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Akhtar Lodgher
Prairie View A&M University

Kiranmai Bellam
Prairie View A&M University

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Teaching Innovation to Graduate Students in Computer Information Systems (CIS)

Akhtar Lodgher
Prairie View A&M University, USA
alodgher@pvamu.edu

Kiranmai Bellam
Prairie View A&M University, USA

ABSTRACT

The goal of this paper is to show how graduate students in a computer information systems (CIS) masters program can learn innovation and can complete innovative thesis or projects in information systems. Graduate MS students in the CIS program are taught how to use information systems, but not taught how to *create and innovate* new information systems. To be competitors in the global economy today, "*Innovate or Evaporate"* is the message for organizations in the United States (US). US employees must know how to innovate, but current CIS programs rarely teach innovation to their students.

To foster innovation, this paper proposes an approach which systematically introduces innovation in a step wise fashion in three courses. The approach in the three courses include: *(i)* introducing innovative technologies in the CINS 5073 course, *(ii)* use of innovative technologies by organizations to remain competitive in the CINS 5013 course, and *(iii)* research innovative information systems in the CINS 5003 course. The approach presented in this paper fosters innovation throughout the program and the use of common systems – something that a student is very familiar with its construction and use, and converting them to intelligent systems using innovative thinking.

The benefit of this approach is to create a new breed of workforce consisting of effective thinkers and innovators. It also teaches students that innovation is a never ending process and that innovation will enable them to survive *long-term* in the constantly changing field of information systems. The approach can be used in other CIS programs nationwide to enable them to teach innovation using cost-effective industry standard technologies and systems.

INTRODUCTION

Nationally, the demand for computer information system analysts, specialist, and managers is predicted to increase from 274,000 in 2008 to 402,000 by 2018 (U. S. Department of Labor, 2009). The National Association of Colleges and Employers (NACE) winter 2010 salary survey lists computer information systems as the seventh top-paid bachelor's degree at $54,038 (2010); information systems professional salary offers remain strong as recruiters have too few graduates to fill job demand, and this trend is expected to continue for the next few years. It is the mission

of PVAMU to prepare its students, for the job market and empower them with capabilities that will help them stay in the field of information systems.

To address the national need for US corporations to be innovative, it is necessary that their employees possess the capabilities to think in innovative ways. *Innovate or Evaporate* is the message for organizations if they are to remain competitive in the global economy. This is especially true for information systems in US because European companies have indicated a higher trend in innovation in all measurement parameters (Ross & Kleingeld, 2006). This paper aims at meeting the demands of innovation by introducing it in three MS courses to enable students to think in innovative ways, and then completing a master's thesis or project using innovative ideas.

Innovation takes place when design is converted into value (Ross & Kleingeld, 2006). In information technologies, innovation is becoming more common and getting embedded in everyday systems (Joo, Park, & Paik, 2007; Nakamura, Tanaka, Igaki, Tamada, & Matsumoto, 2006). These technologies provide innovative ways of enhancing and changing everyday systems, making them more intelligent and easy to use (Xuemei & Gang, 2008; Tsai, Wu, Sun, & Yang, 2000). A simple example is the combination of a coffee-pot and a digital clock. By combining the two, one can set the coffee in the pot at night and tell the clock to brew it in the morning, right as one gets ready to get-up in the morning. For the same example today, a coffee pot connected to a Wi-Fi network could be turned on from a cell phone.

In this paper, an approach of teaching innovation is outlined: that by combining currently established technologies such as web services (Aiello, 2006), the upcoming technologies of cloud computing (Yang, Wei, Jia, Cong, & Shan, 2010), the high-speed internet connections in an average home or office (NTIA, 2010; Shimano et al., 2007), and the use of advanced electronics in everyday systems for controlling them, an innovative set of intelligent information systems can be developed that will ease the lifestyle of the consumer for the next few years (Pakanen, 2002; Wei, Qin, Jia, & Yang, 2010).

The master of science (MS) program in CIS at Prairie View A&M University is located within the computer science department, within the Roy G. Perry College of Engineering. The location of the program gives it a unique strength to bring a level of computer-science related technical strength to the program not found in many other program located with other colleges, such as college of business (Florida Institute of Technology, 2010; Missouri State University, 2010). Students are required to complete a MS project or a MS thesis as part of their program in order to graduate. It has always been a challenge for the instructors in the program to guide students for the master's thesis or projects because of a lack of research infrastructure related to information systems. Many of the faculty members are involved in computer science (CS) research projects but they are too CS focused and out-of-scope for the CIS majors. The result has been that students complete projects which are individual, small, and they do not get a broad perspective of the information technologies that are being used in the industry.

This paper outlines an approach which will enable graduate CIS students to complete innovative real-world master's projects. The nature of the projects will enhance the fundamental critical thinking process of the students. This type of research oriented thinking is critical in today's

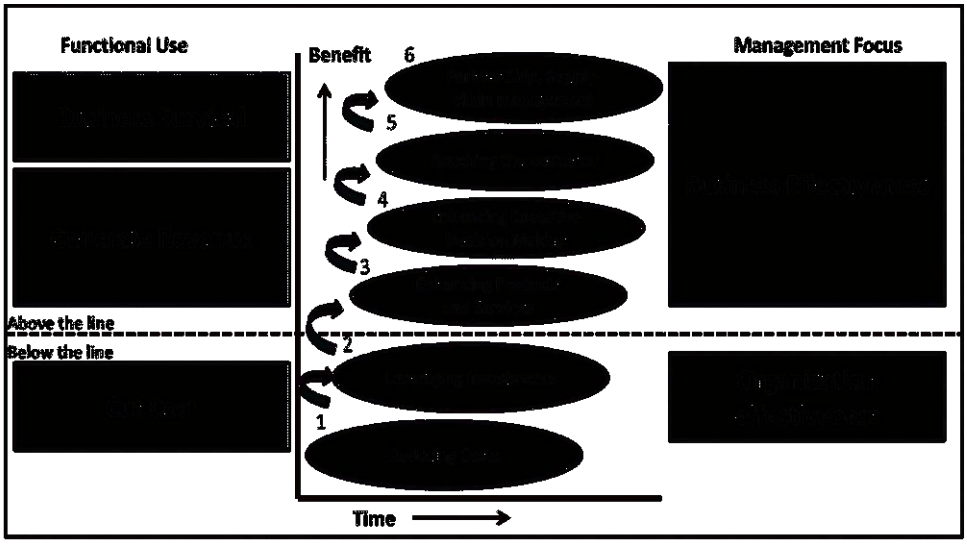
business world, where each day intelligent enhancements are built into existing information systems.

Introducing Innovation in Three Courses

Many CIS masters programs have a course on information technologies and another one on information systems (Florida Institute of Technology, 2010; Missouri State University, 2010). The CIS master's program at PVAMU has the following as core courses, among others: CINS 5073—Information Technologies (taught in fall semester), CINS 5013—Information Resources Management (taught in spring semester) and CINS 5003—Research Methods (taught in fall semester). A typical student entering the program in fall semester would take these courses in a three semester sequence and then in their fourth semester complete their master's project or thesis. Students entering the program in spring semester, take CINS 5013, followed by CINS 5073 in fall. They then take CINS 5003 in following fall semester.

Introduce Innovation in CINS 5073—Information Technologies

Figure 1: Waves of Innovation (adapted from McNurlin, Sprague & Bui, 2009).



The purpose of this course is to cover the spectrum of information technologies being used today from a hardware, software, network, connectivity, and social computing perspective. Current technologies may be emphasized and introduced, but it is necessary to cover some of the fundamental concepts, for example, for networks it is necessary to cover the TCP/IP concept and the network layers before introducing the various networking technologies. A common challenge faced by the instructors of this course is that the volume of material is quite large and an instructor may stay *general*, that is cover many topics but each topic is not covered in detail, or get *specific*, where a few topics are covered in detail and the others are not covered at all. An instructor has to use a combination of these approaches to cover the various topics in the period of one semester. Another approach is to focus more on how an organization is using some of these technologies and less on the technology itself. This becomes more like a *case-based* approach. A drawback of this approach is that the case-based approach becomes more like a

"sales-pitch" because many of the cases found on websites are by the companies involved in the technologies themselves.

Smart organizations however use technologies to innovate and to move up the chain from cutting costs to enhancing products to reaching new customers, to leveraging partnerships as indicated in Figure 1 by the "waves of innovation" by Primozic, Primozic, and Leben, (1991) and illustrated by McNurlin, Sprague, and Bui (2009).

While this theory has been in practice for over two decades, it is not taught effectively in the classroom. In our approach, for some of the technologies that are covered in the class, students are given exercises on how a company uses that technology to innovate and move up the ladder. The combination of technology and company is picked from a matrix consisting of popular company (or their division) names and current technologies being discussed. *For example:* randomly picking Proctor and Gamble (P&G) from a list of companies and randomly picking cloud computing as a technology, the question that the students have to answer is how can P&G or one of its divisions effectively use the cloud computing technology to move up the "waves of innovation" ladder from any one level to the next level? This type of exercise forces the student to not only study the company and the technology, but also forces them to think critically and innovatively about how the combination can be effectively used to save money, make money, get new customers, or to become a leader.

We have developed a list of companies (at least 50, shown in Table 1) whose products and divisions are well known. The list changes every year as new companies are added and other removed. The companies are picked from several industry domains such as hospitals, finance, oil and gas, etc., Example of company names are: Exxon-Mobil, Proctor and Gamble, Apple, etc., A list of technologies is developed (Table 2), categorized by the main technology that is discussed in the class. For example, if the class discussion is on Mobile commerce then some of the technologies are: mobile platforms (Android, Windows Mobile, Apple OS, etc.), mobile payments (e-wallets, e-money), mobile displays, batteries, etc. At the end of the class period where the technology is covered, students randomly pick a token (from a bowl passed around in the class) with a company name and another token (from another bowl) with the technology name on it. Based on that, the student has to answer the question of how that specific company will use the technology to climb up the innovation ladder.

Table 1: List of Companies (in no particular order) Whose Products are Well Known.

Exxon-Mobil	Oracle	Coca-Cola	Whirlpool	Mastercard
Proctor & Gamble	MetLife	FedEx	Toys"R"Us	Barnes & Noble
Lockheed Martin	Microsoft	Amazon	Apple	OfficeMax
Bank of America	Goldman Sachs	DuPont	Google	Texas Children's Hospital
General Motors	Kraft Foods	Continental	Marriott	Hershey
Hewlett Packard	Cisco	Duke Energy	eBay	Sherwin Williams
Hermann Hospital	Walt Disney	Walgreen	Yahoo	Corning
Home Depot	Comcast	AT&T	UPS	State Farm Insurance
Boeing	Hilton	McDonalds	T-Mobile	Chevron
Dell	Schlumberger	Nike	3M	Abbot Laboratories

All graduate classes in CIS are taught once a week in a 170 minute session for 15 weeks (excluding finals week) during a semester. Applying the technique in the classroom, from a class of approximately 35 students, five students are picked randomly at the end of each class period. In the next class, they have to submit a two page report and make a 5 to 7 minute presentation with 3 to 5 minute session for questions. Seven sessions are needed to complete one round of presentations involving all students because a student (and the company and the technology) is selected only once per round. Two such rounds are conducted, so that each student has to make two presentations on using the technology innovatively. The author has taught this class for the past three years and has used this approach a couple of times where the topic and the company are randomly selected by the student. Selection happens by picking a token (with a number from 1 to 50) from a bowl. Some of the example topics picked by students were: use of wireless 802.11n in a Houston hospital system, use of SCRUM agile technology for developing E-Business applications at Philips, the use of JavaFX by Parleys.com, etc. Random picking (versus own choice of selecting the technology) forces the student to be more "innovative" in their thought process and get them out of the comfort zone about their favorite technology. While it is quite possible that a student may not be able to develop an innovative use of the technology for the company, she/he can pick an alternate technology not picked by others. Fifty minutes for presentations in each class is a significant portion of the class time for this technique, but the instructor has experienced that students get a deeper understanding of the company, the technology and its usage. Each presentation leads to a healthy *student led* class discussion and in most cases he had to limit the discussion due to time. The material presented is included for the exam and so students who are not presenting pay close attention to what is being presented.

Table 2: List of Technologies (in no particular order).

VoIP	Security	Middleware	Android	Mobile commerce
Unix	Broadband	Portals	Pad devices	Corporate intranets
SOA	Network monitoring	Document management	eCommerce	EJB
CRM	Agile methods	Windows OS	.Net technologies	XML
ERP	WiFi-802.11	Cellular technologies	Enterprise application integration	Online analytical processing
BPM	HCI	Touch screens	Mac OS	Cloud computing
JavaFX	Biometrics	Smartphones	Business intelligence	LANs/WANs
AI	RFID	Mobile OS	Disaster recovery	Multicore processors
Databases	SCM	Handheld devices	Identity theft	Instant messaging
Linux	Knowledge management	Head mounted displays	Computer viruses	Social networks

Introduce Innovation in CINS 5013–Information Resources Management

The strategy used for this course is the same as that used for CINS 5073; but in this case, it concentrates more on the *innovative use of the information systems for a process* rather than the technologies. The focus is more on the change or improvement of business processes brought

about by the competitive forces as described by Porter (2008). Primozic, Primozic, and Leben's (1991) waves of innovation and Porter's competitive model are discussed as the foundation, and the focus of the course is on the use of information systems to innovate and counter the competitive business forces. Some of the information systems discussed in detail are enterprise resource planning (ERP) systems, customer relation management (CRM), supply chain management (SCM) systems, e-business systems, decision support systems (DSS), Knowledge management systems (KMS), etc.

Table 3: List of Information Systems and Their Sub Modules (in no particular order).

Decision support sys.	Executive info. sys.	Middleware	Customer service sys.	Mobile commerce
Management info. systems	Neural net systems	Portal systems	Pad device sys.	Corporate intranets
Web-services systems	Expert systems	Document management	Ecommerce systems	Enterprise asset sys.
Data mining systems	CRM systems	Intelligent agent sys.	Logistics systems	Inventory sys.
ERP systems	BPM systems	Cellular based system	Enterprise application integration	Online analytical processing
Reporting systems	HCI systems	Touch screen systems	e-Business suites	Cloud computing
GIS	Virtual reality sys.	Smartphone systems	Business intelligence	Forecast/demand plan
AI based systems	RFID	Mobile OS based system	Advanced planning sys.	Transport sys.
Multimedia database sys.	SCM	Marketing systems	Human resource sys.	Collaboration systems
GPS	Knowledge management systems	Retention & loyalty systems	Call center systems	Social networks

The approach uses the same process as in CINS 5073 of picking approximately 50 companies and at least 50 information systems and their sub-modules. The students have to randomly pick a company and the information system and answer the same question of: How can a company or one of its divisions effectively use an information system to move up the "waves of innovation" ladder from any one level to the next level? Two rounds of presentations of the *innovative use of information systems for a process* by a company are conducted. The author has been the instructor of the course for the past three years, has tried this approach with very good success. Examples of some of the topics done by students are: use of web services based information system for a national dental services chain, RFID system for tracking assets for Bank of America, use of Amazon's Cloud storage system for NASDAQ, etc.

Introduce Innovation in CINS 5003–Research Methods

The goal of the CINS 5003—Research Methods course is to prepare the students to conduct research, prepare a report, and make a presentation, primarily for their master's projects or thesis. Most students end up completing a project rather than a thesis because they can complete it faster.

Students take the CINS 5003 course in their third semester (generally) or in the fourth semester (spring admissions) of their program of study. At the beginning of the course, students do not have an idea of the area of work for their master's project topic. By examining several options and discussion in the class a student determines their area of interest. To help guide them in this process, students have to prepare: (i) an initial paper (3 pages) and presentation (7 minutes) about the topic of their choice and the area of work within that. After listening to all presentations, a student is allowed to change this/her topic; (ii) a topic paper (8 pages) and presentation (10 minutes) which lists the goals and objectives and benefits of their project topic and (iii) the semester paper (15 pages) and presentation (15 minutes) which includes a detailed plan of activities they would conduct as well as the background research about their project.

Using this approach, a student selects his/her own technology or information system, and for a company of his/her choice, *demonstrate* an innovative use of the technology for a particular process in detail. Unlike the other two courses where they have to make a random pick from a list of systems and companies, here they have to make their own selection. Students have to submit only two papers and presentations where the first paper is a general answer to how they would use the technology or system to innovate for the company and the second paper would be a detailed step by step plan of the implementation.

RESULTS AND CONCLUSION

The author who is the project or thesis advisor for over 15 CIS projects in the last five years, has directed projects where innovative ideas are part of the project. Examples of some of the projects are: Completely automated RFID based laundry systems for university dormitories, An automated drive-through supermarket, RFID based coupon system for smartphones, Mobile stock portfolio management system, etc. The nature of projects completed by students has changed considerably where students are now always thinking of having an innovative twist to their project idea. In the past, many students who work full-time picked a project based on some topic they select based on their work. Now students seek projects which will benefit their company or division by taking them to the next level—examples include the use of agile technologies, use of ITIL, integrating CAPTCHA with ERP systems, etc.

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