IT INFRASTRUCTURE IN HIGHER EDUCATION INSTITUTIONS IN THE PHILIPPINES

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Abstract

This paper presents a statistical analysis of the level of prioritization and degree of implementation of information technology (IT) infrastructure in higher education institutions (HEIs) in the Philippines. A total of 95 HEIs in the Philippines participated in the study. The respondents are all heads in the Management of Information Technology units. The instrument used in data gathering was a self-constructed survey questionnaire based on the critical questions from EDUCAUSE.

The aggregate mean for IT infrastructure was 4.06, which means it is considered 'high priority' in the Philippines HEIs surveyed. This indicates that the infrastructure component needs to be completed in the next three years in these HEIs. The degree of implementation of IT infrastructure in the HEIs shows an aggregate mean of 3.27, which corresponds to 'moderately implemented', indicating that although this component is in the strategic plan of the HEIs, little or no action has been undertaken in this regard. The level of prioritization of infrastructure has a significant correlation at 0.01 level of confidence with the degree of implementation of these components. In addition, there is a significant difference between the level of prioritization and degree of implementation of IT in the HEIs surveyed in terms of the total number of years of existence of the HEIs, annual IT expenditures of the HEIs, total Internet bandwidth of the HEIs, and extent of participation in decision-making of the respondents.

Keywords: IT Infrastructure, IT management, information technology in education

Introduction

Technology is viewed by Heidegger as a neutral benefactor of humanity. Heidegger pointed out that technology has primarily changed our way of being towards each other and the rest of nature. (Thornton, 2007: 164). The technological phases in the history of being have changed drastically that impact on how people understand and adopt the modernist worldview related to it (Zimmerman, 1990). Information Technology (IT) changed our lives. The rapid growth of technological changes has had a significant impact on the way people think, act, decide, live, work, and play worldwide (Ogunsola and Aboyade, 2005:7-14). Technological changes are represented by the complexity of the infrastructure developed. IT infrastructure is described by the increasing use of computer, information technology necessary for knowledge acquisition, distribution, and knowledge preservation. It refers to the "middle layer that would act as a first-class tool to enable a new level of science". (Ocean ITI Working Group, 2004.) IT infrastructure may describe the institution's collection of people, data, processes, hardware and software, interacting with each other to collect, process, store, and provide a common goal for the organization. Advancements in IT infrastructure include deploying technology that makes easy to collaborate and network in the workplace both internally and externally (Corporation for National Research Initiatives, 2009). It is the foundation of a global knowledge-based economy and society. It contributes "in accelerating growth, eradicating poverty and promoting sustainable development in developing and transition economy countries and in facilitating their beneficial integration into the global economy" (United Nations, 2000). The Philippines' Digital Strategy was developed strategically to make the country a "digitally empowered, innovative, globally competitive, and prosperous society where everyone has reliable, affordable and secure information access in the Philippines".

Reports show that IT in higher education institutions (HEIs) impact the way the educational system operates. Communication Support Systems like chats, forums, e-mails, etc. can be adapted by them. Students can access the on-line libraries and distance learning is also possible. School accountants, office secretaries and other staff improve their performance using any Transactional Processing Systems. Administrative and academic reports are made paperless easily and quickly by using any Office Automation Systems. Most importantly, Management Information Systems help improve the collection, manipulation, interpretation and processing of data. School records are even more accurate, complete, and accessible and secure if IT has been effectively implemented. Decision Support Systems and Executive Information Systems help top management and school administrators in both academic and administrative life in the university in the decision-making process.

IT infrastructure in education describes the equipment, process and tools in the teaching-learning process as media and methodology. Sufficient IT infrastructure is an ideal condition for the adaptation of e-learning (Lee, 2011:51-77). The Silliman Online University Learning (SOUL) is among the successful eLearning infrastructure (Marcial, 2010). However, investment of IT infrastructure challenges the educational institutions both administrative and academic processes. Yap (2005:10-11) reported that education sector garnered 20% of Asia's top IT-using institution. In 2006, Frost and Sullivan s reported that fast-changing technology trends re-defined the way educational institutions operate (cited by Tsang, 2007: 14-15). Tan (2011:1) suggests that "HEIs try to capitalize on 21st century tools and technologies to address 21st century issues and challenges".

EDUCAUSE, a nonprofit association whose mission is to advance higher education by promoting the intelligent use of information technology, reported that IT infrastructure ranked 8th in the 2011 top 10 IT-related issues in HEIs (Ingerman, B., Yang, C. and the 2010 EDUCAUSE Current Issues Committee, 2011). In 2010, IT infrastructure ranked 10th (Ingerman, B., Yang, C. and the 2010 EDUCAUSE Current Issues Committee, 2010). It clearly shows that IT infrastructure is an increasing issue in HEIs. The following excerpts are descriptions about IT infrastructure by EDUCAUSE on its survey on 2011 Top-Ten IT Issues (Ingerman, B., Yang, C. and the 2011 EDUCAUSE Current Issues Committee, 2011):

> *As services spread out to the cloud, and as institutions rely more on their internal networks for access to on-site and off-site services, campus IT connectivity and integration—that is, the infrastructure/cyberinfrastructure—continues to be of strategic importance. The connection to the Internet is used not just for access to external services unaffiliated with the institution but also for critical cloud-based campus services such as e-mail, learning management systems, ERP, and other administrative functions. Even though many institutions are seeing cost savings by moving services to the cloud, the one thing that cannot be moved is the connectivity itself. These connections are in constant need of upgrades, and many institutions are dealing with cabling plants that are reaching the end of their functional lifetimes, such as Category 5 twisted-pair cabling and multimode fiber optics or any cabling more than fifteen years old. Furthermore, the increasing consumerization of technology means that students are bringing multiple devices to campus (e.g., laptop, tablet, smartphone, gaming console) and are expecting all of those devices to be connected to a ubiquitous, fast, and reliable network, both wired and wireless. As some institutions are beginning to pull out of their recent financial troubles or are learning to budget within their new landscape of austerity, investment in critical infrastructure and cyberinfrastructure will be seen as either a welcome new expense or an essential ongoing one, and stalled projects will begin to move forward again out of the necessity to face the above challenges.*

According to the UK Trade & Investment, the Philippines has a well-developed network of communications infrastructure that connects the three largest island groups of Luzon, Visayas and Mindanao. Its specialized IT zones provide computer security and building monitoring systems. The Commission on Higher Education (CHED), an attached agency to the Office of the President of the Philippines for administrative purposes, formulates and recommends development plans, policies, priorities, and programs (including IT) on higher education.

This paper investigates the level of prioritization and degree of implementation of IT infrastructure in HEIs in the Philippines. Prioritization refers to the level of importance or urgency of IT infrastructure in the HEIs while implementation refers to the degree of realization or execution of IT infrastructure in HEIs in the Philippines. This paper also demonstrates the relationship between the level of prioritization and degree of implementation of IT infrastructure in HEIs in the Philippines. It further demonstrates the significant differences between the level of prioritization and degree of implementation of IT infrastructure in HEIs in the Philippines in terms of the HEIs' total number of years of existence, HEIs' annual IT expenditures, HEIs' total Internet bandwidth, respondents' level of proficiency of technical skills, respondents' rating of human skills, respondents' rating of conceptual skills, and extent of participation in decision-making of the respondents.

Methodology

This paper is a supplemental document and form part of the study on the landscape of IT in HEIs in the Philippines (Marcial, 2011). The study was descriptive-correlative and utilized a survey method. The respondents of the study were IT managers or the head in the management of IT and IT-related services in the HEIs. During the administration of the survey, a sample size of the respondents was determined from the list of HEIs published in the official website of the Philippine's Commission on Higher Education as of December 2010. In this case, the total HEIs based on the list is 1,496, 112 of which are public colleges and universities and 1,384 are private colleges and universities. The sample size was rounded off to 316 HEIs. Computation of the sample size is as follows: $n = \frac{N}{1 + Ne^2}$, where *n* is the sample size, *N* is the total population and *e* is the margin of error. A 5% margin of error is used in the study. A total of 316 (n) HEIs in the Philippines was included in the survey. A stratified sampling procedure (% = $\frac{n}{N}$) was conducted in order to get the regional distribution of the respondents. Respondents per region were identified randomly using a computerized random number generator by Weaver and Raulin (2007).

Table 1.

Respondents' Regional Distribution

Regions in Philippines	Public	Private	HEIs-Respondents
1 (Ilocos Region)	1	3	4
2 (Cagayan Valley)	0	5	5
3 (Central Luzon)	1	4	5
4 (Calabarzon)	1	3	4
5 (Bicol Region)	3	3	6
6 (Western Visayas)	1	11	12
7 (Central Visayas)	1	17	18
8 (Eastern Visayas)	2	4	6
9 (Zamboanga Peninsula)	0	5	5
10 (Northern Mindanao)	1	1	2
11 (Davao Region)	2	6	8
12 (Soccsksargen)	0	4	4
13 (National Capital Region)	0	9	9
14 (Cordillera Administrative Region)	0	2	2
15 (Autonomous Region of Muslim Mindanao)	0	1	1
16 (Caraga)	0	2	2
17 (MIMAROPA)	2	0	2
TOTAL	15	80	95

The survey administration process was limited to four distribution methods. The first administration was done by sending the questionnaire through the email addresses of each respondent as published by CHED in its website on February 4, 2011. The second administration was done personally to some identified respondents who attended the 2011 National Convention of the Philippine Society of IT Educators held February 16-19, 2011 in Antipolo City, Manila. The third administration was done on March 4, 2011 by sending a printed copy of questionnaires addressed to the School Heads. The fourth administration was done by sending the electronic questionnaire through email directly to some of the identified respondents (IT Managers or related position). Follow–up processes were also limited through making telephone call and sending text messages to the respondents who did not respond based on the indicated deadline. Telephone numbers were based on the list published in the CHED website. A weekly follow-up through email was also done to have a greater participation from the HEIs. Only those HEIs who sent back the filled-up questionnaire from February 4, 2011 to April 30, 2011 were included in this study. A total of 95 HEIs participated during the administration of the survey. There are two sets of questionnaire that were disqualified because the person answering the survey questionnaire is not an IT manager. There are 14 HEIs which formally signified not to participate in the survey and another two sets of questionnaires were returned via the post office due to addresses which are not found. The remaining respondents did not respond after several follow-ups were made. Table 1 presents the regional distribution of the HEIs qualified in the survey. Of the 95 HEIs, 15 are public colleges and universities and 80 are private colleges and universities (Table 1).

Moreover, the instrument used in data gathering to accomplish the specific objectives of the study was a survey questionnaire. A test-retest of 21 qualified testers was conducted to measure the reliability of the instrument. These testers were composed of different IT stakeholders such as academic heads, IT consultants, IT practitioners who have supervisory or administrative experience and other IT enthusiasts who are active in promoting quality education. The instrument is composed of close-ended questions that are based on the critical questions that EDUCAUSE has pointed out in the 2010 top IT issues in higher education, particularly on the critical questions concerning infrastructure. Respondents were asked to evaluate the level of prioritization according to the five alternative choices: 1-Not a priority, 2-Low priority, 3-Medium priority, 4-High priority, and 5-Essential. Likewise, respondents were asked to evaluate the degree of implementation of each IT component according to the five alternative choices: 1-Not Implemented, 2-Fairly Implemented, 3-Moderately Implemented, 4-Highly Implemented, and 5-Very Highly Implemented.

Results and Discussion

The Prioritization and Implementation of IT Infrastructure

The level of prioritization of IT infrastructure, presented in Table 2, has an aggregate mean of 4.06 which is described as *high priority*. It indicates that the infrastructure component is prioritized and needs to be done in the next 3 years in the HEIs. There are specific items that are rated *essential* such as on items 1, 5, 6, 7 and 15. The interpretation is that these items have the highest level of prioritization and are already in place in the respondent's school. Further, the

study also reveals that the private HEI's level of implementation of IT infrastructure is better ($\bar{x}$ = 4.14) compared to the public HEIs in the Philippines ($\bar{x}$ = 3.73). When the respondents are grouped according to gender, the study reveals that the male IT managers have better weighted mean ($\bar{x}$ = 4.10) than the female ($\bar{x}$ = 4.04) of their level of prioritization of IT infrastructure. When grouped according to civil status, the study reveals that the married IT managers have better level of implementation of IT infrastructure ($\bar{x}$ = 4.16), while the single IT managers is 3.86. When the respondents are classified according to highest educational attainment, those who have bachelor degree ($\bar{x}$ = 4.20) have the highest level of prioritization of IT infrastructure compared to those with doctorate's degree ($\bar{x}$ = 4.17) and master's degree ($\bar{x}$ = 4.03). Lastly, IT managers who are working as fulltime have better weighted mean of level of prioritization of IT infrastructure ($\bar{x}$ = 4.24) than the part-time IT managers with only $\bar{x}$ = 3.95.

The degree of implementation of IT infrastructure in the HEIs (Table 3) shows an aggregate mean of 3.27 described as *moderately implemented*, indicating that this component is in the strategic plan of the HEIs, however, there is no action done yet. The result supports the claim in MIS Asia that the educational institutions in the Philippines have embraced wireless technology. The aggregate mean of the degree of implementation of the IT infrastructure presented in the study shows that all these components were already implemented but no action has been established to achieve these components. However, according to the result on the level of prioritization, the aggregate mean of IT infrastructure is highly prioritized and need to be done by the HEIs in the next 3 years.

Further, the study also reveals that the private HEIs' degree of implementation of IT infrastructure is better ($\bar{x}$ = 3.34) compared to the public HEIs in the Philippines ($\bar{x}$ = 2.86). Surprisingly, the study reveals that the female IT managers have better weighted mean (3.29) in the degree of implementation of IT infrastructure compared to the male IT managers with a weighted mean of 3.24 in their degree of implementation of IT infrastructure. When grouped according to civil status, the study reveals that the married IT managers have better degree of implementation of IT infrastructure ($\bar{x}$ =3.30), while the single IT managers is ($\bar{x}$ = 3.08). When the respondents were classified according to highest educational attainment, those who have master's degree have the highest weighted mean ($\bar{x}$ = 3.33) of their degree of implementation of IT infrastructure compared to those with doctorate's degree ($\bar{x}$ = 3.18) and bachelor's degree ($\bar{x}$ = 3.14). Lastly, IT managers who worked fulltime have better weighted mean of the degree of implementation of IT infrastructure ($\bar{x}$ = 3.43) than the part-time IT managers with only $\bar{x}$ = 3.09.

Table 2.

Level of Prioritization and Degree of Implementation of IT Infrastructure in the HEIs

Items on Infrastructure Component	Prioritization		Implementation	
	$\bar{x}$	Description	$\bar{x}$	Description
1) IT infrastructure should be addressed in the institution's strategic plan.	4.39	E	3.61	HI
2) A "green computing" program should be initiated at the institution.	3.85	HP	2.90	MI
3) The technical network staff should be up-to-date on emerging technologies and standards.	4.19	HP	3.43	HI
4) The infrastructure should have a built-in redundancy to provide continuous service.	4.08	HP	3.21	MI
5) Deans, chairs, faculty, and administrators should periodically be consulted about the adequacy of the IT infrastructure.	4.35	E	3.52	HI
6) Students' satisfaction with the IT infrastructure should be measured..	4.20	E	3.48	HI
7) The institution should have a replacement plan for servers, appliances, network devices, and other hardware.	4.14	E	3.33	MI
8) The institution should compare lease and purchase options.	3.97	HP	3.31	MI
9) The institution should have good monitoring and benchmarking practices.	4.02	HP	3.18	MI
10) Network and systems administrators should have the tools and training to automate problem detection and notification.	4.06	HP	3.23	MI
11) The institution should have an information life-cycle management plan to ensure the continued availability and usability of information.	3.96	HP	3.02	MI
12) The institution should evaluate or deploy virtualization techniques for storage, network, or server consolidation.	3.78	HP	3.01	MI
13) The institution should have adequate planning, staff and infrastructure resources, and funding to support research computing.	3.88	HP	3.16	MI
14) The institution should account for the dynamic change and pace of policy, security, and compliance requirements.	3.82	HP	3.13	MI
15) The institution should effectively meet the current demand for both wired and wireless connectivity and mobile applications.	4.25	E	3.48	HI
Aggregate Mean	4.06	HP	3.27	MI

Legend: E-Essential; HP-High Priority; HI-Highly Implemented; MI-Moderately Implemented

Correlation and Difference between the Level of Prioritization and Degree of Implementation of IT

The level of prioritization in all IT infrastructure components is rated *high priority*. The result shows that these components are prioritized and need to be done in the next 3 years. On the other hand, all IT infrastructure components were rated *moderately implemented*. The result shows that these components are already in the strategic plan but there is no action exercised. Shown in Table 3, the level of prioritization on IT infrastructure has significant correlations at 0.01 level of confidence with the degree of implementation to these components.

Table 3.

Test of Correlation between the Level of Prioritization and Degree of implementation

	ρ-value	**p-value (two-tailed test)**	**Remarks**
Level of Prioritization and Degree of implementation of IT Infrastructure	0.949 **	0.000	significant at 0.01 level

Table 4.

Test of Difference between the Level of Prioritization and Degree of Implementation

Variables	F-value	p-value	t-value	p-value	Remarks
No. of years of existence , Prioritization, Implementation	221.3683	4.35E-58	6.856095	1.04E-10	Significant
Annual IT Expenditures, Prioritization, Implementation	13.16172	4.00134E-06	6.122542	8.09E-09	Significant
Total Internet Bandwidth, Prioritization, Implementation	11.61308	1.88802E-05	5.556795	1.88E-07	Significant
Level of Proficiency of Technical Skills, Prioritization, Implementation	21.95239	1.44351E-09	5.427072	1.81E-07	Significant
Rating of Human Skills, Prioritization, Implementation	68.68906	6.86371E-25	6.776571	1.65E-10	Significant
Rating of Conceptual Skills, Prioritization, Implementation	47.76102	1.63659E-18	5.108236	8.16E-07	Significant
Extent of Participation in Decision-making, Prioritization, Implementation	47.76102	1.63659E-18	5.108236	8.16E-07	Significant

Tables 4 shows that there is a significant difference between the level of prioritization and degree of implementation of IT infrastructure in the HEIs in the Philippines in terms of the HEIs' total number of years of existence, total number of curricular offerings, annual IT expenditures, total Internet bandwidth, respondent's level of proficiency of technical skills, rating of human skills, rating of conceptual skills, and extent of participation in decision-making. The mean values of all items in IT infrastructure show that the degree of implementation is less than the level of prioritization. It indicates that there is a disparity or significant difference in the implementation of IT infrastructure against the prioritization of IT infrastructure in the HEIs in the Philippines. This suggests that the HEIs in the Philippines have notable planning; however, implementation plans are needed for improvement. This result may indicate also that IT managers do not fully implement formal strategizing and planning processes that meet established objectives and install disciplines to manage application acquisition and operation (Frenzel, 1999).

Summary, Conclusion and Recommendation

The level of prioritization of IT infrastructure in the HEIs in the Philippines is described as high priority. This signifies that IT infrastructure components in the HEIs are prioritized and need to be done in the next 3 years. The degree of implementation of IT infrastructure has a description of moderately implemented. This implies that IT infrastructure is in the HEIs strategic plan but there is no action that it has been done. Specifically, infrastructure planning, policy, staffing, funding, monitoring, and benchmarking practices are already in the HEIs' strategic plan for implementation. The level of prioritization of IT infrastructure has significant correlations at 0.01 level of confidence with the degree of implementation of IT infrastructure in the HEIs in the Philippines. There is a significant difference between the level of prioritization and degree of implementation of IT in the higher education institutions in the Philippines in terms of the Total number of years of existence of the HEIs, Total number of curricular offerings by the HEIs, Annual IT expenditures of the HEIs, Total Internet bandwidth of the HEIs, Level of proficiency of the respondent's technical skills, Rating of the respondents' human skills, Rating of the respondent's conceptual skills, and Extent of participation in decision-making of the respondents.

The result of this study may be evaluated and compared to the survey conducted to over 500 companies, cited by O'Brien (1999), adapted from Luftman (1997), on performance problems in managing information systems. The survey revealed that 16% of the respondents, highest in rank, showed that IT effort is poorly prioritized. In a separate survey, cited by Chapman (2004), on why CEOs fail, 70% of 10 CEOs who fail do so not because of bad strategy, but because of bad execution in the implementation. This may be a guide for the HEIs to properly set their priorities and effectively implement IT infrastructure to achieve organizational goals. Likewise, the result of this study affirms to the result of a survey conducted on why only one third of UK companies achieve strategic success 80% of IT heads or directors said they had the right strategy and perhaps the right priorities but only 14% thought that they were implementing them well.

The higher education institutions in the Philippines are challenged technologically in terms of the level of prioritization and degree of implementation. Priorities, initiation and

integration of IT in the higher education institutions in the Philippines is a pressing issue that needs to be addressed not only by the school administration but a collaborative effort among faculty, staff, students and others. The government through its effort on the Philippines Digital Strategy should continue to commit in harnessing the potential and power of IT in order to respond to the global trend towards a digital economy and knowledge societies.

Improving IT infrastructure always entails financial consideration; however, IT infrastructure is more than just an investment. It is a commitment to keep by all stakeholders in higher education institutions. HEIs should review its strategic plans to identify the gap between priorities and implementation of IT infrastructure as determined by the management of information technology. HEIs should elevate its infrastructure into collaboration, networking and other emerging trends such as virtualization and cloud computing. School administrators should consider identifying the strength, weaknesses, opportunities and threats of infrastructure to facilitate sufficient and innovative teaching-learning environment. The administration and management in the HEIs should be active in its role to creativity and innovation (Heskett, 2007) and develop a strategic management response to the challenge of global change (Morrison & Wilson, 2006).

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