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TOTAL COST OF OWNERSHIP: A PROJECT INTEGRATING MULTIPLE TOPICS FOR THE INTRODUCTORY IS COURSE

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Abstract:

One major issue of the introductory IS course is that it covers too many topics and thus lacks the depth of coverage for these topics. One way to keep a balance between breadth and depth of course content is to organize lecture topics into broader modules and design assignments for these modules that allow students to explore these topics in more depth by themselves. To achieve this goal, we have designed a TCO teaching module that includes a project that covers several IS topics.

The purpose of the project is to understand what computer or information systems and technologies (IST) are needed to support an organization and to determine the total cost of ownership (TCO) of the needed IST. We have designed seven lectures to explain the concepts that are needed for the project. The teaching module and project have not been implemented yet, but we plan to implement them in the Fall 2010 term. We have designed a survey to collect student feedback about the usefulness of this project.

Keywords: IS introductory course, Total Cost of Ownership, information systems and technologies

I. INTRODUCTION

Information systems and technologies (IST) are a pervasive organizational phenomenon; today few organizations could survive without support from information systems. Most undergraduate business school programs, therefore, require a basic understanding of IST. In addition, several accrediting organizations, including the leading business school accrediting organization, AACSB, require competence in computer and information systems for accreditation. Students are normally first exposed to IST in a mandatory introductory course. Bakke et al [2007] stated that the introductory IS course often has too large an enrolment, covers "a vast array of subjects", focuses "too broadly on most topics", enrolls students with "a variety of backgrounds and interests", and is often perceived as "impersonal". Students "often enroll in these courses primarily to satisfy graduation requirements rather than to satisfy an inherent interest in the subject matter. Hence, neither students nor professors are satisfied with the learning experience and, more importantly, graduates from business schools do not master fundamental IS skills before entering the professional world."

In this paper, we illustrate how to use a systems planning project to improve students' learning processes and outcomes in an introductory IS course. The purpose of the project is to increase students' understanding of the importance of IS in organizations in general, and several major IS topics in particular. We try to make the project fun and relevant so that students are motivated to engage with the project; we also have designed a teaching module with six lectures to explain the concepts that students will need to complete the project.

The project requires teams, typically composed of four students, to choose a business, specify business processes, identify information systems and technologies (IST) that are needed to support the business processes, estimate the total cost of ownership (TCO) for the needed IST, and discuss the managerial implications of TCO for the business. The final deliverables of the project are a formal project report and a 10-minute presentation in class.

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The remainder of the paper is organized as follows. In section 2, we explain pertinent issues with the introductory IS course and two pedagogical principles guiding our design of the project; in section 3, we describe how the project will be implemented to incorporate these principles in an introductory IS course in the Fall semester of 2010; and in section 4, we discuss how we will collect data regarding the students' evaluations of the usefulness of the project.

II. ISSUES WITH THE IS INTRODUCTORY COURSE AND A PRINCIPLE FOR OUR PROJECT DESIGN

1. Issues with the Introductory IS Course

For most business programs, the primary goal of the introductory IS course is pretty much the same: all graduating students will be required to have a basic understanding of the technological, managerial, and societal aspects of IS. Students will need to understand how IS work, how IS can be used to facilitate business processes, and what societal issues can arise from using IS. Typically, a multitude of topics are covered: computer hardware and software; computer networks and data communication, including the Internet, the World Wide Web, and wireless networks; different types of information systems used by organizations (e.g., transaction processing, decision making, and enterprise systems); database design and management; the information systems development life cycle, security, e-commerce, and ethical and legal issues arising from using IS.

The problem of covering too many topics in an introductory course is that instructors are not able to offer in-depth coverage of each topic. As a result, it is very likely that students' learning is superficial; they may have learned some terminologies and basic concepts but do not understand how these concepts are linked, why these concepts are important and relevant to them, and how these concepts are applied in a real world environment. On the other hand, it may not be an option to reduce the number of topics to cover in the introductory course because the introductory IS course is normally the only IS course that most non-IS major students take in business school. Therefore, as IS instructors, we need to expose students to most of the basic concepts in the IS area.

One way to keep a balance between breadth and depth of class content is to organize lecture topics into broader modules and design assignments for these modules that allow students to explore these topics in more depth by themselves. As an attempt to achieve this goal, we have designed a TCO teaching module and an assignment that covers several IS topics. We followed two pedagogical principles in designing the assignment.

2. The Pedagogical Principle Guiding Our Design of the TCO Project

We used one pedagogical principle in designing the TCO project: the engagement of students in active learning. As Bakke et al [2007] stated:

> *There is consensus among pedagogical researchers that active learning techniques have a positive impact on the quality of students' learning (Astin, 1984; Association of American Colleges, 1986; Miller, 1988; Bonwell and Fison, 1991; House, 2002; Kvarn, 2002; McClanahan and MCClanahan, 2002; Udovic et al., 2002). Active learning theory suggests that students become an integral part of the learning process by studying ideas, solving problems, and applying what they learn.*

For a variety of reasons, most students do not speak up in a large section; discussion seems more of a private conversation between the instructor and the bolder students rather than a broader dialogue. As a result, students appear to become passive listeners rather than active participants. Because of the difficulty in engaging students in active learning in the classroom, we have created an assignment to be done outside of the classroom that would encourage students

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to become active learners. We will teach students all of the basic concepts about the project; students will need to apply these concepts to complete the assignment.

III. DESIGN OF THE TCO PROJECT

The purpose of the project is to understand 1) what software and hardware are needed to support an organization to operate and compete in the digital age and 2) how to determine the total cost of ownership (TCO) of the software and hardware. .

Student teams are to create an information systems plan for the owner or manager of an imaginary small organization. We understand that students at the entry level do not have the expertise to conduct a project with a real world organization; therefore, we ask the students to imagine that they will start or own a small business and complete a system plan for the business. The plan is a formal business document targeted at senior management that introduces the following components: what is the business, what are its business processes, what software or information systems are needed to support the business processes, what hardware is needed to support the software, what services are needed to support and maintain the hardware and software, and what budget (TCO) is required to purchase and support of these technologies. The final deliverables for the project are a formal report and a formal presentation.

We expect the students' reports will include five sections: executive summary, introduction, business processes and IT needed, estimates of TCO for IST in the organization, and discussion. For each section, we also list detailed points to be described or discussed as displayed in Table 1.

Table 1: Project Outline

Section	Major points to be covered
Executive Summary	• Summarize contents of the report
Introduction	• Choose your business (e.g., independent retailer, accounting firm, car repair shop). Choose something that you like, are interested in, or you have experience with). (Note: assume that you are starting a new small business instead of working with a real business) • Specify the scope or size of the business (e.g., office location, number of employees, number of computers, and number of printers) and the industry the business is in. You should choose a small business for the project.

Business Processes and IT needed	• Define the firm's business processes (things that the imaginary business does). For example,
	   o For a retailer: customer placing an order, shipping the product to the customer, customer returning a purchased product, stocking the inventory…
	   o For a car repair shop: booking an appointment, billing the customer, getting customers' feedback…
	• Identify the software that is required (e.g., operating systems, application software, anti-virus software) based on your processes.
	• Identify the hardware that is required (e.g., computers, printers, switches, routers, and cables). Hint: This should include a computer network configuration diagram.
	• Identify IT maintenance or services required (e.g., setup Internet

	access, fix computers when they crash, update software, train staff, etc.).
Total Cost of Ownership of IT	• Estimate the TCO (cost for software, hardware, and services) for three years, and justify your estimate. • Summarize the total cost for each of the categories over the three years. • Discuss TCO implications for management. (Hint: You should include tables and Excel charts in your discussion and presentation).
Discussion	• Discuss what have you learned from this project.

Marking the assignment will be based on critical thinking, content, and writing style. The marking rubric will be included in the assignment write up so that students will know what to expect for the assignment.

IV. DESIGN OF THE TEACHING MODULE FOR TOTAL COST OF OWNERSHIP

Students need to understand the following topics to complete the project: business processes, hardware, software, networking and data communications, network security, and TCO. Here we explain why they need to understand these concepts and how we explain these concepts so that students will gain enough understanding to engage with the project.

Students need to understand what a business process is, how to identify a business process, and how to break down the operation of a business into processes. Without understanding business processes, students may not be able to identify all the applications or IST that are needed to support a business's operations. Some universities covers the topic of business processes in the introductory IS course; others leave the topic for the systems analysis and design course. In our case, we use a textbook that does not have extensive coverage of business processes; we plan to write our own tutorial and lecture to explain the topic and include several cases to illustrate how to identify business processes.

In the class about software, we will explain 1) the difference between system software and application software, 2) different methods of acquiring software (e.g., purchasing off-the-shelf packages, in-house development, and outsourcing), and 3) the pros and cons of these methods.

The class about hardware will allow students to understand 1) how a computer works, 2) how to evaluate a computer's performance, and 3) how to purchase a computer that fits one's needs in a cost-effective manner. Topics 1 and 2 are explained in chapters in most textbooks; very few textbooks explain topic 3. We will include an in-class simulation exercise on computer shopping; we will list at least three computers with configuration specifications and ask students to estimate the price of each computer and rank order the price for each computer. The purpose of the simulation is to help students to conduct comparison shopping for computers and to understand the technical terms that are used to specify a computer's configuration.

We plan to have two classes about networking and data communications. In the first class, we will focus on basic concepts and wired networks: 1) client-server architecture, 2) network operating systems,3) different types of networks (local area networks vs. wide area networks), 3) current wired LAN standards (primarily Ethernet), and 4) connecting devices used in LANs: switch, routers, and cables. In the second class, we will focus on wireless LANs: 1) how wireless LANs work, 2) current wireless LAN standards, 3) drawing of network diagrams, and 4) WANs, including the Internet and the World Wide Web (as an information space).

In the class on network security, we will explain 1) different types of security threats (e.g., malware, Denial of Service attacks, and sniffing), and computer crimes (e.g., identity theft, phishing, and data theft); 2) security measures (e.g., anti-virus software, firewalls, intrusion

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detection systems, access control, and securing wireless networks), and 3) business continuity (e.g., downtime, high availability, fault tolerance, disaster recovery planning).

Most textbooks already have chapters about hardware, software, networking, and security. We will use textbook chapters for our classes (we currently use the Canadian edition authored by Laudon, Laudon, and Brabston, 2009). We will develop a tutorial about network configuration that will include how to configure a network for a small business, how to recommend routers and switches that are frequently used for a small network, and how to draw a network configuration diagram.

TCO is not a concept that is exclusive to the IS domain; it is an accounting concept. TCO refers to the total cost of owning a particular item, either equipment or an information system; it includes direct expenses such as purchasing and indirect expenses such as configuration of the information system and maintenance expenses. TCO is often much more expensive than the direct purchase cost: for example, TCO for an airplane could be several times the direct purchase cost since it would include painting the plane and training the flight crew, as well as routine and non-routine maintenance.

It is not surprising that very few textbooks used for the introductory IS course discuss this concept. Among several textbooks that we reviewed [e.g., Oz, 2004; O'Brien and Montazemi, 2004; Chaffey and Wood, 2005; Stair and Reynolds, 2006; Kroenke, 2007; Laudon, et al. 2009], two textbooks [O'Brien and Montazemi, 2004; Kroenke, 2007] do not mention TCO. Two textbooks explained TCO in one or two short paragraphs (Oz, 2004; Chaffey and Wood, 2005), two remaining textbooks [Stair and Reynolds, 2006 and Laudon, et al. 2009] explain the concept of TCO in more detail however, the discussion of TCO in all these textbooks is not sufficient for students to start the project. As a result, we will develop our own tutorial for TCO. In the TCO tutorial, .we will cover three major topics: what is TCO, how to calculate TCO for an information system, and why TCO is important to organizations. See table 2 for a summary of the class topics.

Table 2 Major Topics in the TCO Module and Sub-topics for Each Topic

Major Topic	Sub-topics
Business Process	- What is a business process - Why identifying business processes is important - How to identify a business process
Software	- Difference between system software and application software - Different methods of acquiring software (e.g., purchasing off-the-shelf packages, in-house development, and outsourcing) and the pros and cons of these methods.
Hardware	- Different hardware components of a computer - How does a computer work - How to buy a computer to meet your needs at a reasonable price
Networking and data communication	- Client-server architecture - Network operating systems - Different types of networks (local area networks vs. wide area networks) - Wired LAN standards (primarily Ethernet) - Connecting devices used in LANs: switches, routers, and cables. - How a wireless LAN works - Current wireless LAN standards - Drawing a network diagram - WANs, including the Internet and the World Wide Web as an information space
Network	Different types of security threats (e.g., malware, Denial of Service

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Security	attacks, and sniffing), and computer crimes (e.g., identity theft, phishing, hacking, and data theft); • Security measures (e.g., anti-virus software, firewalls, and intrusion detection systems, access control, and securing wireless networks), • Business continuity (e.g., downtime, high availability, fault tolerance, disaster recovery planning).
TCO	• What is TCO • How to calculate TCO • Why TCO is important

When students listen to these lectures and tutorials and read the chapters, they are passive learners; they may understand the concepts, but they do not understand how or when to apply them. The proposed project allows students to engage in active learning by exploring more about these topics and applying these concepts to solve a problem: developing an information system plan for a small business from scratch.

Since all concepts of the entry level IS course are not directly related to this project, we use two projects for the course; the other project is a database design and implementation project.

V. IMPLEMENTATION OF THE TEACHING MODULE

We have not implemented the project yet; we plan to implement it in Fall 2010. When we implement the project, we will get anonymous feedback from our students along with comments about their view of the usefulness of the project in terms of student learning after students hand in their assignments. Please see Appendix I for the rough draft of the survey we will ask students to turn in anonymously to give us their feedback. The survey will ask students whether the project was fun or frustrating, whether they have learned by doing the project, and what kind of concepts they have learned.

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Appendix I

Potential Survey Questions to Get Students' Feedback on TCO Assignment

1. Year in University?   ___

2. Gender: Male   ___   Female   ___

3. I am in Section A____ .

4. How many years of full-time work experience do you have?   _____

	1=Strongly Disagree			4=Neutral		7=Strongly Agree	
5. I enjoyed doing the TCO assignment.	1	2	3	4	5	6	7
6. I learned a lot by doing the TCO assignment.	1	2	3	4	5	6	7
7. I had fun doing the TCO assignment.	1	2	3	4	5	6	7
8. I did not like doing the TCO assignment.	1	2	3	4	5	6	7
9. The TCO assignment was time consuming.	1	2	3	4	5	6	7
10. The TCO assignment was difficult and frustrating.	1	2	3	4	5	6	7
11. The skills I learned in doing the TCO assignment are good skills to have.	1	2	3	4	5	6	7
12. The TCO assignment was relevant to the course content.	1	2	3	4	5	6	7
13. I am satisfied with the instructions that the instructor provided for the TCO assignment.	1	2	3	4	5	6	7
14. I am satisfied with how much I learned from the TCO assignment.	1	2	3	4	5	6	7
15. The TCO assignment increased my understanding of IT usage in organizations.	1	2	3	4	5	6	7

16. The TCO assignment increased my understanding of business processes.	1	2	3	4	5	6	7
17. The TCO assignment increased my understanding of computer hardware.	1	2	3	4	5	6	7
18. The TCO assignment increased my understanding of computer software.	1	2	3	4	5	6	7
19. The TCO assignment increased my understanding of computer networks.	1	2	3	4	5	6	7
20. The TCO assignment increased my understanding about computer security.	1	2	3	4	5	6	7
21. The TCO assignment increased my understanding of the concept of total cost of ownership in an IT context.	1	2	3	4	5	6	7

Please write any additional comments in the following box.