and at what rate. This study's reliability can be assessed by future researchers and their studies as well via survey questions that will provide multiple indicators to ensure the outcome of the study can be repeated (Baker, 1998).

This study will not consider adoption of IT emerging technologies by industry groups outside higher education and it will not evaluate factors beyond those identified in this study. The results may be appropriately used as the reason or cause IT emerging technologies are adopted but may not be generalized outside of the sample group.

LITERATURE REVIEW

The literature review will initially present an examination of the research related to models and theories of emerging technology adoption and use as well as a specific industry research with a focus on adoption of IT emerging technology. Research related to the impact of organizations on acceptance and adoption of emerging technologies will be discussed including a review of business models and theories which impact adoption and use of IT emerging technology. Finally, it will conclude with studies and information related to adoption and use of IT emerging technology in higher education with a specific focus on research and non-research based higher education institutions.

Models and Theories Related to Use of Emerging Technologies

The concept that creates an emerging technology might begin with an idea, drawing, or invention that eventually offers a means to solve a problem or lessen a burden but the chance to take advantage of an IT emerging technology only has a brief window of opportunity (Carr, 2003).

Ray, Muhanna, and Barney (2007) state that firms should strive to be innovation leaders, as the fast paced development of new technology has spurred acceptance of change that might have once been avoided. Anxiety over a new technology's affect on jobs, services, and social

values may no longer even be considered when evaluating the usefulness of an emerging technology. Ray, Muhanna and Barney also state the key capability impacting how well IT innovation is accepted by an organization is a shared IT-business understanding between IT and line managers regarding how IT can be used to improve performance of a specific process. Emerging technologies are overturning presumptions in every business sector as companies search for ways to accelerate innovation efforts to gain maximum competitive advantage (Teresko, 2008).

But technology also has a life cycle in which it emerges, sustains, and then falls behind newer technology. The Emerging Technology Management Research Program at the University of Pennsylvania's Wharton Business School defines three stages of emerging technology: (1) the scientific advancement or breakthrough stage; (2) the technical implementation stage which includes testing and pre-marketing; and (3) the commercialization stage should it become a viable product for sale (Emerging Technology Management Research Program, 2003).

Some emerging technologies may be hard to identify in advance as the concept or idea may be difficult to envision when its purpose and possible value may not be immediately clear (Drew, 2006). The most difficult emerging technologies to identify are generally ones thought to be so disruptive and where little or no relevant market data exists to support a decision to move forward beyond the feasible idea or breakthrough stage. Adding to this difficulty is the adoption of an emerging technology as traditional models for sales and marketing may impede decision makers from moving forward to successive stages in the emerging technology life cycle (Drew). Drucker (1998) states the greatest praise innovation and the resulting product can receive are for the user to immediately recognize the usefulness of the device, product, or process.

Christensen, Anthony, and Roth (2004) highlight three core management theories that evaluate innovation and are useful for predicting industry change—the disruptive innovative theory; the resources, processes, and values theory; and the value chain evolution theory. The disruptive innovative theory focuses on new organizations that use simple, convenient, or low-cost innovations to create growth and surpass incumbents (Christensen, Anthony, & Roth). The theory states that existing companies have an edge when the contest is about sustaining innovation but new entrants can move past and even beat out established companies when deploying disruptive innovations (Christensen, Anthony, & Roth).

Non-research based higher education institutions may consider the disruptive innovative theory when valuating new entrants such as on-line, non-accredited, and diploma mill schools. IT emerging technologies provide a means to advertise an accredited institution's reputation, the value of its degree in a future job market, as well national rankings via Web 2.0 sites.

The resources, processes, and values theory focuses on why existing companies have difficulty accepting or reacting to disruptive innovation. This theory states that a company may be limited in their readiness or ability to adapt by their own resources – what the firm has; its processes – how the firm works; and its values – what the firm wants to do (Christensen, Anthony, & Roth, 2004). This theory may have some application at research and non-research based higher education institutions as they struggle to retain skilled workers and ensure technology, library, and student services staff maintain training and skill sets needed to effectively implement and use IT emerging technologies.

The value chain evolution theory evaluates if a company has made the correct organizational design decisions to react to or challenge an entrant's deployment of innovations. Organizational decisions may be directly related to the company's choice to integrate and conduct activities related to innovation in house or specialize and rely on suppliers and partners

to compete (Christensen, Anthony, & Roth, 2004). Research and non-research based higher education institutions may consider this theory when deciding whether to host or use off-site services when competing against on-line or for-profit higher educational institutions which may not have academic senates who control course curriculum and program content or powerful alumni groups that stress continuance of traditions and culture of a university.

A study of emerging technology innovation, grounded to the resource-based view of the firm, determined innovation is an iterative process that comes from activities in five areas: (1) technology, (2) design requirements, (3) customer, (4) manufacturing, and (5) application development (Taylor Coates, 2007). Two longitudinal case studies and data from 132 emerging technologies projects at the firm level in the area of micro electro mechanical systems and super attribute polymers were used to assess emerging technology innovation (Taylor Coates). The study concluded emerging technology innovation is a direct result of the relationship between core competencies of the firm and drivers of competitive advantages (Taylor Coates).

Technology Change Theories

Davila, Epstein, and Shelton (2006) highlight the technology change theory and state that technology can fuel innovation in three ways: (1) product and service offerings; (2) process technologies; and (3) enabling technologies. The most easily recognized type of innovation is a change to a product or service offering. Consumers see the changes first hand and have a role to play in the success or failure of a product or service. This can either be an actual new service or product or new features to existing services or products. Examples, as related to higher education's use of IT emerging technologies, are pod cast course broadcasts, on-line degrees, and correspondence courses which in the end produce more or less the same result for a student regardless if they attended the class on campus or in a classroom.

A change in service delivery or manufacturing can result in a process driven change in technology (Davila, Epstein, & Shelton, 2006). These types of innovations may be vital to retain or accelerate a product's competitive posture although completed behind the scenes and all but invisible to consumers. Learning management systems such as Blackboard, Moodle, or eCollege, and others, which offer on-line course systems via Web portals, are examples of the same service-on-line course completion, but with a focus toward providing a more structured course delivery mechanism.

Enabling technologies change innovation as they allow a company to execute strategy and leverage time to develop a competitive advantage (Davila, Epstein, & Shelton, 2006). Carr (2003) cites chief executives that routinely address the strategic value of information technology and how it is a competitive advantage for a firm. This is the least visible type of innovation for consumers but one that ensures better decision-making and financial management for a company. Strategic goals of higher education institutions which integrate innovation are generally not well known by students but are critical road maps for academic institutions as they determine priorities for several years into the future. Santovec states that business strategic plans produce goals which are then converted to projects which generally involve the integration of an IT emerging technology or innovation (2001).

Three types of innovation

Davila, Epstein, and Shelton (2006) discuss three types of innovation as incremental, semi-radical, and radical. Incremental innovation leads to small changes to existing products and business processes and can be a problem-solving exercise (Davila, Epstein, & Shelton). Semi-radical innovations can change the competitive landscape in ways an incremental innovation cannot. Although noted by substantial change, semi-radical innovation changes the business model or the technology used by an organization but not both (Davila, Epstein, & Shelton). Radical innovation results in exploration and delivery of new products or services in entirely new ways (Davila, Epstein, & Shelton). It results in changes to both the business model and technology of a company.

Academic institutions may implement incremental change using IT emerging technologies via an existing Web site by offering an on-line store front to sell books, athletic event tickets, or to provide a portal for alumni to donate to their alma mater. Semi-radical change for research and non-research based institutions might be the movement from paper based class schedules and check payment to on-line class registration, electronic fund transfers, and Internet security compliant credit card payments. Radical change for a traditional non-research based institution may be a movement to on-line classes as this might be seen as a dramatic change to both how they teach as well as their ability to personally impact a student's learning skills.

Solution Based and Vendor Driven Approach to Sustainable Networks

Joshua (2006) examined how technology vendors can build sustainable computing and network technologies agile enough to react to emerging technologies, sufficiently robust to support client services, and in tune with business objectives that they continue to generate revenue as even newer emerging technologies are introduced into the network and presented to customers. His unit of analysis was carrier and service providers that resell services to other carrier class providers or offer the direct sale of services to consumer level customers.

The solution approach, developed by Joshua (2006), is business case centered, driven by customer requirements, and constrained by the broad paradigm that the network must continue to serve long after initial build-out (up scaling). He countered this research with an analysis that a vendor driven approach in which the concentration is to support domains or needs of other vendor is not sustainable. He concluded that a solution based approach is the only long-term model that will ensure emerging technology services are deployed to meet both customer and vendor demands (Joshua).

Impact of Organizations on Acceptance and Adoption of Emerging Technologies

Models and theories are important frameworks to study emerging technologies. Another important area of study as related to the study of emerging technologies is how organizations impact acceptance or rejection of an innovation. If IT and organizational goals are not aligned then the result is out of balance when generally it must be in sync for successful deployment of an IT emerging technology or innovation (Van de Wijngaert, Versendaal, & Matia, 2008).

Emerging technologies offer organizations a major opportunity to differentiate themselves from their competitors and have the ability to alter the competitive landscape (Porter, 2001). Porter also states emerging technologies offer an organization a means to sustain a

competitive advantage. Brandyberry (2003) notes the impact of organizations of adoption of emerging technologies is influenced by the number that actually adopt which decreases dramatically as the technology reaches saturation and that organizational determinants can produce both early and late adopters of a technology.

The determinants and moderators caused by organizational behavior, culture, standards, expectations, and ideals are critical to the success or failure of a new innovation or system. There are at least 10 organizational determinants which have a positive impact on adoption rates of emerging technologies which are specialization; functional differentiation; professionalism; managerial attitude toward change; managerial tenure; technical knowledge resources; administrative intensity; slack resources; and external and internal communications (Damanpour, 1991). The negative organization determinants are formalization; centralization; and vertical differentiation which reduce the likelihood that an emerging technology will be adopted (Damanpour, 1991).

Bajwa, Lewis, Pervan, and Lai (2005) state organizational size is the most widely investigated determinant as related to innovative behavior and that resource rich organizations are most likely to absorb and afford the cost of innovation and the chances of success, as determined by the organization, are deemed greater. Although organizational size, as a factor related to success of an innovation, is reduced when the cost of adoption of a technology is deemed to be inexpensive (Bajwa, et al.) This is easily seen in higher education as national universities report proportionally higher salaries, budgets, and pressure to innovate than non-research institutions and therefore accordingly, should have a higher chance of success (IT Management and Financing, 2006).

Implementation of emerging technologies is measured within an organizational setting by Larsen (2000) who developed an implementation research tool to integrate streams of data on information systems implementation. The purpose of the implementation research tool was to improve the speed of reliability of the research used to measure implementation of emerging technologies within an organizational setting. The tool relies on an extensive set of operational definitions established in existing quantitative research.

As the technology life cycle comes to an end many products reach saturation within their market share. Brandyberry (2003) explored this issue by examining adoption of computer aided design technologies and five organizational characteristics impacting acceptance. His research evaluated bureaucratic control, internal communication, external communication, organization innovation, and firm size to determine when a specific technology is adopted and when it reaches saturation (Brandyberry). The study concluded that bureaucratic control, internal communication, and external communication do impact adoption rates of computer aided design technologies but organizational innovation and firm size are not likely determinants (Brandyberry).

IT Emerging Technology Adoption and Use - Business Models and Theories

Acceptance of emerging technologies by an organization offers practical aspects and reasons for adoption whereas models and theories provide business a means to understand how and why emerging technologies are useful. In many cases however, business managers and executive decisions makers cannot wait to adopt until an organization is ready to accept a new IT emerging technology. They typically must make decisions based on whatever information is available at any given time (Santovec, 2001).

Rate, causes, and reasons for adoption or rejection of IT emerging technologies by business has been studied by several researchers that developed behavioral models and innovation theories to quantitatively measure adoption rates. The theory of reasoned action, absorptive capacity of IT, technology acceptance model, decomposed theory of planned behavior, theory of diffusion of innovations, and Chief Information Officer-led innovation model are presented below as examples of theories and models used to understand factors related to business adoption of IT emerging technologies.

The theory of reasoned action (Ajzen & Fishbein, 1980; Xu & Quaddus, 2007) has been rigorously tested and is considered successful in predicting and explaining behavior across a wide variety of domains. It is designed to assess human behavior in virtually any environment and explains how decisions are made to adopt, use, perform, or engage (or not) in a specific behavior such as adoption of IT emerging technologies. The theory states a person's decision to adopt or not to adopt is the immediate determinant which may be influenced by social behavior as well as a person's beliefs, or personal decisions, about the behavior as an antecedent to adopt or use a system (Ajzen & Fishbein).

Ajzen and Fishbein (1980) state humans are rational and make systemic use of the information available to them to make decisions. Actions are reasons based on available information and are not controlled by unconscious motives, overpowering desires, or capricious thoughts (Ajzen & Fishbein, 1980). This theory contrasts with Russell (2008) who identified five escalators fueling an IT race among higher education institutions which lead to subjective decision making within IT organizations rather than objective or rational decisions.

The absorptive capacity of IT (Boynton, Zmud, & Jacobs,1994; Ray, Muhanna, & Barney, 2007), another theory impacting IT emerging technology and adoption, is an important consideration for large organizations as it may impact the ability of IT leaders to distribute IT innovation through-out the organization and creatively apply it to critical tasks. IT absorptive capacity is dependent on both IT knowledge and IT processes that develop from an interrelationship between IT and line managers (Boynton, Zmud, & Jacobs).

IT knowledge is not an entity contained within a single department but a mosaic of interactions, exchanges, and activities between the organization's IT office and value chain primary activity departments (Porter, 2008) that depend on IT for operational and strategic success. IT processes that evolve from IT knowledge are the routines and procedures line and operational organizational units develop (Boynton, Zmud, & Jacobs, 1994). The absorptive capacity and interaction between these departments determines the effectiveness of IT emerging technologies within the firm.

Business adoption of an emerging technology is also examined within the technology acceptance model (Davis, 1986; Xu & Quaddus, 2007). The technology acceptance model has been reliably tested in multiple studies to predict computer usage behavior and is now the standard for modeling computer acceptance and usage (Xu & Quaddus). Xu and Quaddus state that computer usage is determined by two key beliefs, perceived usefulness and perceived ease of use. Perceived usefulness, an extrinsic characteristic of IT, measures how IT helps users achieve task related objectives. Ease of use, learning, flexibility, and the clarity of the interface between a user and a computer is an intrinsic characteristic of IT which is measured by the perceived ease of use determinant (Xu & Quaddus). The model states that perceived ease of use has a direct influence on perceived usefulness and thereby the user's decision to adopt the technology.

Zhang and Gutierrez (2007) studied the decomposed theory of planned behavior as related to adoption of IT emerging technologies in the social services sector. The decomposed theory of planned behavior uses empirical findings to break down decisions to adopt or not into multidimensional beliefs. The relationship between the beliefs and the antecedents to use IT is then examined. The empirical measurements are examined and are then capable of determining decisions to adopt across many studies and organizational environments (Zhang & Gutierrez). This theory can also predict management's influence over acceptance and adoption.

The theory of diffusion of innovations states that diffusion is a process in which innovation is communicated within a social system over time and may be the most widely accepted theoretical model in specifying critical characteristics for innovation research (Rogers, 2003; Bajwa, Lewis, Pervan, & Lai, 2005; Xu & Quaddus, 2007; Al-Qirim, 2007). Decisions made as to adopt or reject an innovation are impacted by perceptions about the innovation. Even when a decision is made to adopt an innovation the maximum benefits may not be gained until end users institutionalize the innovation into their daily work habits through continued and sustained use (Xu & Quaddus). This theory is easily understood when an IT emerging technology is implemented without end user acceptance and buy-in and becomes a white elephant that is viewed from a distance or even thought to be a failure.

Rogers (2003) states one of the most important measures of how diffused innovation is within a group is the degree of homophily. The degree in which individuals interact and have certain common attributes is known as homophily while the degree in which the attributes are not common is known as heterophily. Homophily individuals belong to the same groups, share interests, and may live and work near each other (Rogers). This relationship is typically more rewarding and generally produces more effective results (Rogers).

Headshift (2007) moves beyond the theory of diffusion of innovations stating that IT emerging technologies require more than just use but a sense of socializing and connecting and that the second wave of adopters drive sustained usage beyond just the selected initial groups of early adopters. Web 2.0 tools, or those that develop a Web-based architecture of participation, will encourage a base of on-line learners that move beyond passive consumption and offer a genuine transformational effect for participants (O'Reily, 2005). The idea of social Web-based tools is that they become more useful as more people use them (Headshift). This concept is seen with friends and fans lists which grow exponentially causing more than just early adopters to participant.

Petrie (2004) examined information systems management technological discontinuities that significantly advance the technological resources of companies and entire industries via a field study of 13 case studies of business-to-business Web commerce initiatives in various industries. Technological discontinuities also pose a threat to business as they may make existing system obsolete. Results from case studies showed information systems managers have problems both assessing a technology's impact on organizational competencies which resulted in disappointing project outcomes (Petrie).

Collaborative innovation is at the center of the Chief Information Officer (CIO)-led innovation model presented by Newbold and Azua (2007). The goal of the CIO-led innovation model is to accelerate adoption of internal innovations, quantify the business value of the innovations, and provide a proving ground for other participates to review and provide feedback (Newbold & Azua).

Adoption and Use of IT Emerging Technology in Higher Education

The use of information technology in higher education is expected to solve many challenges by increasing efficiency for administrators; providing better access to research for both faculty and students; and serve more students from larger demographic, social, and geographical bases which will in turn enhance a university's global competitiveness (Eynon, 2008). The use of IT for teaching, learning, and research generally supplements, but usually does not replace, existing teaching methods and practices (Eynon). The total positive effect, however, of adopting and using IT emerging technologies within higher education is still unknown and the influence of technology both in research and non-research based educational environments varies based on a set of complex and interrelated factors. This issue will be examined within this paper by survey and quantitative analysis.

EDUCAUSE Learning Initiative's The Horizon Report (2008, 2010) offers an annual assessment of emerging technologies that will most likely impact teaching, learning, and creative expression in higher education learning focused organization. The 2008 report describes six emerging technologies that are most likely to be used in higher education environments as grassroots video; collaborative Webs; mobile broadband; data mash-ups; collective intelligence; and social operating systems. Although some of these technologies may already be in use, the wave of adoption is still building and the report's purpose is both to inform and make educational institutions aware of the potential use and importance of these new technologies.

Adoption of IT emerging technology in both K-12 and higher education environments, specifically the adoption of computer-based instructional technology, is examined by Rogers (1999) using a five-step hierarchical model (cited in Reiber & Welliver, 1989; Hooper & Reiber, 1995). Infusing new technology in education requires a gestation period that involves familiarization via workshops; utilization that tries out the technology; integration by delivering and developing the technology; reorientation on the purpose and function of technology in the classroom; and evolution which results in the ability to grow and change in order to facilitate learning (Rogers).

Roger's (1999) study also presents multiple reasons for failure to adopt technology such as socio-cultural factors related to economics and location; personal variables of the instructor such as age, gender, and attitude; and internal and external factors such as availability of equipment and the accessibility of technical support during the phases noted above to reduce anxiety of the education professional. Rogers concludes that external barriers impact instructors at the beginning stages of technology adoption, that access and availability are important to professionals as they increase their integration of technology, and lack of technical support has the most impact on teachers with advanced level of technology adoption as they require more in depth support for their broader use as they move beyond the level of training and use provided at inception of the technology (Roger, 1999).

Song (2002) conducted a research study, via the use of a survey of 58 IT Directors, Deans, and student representatives at Canadian universities, to analyze the management of technology in post-secondary institutions. Song focused on three technologies-- online courseware, mobile/wireless computing, and smart classrooms to determine the significance of these technologies and how they are integrated and adopted by higher education. The technologies selected for this Canadian study were determined to be technologies that had widespread knowledge but not widespread use. Song concluded the selected technologies had a

pronounced impact on a traditional classroom as well as the management of technology within higher education.

Adoption of the IT emerging technology known as e-learning, in higher education, is examined by Downs (2007) which states this once rich concept has yet to fulfill its promise of empowering both students and teachers to provide enriched course material and a collaborative work space for class participants. Downs states the idea of moving the management of learning from the institution to learner has yet to be realized as some instructors simply post hand-outs online and offer a simple multiple choice quiz as their means of e-learning. Downs addresses the problem facing e-learning in higher education by stating the concept is not just use of online software where students expect traditional exercises and assignment but rather a mash-up of various application and services in which learners and facilitators participate. The problem faced with effective use of e-learning tools is one that both research and non-research based educational institution must address and is an example of the importance in studying the rate, cause, or reason for adoption of an IT emerging technology at all.

Russell (2008) conducted a study on the behavior of chief information officers (CIOs) within a university system, specially the southeastern region of the United States, with respect to information technology innovations based on six constructs of utility. Russell researched the CIOs behavior as related to adoption of emerging technology before the technology had a proven utility to the institution. The study identified five escalators that fueled an IT race among higher education institutions which led to subjective decision making with IT organizations. The five escalators fueling the IT race identified by Russell within higher education are rapid growth of IT; increasing rate of change of IT; changing technology; rising costs; and highly competitive markets that have a smaller student base to attract (2008). This quantitative study and EDUCAUSE's Horizon Report are part of the few available resources for review as related to the adoption of IT emerging technologies by higher education institutions.

Adoption of IT Emerging Technology in Non-Research Based Higher Education Institutions

EDUCAUSE identities 250 non-research based institutions with Carnegie Foundation classification (2007) Master I (MA I) and Masters II (MA II) as members that offer graduate degrees. All maintain, operate, and provide some level of information technology services, either with in-house or outsourced staff, in support of their major constituent groups-- students, faculty, and staff. (EDUCAUSE, 2009).

Padron (2008) states that non-research based higher education institutions cannot replace their core technology continuously as they have already spent considerable resources to obtain them. This premise offers support as to why a study of the adoption of IT emerging technologies by research and non-research based higher education institutions would allow practitioners and academic scholars to understand the factors related to adoption.

The population for this research will be research (DR or national universities) and non-research (MA I and MA II) higher education institutions that are members of EDUCAUSE. A survey instrument will be used to record participants' responses and conduct a quantitative analysis of the responses comparing research and non-research based education institutions.

HYPOTHESES

Ho1: Factors of cost of IT adoption, return on investment, total cost of ownership, staff training levels, competition, or strategic goals will not cause a research and non-research based higher education institution to adopt IT emerging technologies.

Ho2: External issues such as a research and non-research based higher education institutions comparable or competitor's use of IT emerging technologies will not impact the rate or decision to adopt.

Ho3: Internal issues such as a research and non-research based higher education institution's strategic academic goals, use of existing physical infrastructure, integration with existing legacy equipment, and perceived worker skill sets will not affect the decision to adopt IT emerging technologies.

Ho4: Use of IT emerging technologies will not impact a research and non-research based higher education institution's productivity and an expected increase in productivity is not the primary reason for adoption by institutions.

Ho5: Rapid IT emerging technologies adoption is not a valuable asset for research and non-research based higher education institutions attracting the highest quality students, faculty, and staff, quality of computing services, and maintaining academic standing ahead of the comparable schools and competitors.

METHODOLOGY

Research Design

This study examined the adoption of information technology (IT) emerging technology by higher education institutions with a focus on non-research and research based institutions that are members of EDUCAUSE, a higher education non-profit organization, whose mission is the use of IT in higher education. Publicly available archival information was used to present aggregate data on the selected population from 2002 to 2008 from EDUCAUSE's Core Data Service™ and membership Web site. EDUCAUSE total member population is predominately administrators with 51% in IT professions; 15 % academic officers; 15% faculty; 9% librarians; 6% business officers; and 6% higher education institution presidents (EDUCAUSE Roles, 2009). Only members of EDUCAUSE at national or doctorate research (DR) and Masters of Arts I (MA I) or Masters of Arts II (MA II) universities that offer graduate degrees will be selected as participants in this study.

A thirty questions quantitative survey instrument including demographic questions, was developed to determine the reason, rate, or cause for research and non-research based higher education institutions adopt IT emerging technologies. This study used a non-random convenient sample of the population of higher education institution that are members of EDUCAUSE and did not consider institutions that are not members of this organization. Permission was obtained from EDUCAUSE to send a survey link to EDUCAUSE members via on line EDUCAUSE Constituent Groups per conditions established by EDUCAUSE to survey their membership.

The current EDUCAUSE membership population lists over 400 MA I/MAII and DR/national institutions. A minimum sample size of 100 institutions is required to obtain the highest case-per-variable ratio (Hair, Black, Babin, & Anderson, 2010). A request to complete the survey and survey link was sent to EDUCAUSE Constituent Groups related to business

schools (BUSINESS); strategic planning (ITSTRATPLAN); communication (ITCOMM); chief information officers (CIO); change leadership (LEADERSHIP); public universities (STATESYSTEMS); small colleges (SMALLCOL); and emerging technologies and networking (NETMAN). Sample bias may be present in the study as non-members were not be surveyed.

Out of thirty survey questions, twenty-two measured five factors on a Likert scale 1-5 with 1 = strongly disagree through 5 = strongly agree. The five factors represent (1) reasons for adoption; (2) external issues impacting rate or adoption; (3) internal issues impacting rate or adoption; (4) productivity impacting rate or adoption; (5) competing and comparable schools. The demographic questions included: are you a member of EDUCAUSE, are you a decision maker, Carnegie Mellon classification, job title, and length of service. A pilot study of 15 research and non-research institution EDUCAUSE members was conducted to assess for content validity to ensure that the questions measured the importance of each of the factors related to IT, emerging technologies, and the rate, cause, and reason for adoption by research and non-research based higher education institutions. Once the pilot survey was checked for content validity, the survey was made available to all EDUCAUSE listserv participants from December 12, 2009 to January 9, 2010. Out of some 400 institution members of EDUCAUSE, a total of 115 institution responses were collected.

DATA ANALYSIS AND RESULTS

Data Reliability Test

A reliability test was conducted to check for internal bias of the survey responses. The Cronbach Alpha was observed to be 0.783 (number of items 22) indicating an acceptable level of reliability (Hair, et al. 2010).

Data Statistical Test

The Chi Square analysis was conducted to observe the differences is the proportion of responses between the three Carnegie Mellon categories. The multivariate analysis of variance (MANOVA) was conducted to test the equality of vectors of mean scores on multiple dependent variables simultaneously across the three Carnegie Mellon categories stated in each hypothesis as major reasons for the higher education institution adopting IT emerging technologies. The statistical test of significance alpha (Type I error) was set at .05.

Demographics

The demographics of survey participants as related to Carnegie Mellon categories, out of 115 respondents 40 (34.8%) were MAI and MAII; 30 (26.1%) were DR or national university; and 45 (39.1%) were BA, community college, or none of the above. Overall, out of 115 respondents 94 (81.7%) indicated that they were decision makers. The majority (83.5%) of the decision makers was staff/administrators and 12.2% were combined faculty/administrators. For respondents' length of service, the distribution was 9.7% for service <=12 months, 22.1% for 12<=36 months, 11.5% for 36<=60 months, 29.2% for 60<=120 months, and 27.4% for 120 plus months.

Hypothesis One Testing

Factors of cost of IT adoption, return on investment, total cost of ownership, staff training levels, competition, or strategic goals will not cause a research and non-research based higher education institution to adopt IT emerging technologies.

The Chi Square analysis was conducted to observe the differences is the proportion of responses between the three Carnegie Mellon categories. The multivariate analysis of variance (MANOVA) was conducted to test the equality of vectors of mean scores on multiple dependent variables simultaneously across the three Carnegie Mellon categories of cost, return on investment, total cost of ownership, staff training levels, competition, or strategic goals as major reasons for the higher education institution adopting IT emerging technologies. The following results are out of 115 responses.

Fifty-eight percent of respondents agree to strongly agree that the cost, defined as the total value to the organization is a major reason their higher education institution adopts IT emerging technologies. This observation is similar among all three Carnegie Mellon categories: MA I or MA II; DR or National University; and BA or Community College or none of the above (Chi-Square = 8.14, df = 6, p = 0.228).

Forty-three percent of respondents agree to strongly agree that the return on investment, defined as the time it takes to recover the cost spent on the product or service over time is a major reason their higher education institution adopts IT emerging technologies. This observation is similar among all three Carnegie Mellon categories: MA I or MA II; DR or National University; and BA or Community College or none of the above (Chi-Square = 7.05, df = 8, p = 0.531).

Twenty percent of respondents agree to strongly agree that to ensure staff training levels, defined as a goal to retain or recruit high valued employees is a major reason their higher education institution adopts IT emerging technologies. This observation of agree to strongly agree is similar among all three Carnegie Mellon categories: MA I or MA II; DR or National University; and BA or Community College or none of the above (Chi-Square = 11.97, df = 8, p = 0.153).

Fifty-three percent of respondents agree to strongly agree that to stay ahead of the competition is a major reason their higher education institution adopts IT emerging technologies. This observation is similar among all three Carnegie Mellon categories: MA I or MA II; DR or National University; and BA or Community College or none of the above (Chi-Square = 9.88, df = 8, p = 0.273).

Ninety-one percent of respondents agree to strongly agree that to meet organizational strategic goals is a major reason their higher education institution adopts IT emerging technologies. This observation is similar among all three Carnegie Mellon categories: MA I or MA II; DR or National University; and BA or Community College or none of the above (Chi-Square = 7.02, df = 8, p = 0.319).

In addition to the Chi-Square analysis, a multivariate analysis of variance (MANOVA) was conducted to test the equality of vectors of mean scores on six dependent variables simultaneously across the three Carnegie Mellon categories (Table 1) of cost, return on investment, total cost of ownership, staff training levels, competition, or strategic goals as major reasons for the higher education institution adopting IT emerging technologies. The results of MANOVA show Hotelling's Trace in Table 2 to be .092 indicating not significant differences among the three Carnegie Mellon categories: MA I or MA II; DR or National University; and

BA or Community College or none of the above in the level of adopting IT emerging technologies involving the five dependent variables stated in hypothesis one (Hotelling's trace=.092, df1/df2=10/212, p=.462).

Table 1. Combined means scores related to Ho1

Descriptive Statistics
Factors of cost, return on investment, total cost of ownership, staff training levels, competition, or strategic goals

Survey Questions	Carnegie Mellon Category	Mean	Std. Deviation	N
Q1. Cost, defined as the total value to your organization, is a major reason your higher education institution adopts IT emerging technologies.	MA I or MA II	3.59	.938	39
	DR or National University	3.57	.971	30
	BA or Community College or None of the Above	3.40	1.095	45
	Total	3.51	1.007	114
Q2. Return on investment, defined as the time it takes to recover the cost spent on the product or service over time, is a major reason your higher education institution adopts IT emerging technologies.	MA I or MA II	3.10	1.046	39
	DR or National University	3.17	.950	30
	BA or Community College or None of the Above	3.07	1.031	45
	Total	3.11	1.008	114
Q3. To ensure staff training levels, defined as a goal to retain or recruit high valued employees, is a major reason your higher education institution adopts IT emerging technologies.	MA I or MA II	2.79	.894	39
	DR or National University	2.73	1.048	30
	BA or Community College or None of the Above	2.47	.894	45
	Total	2.65	.941	114
Q4. To stay ahead of the competition is a major reason your higher education institution adopts IT emerging technologies.	MA I or MA II	3.62	.935	39
	DR or National University	3.50	1.167	30
	BA or Community College or None of the Above	3.24	1.111	45
	Total	3.44	1.073	114
Q5. To meet organizational strategic goals is a major reason your higher education institution adopts IT emerging technologies.	MA I or MA II	4.36	.628	39
	DR or National University	4.10	.923	30
	BA or Community College or None of the Above	4.40	.654	45
	Total	4.31	.730	114

Table 2. MANOVA testing Ho1

Multivariate Tests The equality of vectors of mean scores on six dependent variables simultaneously across the three Carnegie Mellon categories						
Carnegie Mellon Category		Value	F	Hypothesis df	Error df	Significance
MA I or MA II, DR or National University, BA or Community College or None	Pillai's Trace	.087	.985	10	216	.458
	Wilks' Lambda	.914	.982	10	214	.460
	Hotelling's Trace	.092	.980	10	212	.462
	Roy's Largest Root	.072	1.545	5	108	.182

Hypothesis Two Testing

External issues such as a research and non-research based higher education institutions comparable or competitor's use of IT emerging technologies will not impact the rate or decision to adopt.

The Chi Square analysis was conducted to observe the differences is the proportion of responses between the three Carnegie Mellon categories. The multivariate analysis of variance (MANOVA) was conducted to test the equality of vectors of mean scores on multiple dependent variables simultaneously across the three Carnegie Mellon categories of the use of IT emerging technologies by a comparable school or by a competitor's school that increases the rate and the impact on the institution's decision to adopt IT emerging technologies for high quality students, faculty, and/or staff. The following results are out of 115 responses.

Sixty-four percent of respondents agree to strongly agree that the use of IT emerging technologies by a comparable school, i.e. schools that are in their Carnegie Mellon classification, increases the rate at which IT emerging technologies are adopted by their institution. This observation is similar among all three Carnegie Mellon categories: MA I or MA II; DR or National University; and BA or Community College or none of the above (Chi-Square = 3.45, df = 8, p = 0.903).

Sixty-four percent of respondents agree to strongly agree that the use of IT emerging technologies by a competitor's school, i.e. schools that their institution competes against for high quality students, faculty, and/or staff, increases the rate at which they decide to adopt this type of technology. This observation is similar among all three Carnegie Mellon categories: MA I or MA II; DR or National University; and BA or Community College or none of the above (Chi-Square = 4.06, df = 8, p = 0.852).

Sixty-four percent of respondents agree to strongly agree that the use of IT emerging technologies by a comparable school, i.e. schools that are in their Carnegie Mellon classification, impacts their decision to adopt this type of technology. This observation of agree to strongly agree is similar among all three Carnegie Mellon categories: MA I or MA II; DR or National University; and BA or Community College or none of the above (Chi-Square = 5.44, df = 8, p = 0.709).

Sixty-seven percent of respondents agree to strongly agree that the use of IT emerging technologies by a competitor's school, i.e. schools that their institution competes against for high

quality students, faculty, and/or staff, impacts their decision to adopt this type of technology. This observation is similar among all three Carnegie Mellon categories: MA I or MA II; DR or National University; and BA or Community College or none of the above (Chi-Square = 3.77, df = 8, p = 0.877).

Table 3. Combined means scores related to Ho2

Descriptive Statistics
External factors of the use or decision to adopt IT emerging technology by a comparable school or by a competitor school

Survey Questions	Carnegie Mellon Category	Mean	Std. Deviation	N
Q6. Use of IT emerging technologies by a comparable school, i.e. schools that are in your Carnegie Mellon classification, increases the rate at which IT emerging technologies are adopted by your institution.	MA I or MA II	3.74	.850	39
	DR or National University	3.57	1.104	30
	BA or Community College or None of the Above	3.55	1.066	44
	Total	3.62	1.003	113
Q7. Use of IT emerging technologies by a competitor's school, i.e. schools that your institution competes against for high quality students, faculty, and/or staff, increases the rate at which you decide to adopt this type of technology.	MA I or MA II	3.77	.902	39
	DR or National University	3.57	.971	30
	BA or Community College or None of the Above	3.57	1.043	44
	Total	3.64	.973	113
Q8. Use of IT emerging technologies by a comparable school, i.e. schools that are in your Carnegie Mellon classification, impacts your decision to adopt this type of technology.	MA I or MA II	3.69	.800	39
	DR or National University	3.40	1.003	30
	BA or Community College or None of the Above	3.64	.917	44
	Total	3.59	.903	113
Q9. Use of IT emerging technologies by a competitor's school, i.e. schools that your institution competes against for high quality students, faculty, and/or staff, impacts your decision to adopt this type of technology.	MA I or MA II	3.69	.800	39
	DR or National University	3.63	.964	30
	BA or Community College or None of the Above	3.66	.987	44
	Total	3.66	.912	113

In addition to the Chi-Square analysis, a multivariate analysis of variance (MANOVA) was conducted to test the equality of vectors of mean scores on four dependent variables simultaneously across the three Carnegie Mellon categories (Table 3) of the use of IT emerging technologies by a comparable school or by a competitor's school that increases the rate and the impact on the institution's decision to adopt IT emerging technologies for high quality students, faculty, and/or staff. The results of MANOVA show Hotelling's Trace in Table 4 to be .056 indicating not significant differences among the three Carnegie Mellon categories: MA I or MA II; DR or National University; and BA or Community College or none of the above that increases the rate and the impact on the institution's decision to adopt IT emerging technologies involving the four dependent variables stated in hypothesis two (Hotelling's trace=.056, df1/df2=8/212 p=.649).

Table 4. MANOVA testing Ho2

Multivariate Tests

The equality of vectors of mean scores on four dependent variables simultaneously across the three Carnegie Mellon categories

Carnegie Mellon Category		Value	F	Hypothesis df	Error df	Significance
MA I or MA II, DR or National University, BA or Community College or None	Pillai's Trace	.055	.761	8	216	.637
	Wilks' Lambda	.946	.755	8	214	.643
	Hotelling's Trace	.056	.748	8	212	.649
	Roy's Largest Root	.033	.901	4	108	.466

Hypothesis Three Testing

Internal issues such as a research and non-research based higher education institution's strategic academic goals, use of existing physical infrastructure, integration with existing legacy equipment, and perceived worker skill sets will not affect the decision to adopt IT emerging technologies.

The Chi Square analysis was conducted to observe the differences is the proportion of responses between the three Carnegie Mellon categories. The multivariate analysis of variance (MANOVA) was conducted to test the equality of vectors of mean scores on multiple dependent variables simultaneously across the three Carnegie Mellon categories of strategic academic goals, use of existing physical infrastructure, integration with existing legacy equipment, and perceived worker skill sets as major reasons for the higher education institution adopting IT emerging technologies. The following results are out of 115 responses.

Eighty-two percent of respondents agree to strongly agree that their institution uses IT emerging technologies to meet strategic academic goals i.e. long term goals defined by the institution. This observation is similar among all three Carnegie Mellon categories: MA I or MA II; DR or National University; and BA or Community College or none of the above (Chi-Square = 5.33, df = 8, p = 0.722).

Seventy-five percent of respondents agree to strongly agree that the continued use of existing physical infrastructure in place at their institution impacts the decision to adopt

emerging technology at their institution. This observation is similar among all three Carnegie Mellon categories: MA I or MA II; DR or National University; and BA or Community College or none of the above (Chi-Square = 4.03, df = 8, p = 0.854).

Sixty-three percent of respondents agree to strongly agree that the continued integration with existing legacy equipment at their institution impacts the decision to adopt emerging technology at their institution. This observation of agree to strongly agree is similar among all three Carnegie Mellon categories: MA I or MA II; DR or National University; and BA or Community College or none of the above (Chi-Square = 13.29, df = 8, p = 0.102).

Forty-five percent of respondents agree to strongly agree that the integration of perceived worker skill sets impacts decisions to adopt emerging technology at their institution. This observation is similar among all three Carnegie Mellon categories: MA I or MA II; DR or National University; and BA or Community College or none of the above (Chi-Square = 3.38, df = 8, p = 0.760).

Table 5. Combined means scores related to Ho3

Descriptive Statistics

Internal factors of institution's strategic academic goals, use of existing physical infrastructure, integration with existing legacy equipment, and perceived worker skill sets

Survey Questions	Carnegie Mellon Category	Mean	Std. Deviation	N
Q10. My institution uses IT emerging technologies to meet strategic academic goals i.e. long term goals defined by the institution.	MA I or MA II	4.23	.733	40
	DR or National University	4.07	.944	30
	BA or Community College or None of the Above	4.11	.804	45
	Total	4.14	.815	115
Q11. Continued use of existing physical infrastructure in place at my institution impacts the decision to adopt emerging technology at my institution.	MA I or MA II	3.88	.791	40
	DR or National University	3.83	.834	30
	BA or Community College or None of the Above	3.96	.903	45
	Total	3.90	.842	115
Q12. Continued integration with existing legacy equipment at my institution impacts the decision to adopt emerging technology at my institution.	MA I or MA II	3.70	.823	40
	DR or National University	3.47	.681	30
	BA or Community College or None of the Above	3.53	1.079	45
	Total	3.57	.899	115
Q13. Integration of perceived worker skill sets impacts decisions to adopt emerging technology at my institution.	MA I or MA II	3.10	1.008	40
	DR or National University	3.10	1.062	30
	BA or Community College or None of the Above	3.44	1.035	45
	Total	3.23	1.037	115

In addition to the Chi-Square analysis, a multivariate analysis of variance (MANOVA) was conducted to test the equality of vectors of mean scores on four dependent variables

simultaneously across the three Carnegie Mellon categories (Table 5) of strategic academic goals, use of existing physical infrastructure, integration with existing legacy equipment, and perceived worker skill sets as major reasons for the higher education institution adopting IT emerging technologies. The results of MANOVA show Hotelling's Trace in Table 6 to be .066 indicating not significant differences among the three Carnegie Mellon categories: MA I or MA II; DR or National University; and BA or Community College or none of the above as major reasons in adopting IT emerging technologies involving the four dependent variables stated in hypothesis three (Hotelling's trace=.066, df1/df2=8/212 p=.520).

Table 6. MANOVA testing Ho3

Multivariate Tests

The equality of vectors of mean scores on four dependent variables simultaneously across the three Carnegie Mellon categories

Carnegie Mellon Category		Value	F	Hypothesis df	Error df	Significance
MA I or MA II, DR or National University, BA or Community College or None	Pillai's Trace	.064	.903	8	220	.515
	Wilks' Lambda	.937	.900	8	218	.517
	Hotelling's Trace	.066	.897	8	216	.520
	Roy's Largest Root	.053	1.458	4	110	.220

Hypothesis Four Testing

Use of IT emerging technologies will not impact a research and non-research based higher education institution's productivity and an expected increase in productivity is not the primary reason for adoption by institutions.

The Chi Square analysis was conducted to observe the differences is the proportion of responses between the three Carnegie Mellon categories. The multivariate analysis of variance (MANOVA) was conducted to test the equality of vectors of mean scores on multiple dependent variables simultaneously across the three Carnegie Mellon categories of an increase in productivity, of technologies likely hood of increasing productivity are adopted ahead of those that are not likely, of positively impacting productivity and impacting the decision to adopt, and the institution expectations in adopting IT emerging technologies to increase productivity at their institution as major reasons for the higher education institution adopting IT emerging technologies. The following results are out of 115 responses.

Sixty-six percent of respondents agree to strongly agree that an increase in productivity is a major decision making factor for adoption of IT emerging technologies for their institution. This observation is similar among all three Carnegie Mellon categories: MA I or MA II; DR or National University; and BA or Community College or none of the above (Chi-Square = 4.15, df = 6, p = 0.656).

Sixty-two percent of respondents agree to strongly agree that IT emerging technologies that have the most likely hood of increasing productivity are adopted ahead of those with the least likely hood at their institution. This observation is similar among all three Carnegie Mellon categories: MA I or MA II; DR or National University; and BA or Community College or none

of the above (Chi-Square = 5.53, df = 8, p = 0.699).

Seventy-six percent of respondents agree to strongly agree that they perceive the use of IT emerging technologies positively impacts productivity and impacts their decision to adopt IT emerging technologies. This observation of agree to strongly agree is similar among all three Carnegie Mellon categories: MA I or MA II; DR or National University; and BA or Community College or none of the above (Chi-Square = 6.45, df = 8, p = 0.374).

Sixty-seven percent of respondents agree to strongly agree their institution expects adoption of IT emerging technologies will increase productivity at their institution. This observation is similar among all three Carnegie Mellon categories: MA I or MA II; DR or National University; and BA or Community College or none of the above (Chi-Square = 5.36, df = 6, p = 0.498).

Table 7. Combined means scores related to Ho4

Descriptive Statistics

The use of IT emerging technologies impacts a research and non-research based higher education institution's productivity, and the expected increase in productivity are primary reason for adoption

Survey Questions	Carnegie Mellon Category	Mean	Std. Deviation	N
Q14. An increase in productivity is a major decision making factor for adoption of IT emerging technologies for my institution.	MA I or MA II	3.58	.958	40
	DR or National University	3.80	.925	30
	BA or Community College or None of the Above	3.76	.802	45
	Total	3.70	.888	115
Q15. IT emerging technologies that have the most likely hood of increasing productivity are adopted ahead of those with the least likely hood at my institution.	MA I or MA II	3.60	.871	40
	DR or National University	3.67	.922	30
	BA or Community College or None of the Above	3.76	.857	45
	Total	3.68	.874	115
Q16. I perceive the use of IT emerging technologies positively impacts productivity and impacts my decision to adopt IT emerging technologies.	MA I or MA II	3.98	.768	40
	DR or National University	4.00	.743	30
	BA or Community College or None of the Above	3.87	.726	45
	Total	3.94	.741	115
Q17. My institution expects that adoption of IT emerging technologies will increase productivity at my institution.	MA I or MA II	3.70	.758	40
	DR or National University	3.80	.887	30
	BA or Community College or None of the Above	3.67	.739	45
	Total	3.71	.781	115

In addition to the Chi-Square analysis, a multivariate analysis of variance (MANOVA)

was conducted to test the equality of vectors of mean scores on four dependent variables simultaneously across the three Carnegie Mellon categories (Table 7) of an increase in productivity, of technologies likely hood of increasing productivity adopted ahead of those that are not likely, of positively impacting productivity and impacting the decision to adopt, and the institution expectations in adopting IT emerging technologies to increase productivity at their institution as major reasons for the higher education institution adopting IT emerging technologies. The results of MANOVA show Hotelling's Trace in Table 8 to be .043 indicating not significant differences among the three Carnegie Mellon categories: MA I or MA II; DR or National University; and BA or Community College or none of the above as major reasons in adopting IT emerging technologies involving the four dependent variables stated in hypothesis four (Hotelling's trace=.043, df1/df2=8/212 p=.789).

Table 8. MANOVA testing Ho4

Multivariate Tests

The equality of vectors of mean scores on four dependent variables simultaneously across the three Carnegie Mellon categories

Carnegie Mellon Category		Value	F	Hypothesis df	Error df	Significance
MA I or MA II, DR or National University, BA or Community College or None	Pillai's Trace	.042	.583	8	220	.791
	Wilks' Lambda	.959	.579	8	218	.794
	Hotelling's Trace	.043	.575	8	216	.798
	Roy's Largest Root	.032	.873	4	110	.482

Hypothesis Five Testing

Rapid IT emerging technologies adoption is not a valuable asset for research and non-research based higher education institutions attracting the highest quality students, faculty, and staff, quality of computing services, and maintaining academic standing ahead of the comparable schools and competitors.

The Chi Square analysis was conducted to observe the differences is the proportion of responses between the three Carnegie Mellon categories. The multivariate analysis of variance (MANOVA) was conducted to test the equality of vectors of mean scores on multiple dependent variables simultaneously across the three Carnegie Mellon categories of adopting ahead of competitors, ahead of comparable schools, enhances academic standing of the school, quality of computing services, and attracting quality students, faculty, and staff as major reasons for higher education institution in adopting IT emerging technologies. The following results are out of 115 responses.

Seventeen percent of respondents agree to strongly agree that they believe IT emerging technologies adoption at the fastest rate possible ahead of competitors is best for their institution. This observation is similar among all three Carnegie Mellon categories: MA I or MA II; DR or National University; and BA or Community College or none of the above (Chi-Square = 8.36, df =86, p = 0.399).

Thirty-three percent of respondents agree to strongly agree that they believe IT emerging technologies adoption at the faster rate possible ahead of comparable schools is a positive strategic goal for their institution. This observation is not similar among all three Carnegie Mellon categories: MA I or MA II; DR or National University; and BA or Community College or none of the above (Chi-Square = 16.34, df = 8, p = 0.038), and the weakest (20%) support was found among the MA I or MA II institutions.

Table 9. Combined means scores related to Ho5

Descriptive Statistics
The rate of adoption ahead of competitors; rate of adoption ahead of comparable schools; accelerated adoption; quality of computing services; and valued assets

Survey Questions	Carnegie Mellon Category	Mean	Std. Deviation	N
Q18. I believe that IT emerging technologies adoption at the fastest rate possible ahead of competitors is best for my institution.	MA I or MA II	2.58	.844	40
	DR or National University	2.90	1.094	30
	BA or Community College or None of the Above	2.37	.817	43
	Total	2.58	.923	113
Q19. I believe that IT emerging technologies adoption at the faster rate possible ahead of comparable schools is a positive strategic goal for my institution.	MA I or MA II	3.00	.816	40
	DR or National University	3.13	1.196	30
	BA or Community College or None of the Above	2.86	1.014	43
	Total	2.98	1.000	113
Q20. I believe that accelerated IT emerging technologies adoption enhances the academic standing of my institution.	MA I or MA II	3.68	.829	40
	DR or National University	3.73	.980	30
	BA or Community College or None of the Above	3.23	.922	43
	Total	3.52	.927	113
Q21. I believe that IT emerging technologies adoption improves the quality of computing services offered to the students, faculty, and staff at my institution.	MA I or MA II	3.85	.802	40
	DR or National University	4.20	.997	30
	BA or Community College or None of the Above	3.79	.773	43
	Total	3.92	.857	113
Q22. I believe that rapid IT emerging technologies adoption is a valuable asset for my institution which attracts the highest quality students, faculty, and staff at my institution.	MA I or MA II	3.65	.802	40
	DR or National University	3.70	.988	30
	BA or Community College or None of the Above	3.40	.791	43
	Total	3.57	.854	113

Sixty percent of respondents agree to strongly agree that they believe accelerated IT emerging technologies adoption enhances the academic standing of their institution. This observation of agree to strongly agree is similar among all three Carnegie Mellon categories: MA I or MA II; DR or National University; and BA or Community College or none of the above (Chi-Square = 15.01, df = 8, p = 0.059).

Seventy-six percent of respondents agree to strongly agree that they believe IT emerging technologies adoption improves the quality of computing services offered to the students, faculty, and staff at their institution. This observation is not similar among all three Carnegie Mellon categories: MA I or MA II; DR or National University; and BA or Community College or none of the above (Chi-Square = 15.72, df = 8, p = 0.047), and the strongest support was found among the DR or National University (83%).

Fifty-eight percent of respondents agree to strongly agree that they believe rapid IT emerging technologies adoption is a valuable asset for their institution which attracts the highest quality students, faculty, and staff at their institution. This observation is similar among all three Carnegie Mellon categories: MA I or MA II; DR or National University; and BA or Community College or none of the above (Chi-Square = 9.54, df = 8, p = 0.299).

In addition to the Chi-Square analysis, a multivariate analysis of variance (MANOVA) was conducted to test the equality of vectors of mean scores on five dependent variables simultaneously across the three Carnegie Mellon categories (Table 9) of adopting ahead of competitors, ahead of comparable schools, enhances academic standing of the school, quality of computing services, and attracting quality students, faculty, and staff as major reasons for higher education institution in adopting IT emerging technologies. The results of MANOVA show Hotelling's Trace in Table 10 to be .130 indicating not significant differences among the three Carnegie Mellon categories: MA I or MA II; DR or National University; and BA or Community College or none of the above as major reasons in adopting IT emerging technologies involving the five dependent variables stated in hypothesis five (Hotelling's trace=.130, df1/df2=10/212 p=.196).

Table 10. MANOVA testing Ho5

Multivariate Tests

The equality of vectors of mean scores on five dependent variables simultaneously across the three Carnegie Mellon categories

Carnegie Mellon Category		Value	F	Hypothesis df	Error df	Significance
MA I or MA II, DR or National University, BA or Community College or None	Pillai's Trace	.121	1.376	10	214	.193
	Wilks' Lambda	.882	1.373	10	212	.195
	Hotelling's Trace	.130	1.369	10	210	.196
	Roy's Largest Root	.096	2.056	5	107	.077

CONCLUSIONS AND RECOMMENDATIONS

Adoption of information technology (IT) emerging technology by large organizations is an important area of study, especially its use by higher education institutions, which on average

spend approximately 5% of their total annual budgets on IT (Arroway & Sharma, 2009). The decision to adopt IT emerging technology is one that both business and academia must evaluate from several perspectives. As with business, academic institutions must meet the computing and communications needs of internal customers – staff, faculty, and students; external customers – alumni, donors, grant award organizations, and other stakeholders; as well as meet the needs of new customers – future students. Similarly, academic institutions adopt IT emerging technologies to remain competitive, enhance academic standing, and to increase productivity. CIO Insight's annual survey of 396 senior IT executives consider IT to be a significant ingredient in their business plans with 28% reporting they are early adopters of IT (Alter, 2006).

Factors that cause higher education institutions to adopt IT emerging technologies may be unique. The purpose of this study was to evaluate factors related to the adoption of IT emerging technologies, prior to adoption of the technology, by members of EDUCAUSE. The research was conducted via a Web-based quantitative survey instrument sent to EDUCAUSE listserv members. The resultant analysis compared reasons for adoption of IT emerging technologies between research and non-research based higher education institutions.

Analysis of research institutions was based on the Carnegie Classification of Institutions of Higher Education doctoral research (DR) or national university. Analysis of non-research institutions was based on the Carnegie Classification of Institutions of Higher Education Masters of Arts I (MA I) and Masters of Arts II (MA II). The sample size for the study was 115 EDUCAUSE member institutions. The survey responses consisted of 40 (34.8%) MAI and MAII; 30 (26.1%) DR or national university; and 45 (39.1%) Bachelors of Arts, community college, or none of the above.

Conclusion of Hypothesis One

Most of the respondents indicated that the factors of cost of IT adoption, return on investment and total cost of ownership, competition, or strategic goals are main reasons for a research and non-research based higher education institution to adopt IT emerging technologies. The most important reason for adopting IT emerging technologies is to meet organizational strategic goals. However, staff training levels was not considered to be a major reason for adopting IT emerging technologies. Similar results were observed among all three Carnegie Mellon categories: MA I or MA II; DR or National University; and BA or Community College or none of the above.

Conclusion of Hypothesis Two

Most of the respondents indicated that the external issues such as a research and non-research based higher education institutions comparable or competitor's use of IT emerging technologies impact their rate or decision to adopt. Similar results were observed among all three Carnegie Mellon categories: MA I or MA II; DR or National University; and BA or Community College or none of the above.

Conclusion of Hypothesis Three

Most of the respondents indicated that the internal issues such as a research and non-research based higher education institution's strategic academic goals, use of existing physical

infrastructure, integration with existing legacy equipment, and perceived worker skill sets do affect the decision to adopt IT emerging technologies. Similar results were observed among all three Carnegie Mellon categories: MA I or MA II; DR or National University; and BA or Community College or none of the above.

Conclusion of Hypothesis Four

Most of the respondents indicated that the use of IT emerging technologies do impact a research and non-research based higher education institution's productivity and an expected increase in productivity is the primary reason for adoption by their institutions. Similar results were observed among all three Carnegie Mellon categories: MA I or MA II; DR or National University; and BA or Community College or none of the above.

Conclusion of Hypothesis Five

Most of the respondents indicated that rapid IT emerging technologies adoption is a valuable asset for research and non-research based higher education institutions attracting the highest quality students, faculty, and staff, quality of computing services. However, maintaining academic standing ahead of the comparable schools and competitors was not considered to be a major reason for adoption of IT emerging technologies at the fastest rate. Similar results were observed among all three Carnegie Mellon categories: MA I or MA II; DR or National University; and BA or Community College or none of the above.

OVERALL CONCLUSIONS

Research and non-research based higher education institutions mostly considered in their decision making process for adopting IT emerging technologies the cost of IT adoption, return on investment, total cost of ownership, competition, strategic and academic goals, comparable or competitor's use of IT emerging technologies, use of existing physical infrastructure, integration with existing legacy equipment, perceived worker skill sets, productivity, attracting quality students, faculty and staff, and quality of computing services. Staff training levels and academic standing with comparable schools and competitors were least considered in the decision making process for adopting IT emerging technologies.

Implications of the Study

Practitioners in business and academia would find this study of importance as it provides quantitative results to survey questions related to the rates, reasons, and causes of adoption of IT emerging technology by research and non-research based higher education institutions. The adoption of IT emerging technologies is an important area of study that can assist both academic institutions and business in allocating limited resources and prioritizing research and development budgets based on current use and future needs.

Factors not examined in this study such as perceived benefits and utility of specific types of IT emerging technology or the impact of IT emerging technology on specific groups within an organization should be considered by future researchers to further expand the body of research as related to adoption of IT emerging technology.

Recommendations

The recommendations for this study are for future researchers to build and expand on this research to include a larger sample of respondents to potentially enhance the statistical results. A continued analysis of the rates, reasons, and causes of adoption of IT emerging technology by higher education institutions as related to accelerated adoption of IT emerging technologies to enhance the academic standing of the school may provide both business and academic organizations further conclusive evidence to develop long term strategic plans and processes as related to IT emerging technology consideration, purchase, and use. In addition future researchers may choose to evaluate IT use as related to productivity and percentage of revenue or budget to better relate cost of IT emerging technology and expected benefits.

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