E-business technology education: a preliminary model

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Abstract

In this paper, we describe a preliminary model proposing that the e-business technology (EBT) should be one area of many specialization areas within Computing Science & Information Technology (CS&IT) departments. This paper explores the emerging educational models, methods and technologies that are associated with CS&IT education from the perspective of EBT. To be able to produce the qualified specialists who can overcome the various obstacles that have presented themselves to the new economy throughout recent global economic crises, we have to make appropriate changes to the CS&IT educational model of the Colleges, Technological Educational Institutions and Universities. This paper proposes possible changes, makes appropriate recommendations and describes implementation strategies for several important undergraduate courses (including Database Management Systems (DBMS), Web-based Information Systems, Programming Languages, Operating Systems, Software Engineering, and Computer Networks; taught many times by the authors during the past decade) from the viewpoint of the preliminary model developed in this paper.

One of the original contributions of this paper is that the authors have coined two new terms to reflect the latest technological developments and proposed educational changes: the “mobile PC telephone”, and the “e-business centric programming”.

Keywords: e-business, e-business technology, e-business centric programming, mobile PC telephone, m-business, education model, DBMS, programming languages, operating systems, software engineering, computer networks.
1 Introduction

The objective of this paper is to explore the emerging educational models, methods and technologies that are associated with Computing Science & Information Technology (CS&IT) education from the perspective of EBT and services utilization by consumers, business, Non-Government Organizations (NGOs), and government. Authors are convinced that many of the largest organizations (largest business companies, largest Universities, and educational training centers) are already effectively involved into e-business. In our opinion, the next wave of the e-business development and utilization is predominantly for middle-size and small businesses, small universities, local government institutions and NGOs.

To involve middle-size and small businesses, the post secondary education system should produce a large number of qualified specialists, who should be able to break developments into appropriate categories such as business-to-business (B2B), and business-to-customer (B2C). These specialists should be able to make appropriate electronic business implementations that are not as expensive and complicated, as the solutions developed for the largest organizations.

To produce these qualified specialists, and to overcome the various obstacles that have presented themselves to the new economy throughout recent global economic crises, we have to make appropriate changes to CS&IT educational model of the Colleges, Technological Educational Institutions and Universities. We propose a preliminary model that the EBT should be one area of many specialization areas within CS&IT departments.

The organization of the remainder of this paper is as follows:

The next section of this paper describes the recent developments in e-business & EBT, and develops the rationale for the preliminary model proposed in this paper. It outlines the typical CS&IT courses, which should be modified to emphasize the e-business solutions and technology. This section essentially concentrates on what should be changed, and why?

Section 3 analyzes possible changes for several important undergraduate courses (including Database Management Systems, Web-based Information Systems, Programming Languages, Operating Systems, Software Engineering, and Computer Networks) taught many times by the authors during the past decade. This section addresses the issue: how to change. It makes appropriate recommendations and describes implementation strategies for course changes from the viewpoint of the preliminary model proposed in this paper.

The conclusion summarizes the original contribution of this paper.

2 E-business and e-business technology

E-business a hot topic in the Colleges and Universities and can be defined as “the conduct of business with the assistance of telecommunications and telecommunications-based tools” [1]. This definition covers a broad range of activities, from B2B, to B2C, to intra-organizational commerce [2] and includes
some new activities such as customer-to-customer (C2C) activities. E-business also includes e-commerce, and a relatively new area of m-business (mobile business) technology and covers much more than just the selling of goods through Internet and mobile devices. Business departments also teach e-business courses, but from business and management point of view. Whereas the e-business courses taught by the Business departments focus more on the management and business issues [3], the CS&IT courses have to be focused on programming skills, networking, database management systems (DBMS), software (SW) and information systems (IS) engineering and development, Models of Computation, Programming Languages, and Operating Systems (OS). It is important for CS&IT professors to differentiate between what should be taught in a CS&IT e-business course and what should be taught by the professors from business department. In our preliminary model in this paper, we propose that an e-business component as a small part of several important CS&IT courses should teach students EBT elements and how to build an e-business with the existing technologies.

Many professors and academicians believe that we have strong trend towards free and open source technology, and we should be concentrating on middle-size or small-size e-business technology now. Our CS&IT courses should be oriented for specialists, which will work within small and middle-size business companies, especially while we are facing IT crises at present. The famous economist Rinald Coase, who won the economics Nobel Prize in 1991, recognized the basic concepts in the field of e-commerce as early as 1930. G. Sampson [4] presents an observation for business size companies, based on Rinald Coase’s works (works for which he is chiefly known and is today most associated with e-commerce) as follows: “Many contemporary firms are smaller than their counterparts of 20 years ago. Outsourcing is encouraged by factors apart from information technology, often as a response to low wage levels in the Third World; but, in many cases, outsourcing exploits information technology to achieve collaboration across firm boundaries over activities previously conducted within a single firm. However, we also see many mergers producing ever-larger companies. Two recent examples in the IT sector are Hewlett-Packard/Compaq and IBM/PricewaterhouseCoopers Consulting.” [4]. Moreover we now have only a few enterprise systems within the so-called enterprise resource planning (ERP) systems (such as SAP, PeopleSoft, Baan and Oracle Financials).

It is important to understand the role of the telecommunications and telecommunications-based tools within EBT. Equally important is to understand the opportunities, which can be exploited by utilizing new inventions in the area of telecommunications. The following examples will illustrate the rationale:

1. One of the most significant inventions in personal computers technology has been networking in the last 10 years. The Internet is the most impressive example of the telecommunications and telecommunications-based tools, and has proven to be an easy and efficient way to provide businesses to millions of customers all over the world (or to provide e-business).
2. Another very important technology from the e-business point of view is mobile telephones and mobile computers, which has been growing rapidly to increase the sophistication of the mobile devices. We now have new mobile telephone devices, which include VCR, Digital Camera, mini-keyboard, operating systems with office software integrated in a single mobile telephone unit. The authors of this paper feel that we should change the name of this unit from the “mobile telephone” to the “mobile PC telephone” to reflect these technological changes. The number of mobile phone users worldwide reached one billion for the first time in 2002. “At the same time, 136 million people owned a mobile phone in the U.S. In parts of Scandinavia and Southeast Asia, penetration is more than 80%.” [5].

3. Whereas the computer hardware (including mobile PC telephone industry) has been rapidly growing as described above, the software industry has been facing a number of problems. For example, the “software productivity has been dropping more rapidly than any other industry. The semiconductor industry had the most productivity growth (86%) from 1990 to 1995. In that same period, productivity for the software industry decreased by 10%, indeed, the worst decline of all industries surveyed.” [6]. We are facing a big SW development crisis, which can be faster overridden, if we include modifications for some CS&IT courses proposed in this paper. Consequently, we should start teaching our students “e-business and m-business technology component based” SW development in the courses (such as Web-based Information Systems, Programming Languages, Operating Systems, and Computer Networks) in our current CS&IT curricula.

4. Some important new trends in IT sector related to EBT are: Optical Technologies (OT), Quantum Computing (QC), Nanotechnology (NT), Grid Computing (GC), image recognition, speech processing (e.g. text-to-speech capabilities), high speed communications, and mobile computing. Nowadays, for example mobile devices, which combine mobile telephone, web-browser, computer, VCR and Digital Camera, MIDI device are already on the market. The authors firmly believe that we should teach all these new trends in several important CS&IT courses, such as Database Management Systems, Web-based Information Systems, Programming Languages, Operating Systems, SW Engineering, Computer Networks, Image Processing, Models of Computation, Artificial Intelligence and Computer Graphics.

Based on these observations, the possible changes to the first six CS&IT courses mentioned in the above list are proposed in the following section. We believe that the students educated with our proposed modifications will be able to face modern business and SW challenges much more efficiently.

3 Proposed changes for some undergraduate courses

3.1 Database management systems and advanced database systems

An important new tendency in classical DBMS courses is to use relatively new information technologies, e.g. Open Grid Services Architecture (OGSA), to
introduce the secure and reliable virtualization and management of distributed data and computing resources [7, 8]. Web-based data infrastructures support discovery, exploration, analysis, integration, and mining of remote and distributed data [9]. Such efforts are pioneering a new generation of distributed data discovery, access, and exploration technologies promising to transform the Internet into a data-integration platform. On it, users will be able to perform sophisticated operations on remote and distributed petascale datasets [10].

Distributed virtual computers (DVC) components should be included into course outlines, because DVC enable applications to view their world as a safe local cluster environment rather than as a hostile, best-effort, open Internet.

Dynamic DVC serves as a single administrative domain with centralized resource control already used for database systems by major DBMS development companies as well as business companies [11].

The voluminous data, especially produced by e-business environment, needs to be managed, analyzed, and fed into the decision-making process. Data warehouses solutions, which provide decision support to organizations with the help of analytical databases and online analytical processing (OLAP) tools should be special part of the DBMS courses. Incorporating OLAP tools into decision models of e-business as a part of decision support systems improves decision making [12, 13].

### 3.2 Web-based database and information systems

To teach students how to implement e-business, the professors must be knowledgeable about the tools they can use to do so. Some examples of how to modify specific courses for e-business education exist in literature. One of them is [3], which gives an example of one way to teach e-business with a popular technology called Enterprise JavaBeans (EJB), which means distributed components that encapsulate business logic. EJBs allow business to evolve as the environment and the requirements change. How to implement EJBs for a class project, how to select the appropriate tools such as web servers, databases and hardware components, and after this the foundation of Enterprise JavaBeans has been covered including entity beans and session beans deployment by L. Moffitt [3].

Some other technologies for e-business, such as Java Developer (JDeveloper) and Business Components for Java (BC4Java) from Oracle, Extensible Markup Language (XML), Personal Home Page (PHP) tools and MySQL, PL/SQL Server Pages (PSP), Active Server Pages (ASP), Java Server Pages (JSP), list of most popular Application Servers and Internet Portals (e.g. Sybase, SAP/TopTier mySAP Enterprise Portal, Sun Microsystems Application Server, IBM WebSphere, InfoImage Decision Portal, Oracle Application Server and Portal, Computer Associates, Peoplesoft, Microsoft Share Point Portal Server, Epicentric Foundation Server, BEA WebLogic Portal) should be demonstrated for the students and used for their research projects and presentations.
3.3 Programming languages

Most Programming Languages courses traditionally include discussions around four major programming paradigms: Procedural (or Imperative) programming, OOP, Functional (or Applicative) programming, and Logic (or Declarative or Relational) programming. However, it is important to recognize [14, 15] that “the most dynamic area of new programming community growth is the World Wide Web, which is the enabling vehicle for electronic commerce …” [14]. Consequently, we have coined a new term “e-business centric programming.” We propose that the Programming Languages course should emphasize more on the e-business centric programming and the students should get more exposure to programming languages that support e-business centric programming. Several languages have already been mentioned in the previous sub-section. Other languages such as PERL (Practical Extraction & Report Language), TCL/TK (Tool Command Language/Tool Kit), Python, JavaScript, and Visual Basic can also be included.

3.4 Operating systems

Most Operating Systems courses traditionally include discussions around operating systems for mainframes, minicomputers, and microcomputers. Our preliminary model proposes that the Operating Systems course should emphasize more on the mobile operating systems (the operating systems for Tablet computers, Handheld computers (Personal Digital Assistants or PDAs or palmtops), and embedded operating Systems (operating systems for Microcontrollers or Embedded computers or Hidden computers). The mobile devices are small in size, have a small amount of memory, include slow processors and feature small display screens [16]. Network computers (or thin clients), and Internet Appliances (or Information Appliances or Web pads) fall between stand-alone self-sufficient PCs and dumb terminals because of their limited processing capabilities. The operating systems for these devices as well as the operating systems for the mobile PC telephone proposed by the authors earlier in this paper also fall under a category different than the traditional operating systems. Consequently, the students should be exposed more and more to the challenges presented by the design of the operating systems of these devices.

3.5 Software engineering

Component-based Software Development (CBSD) technology is an interesting approach in the SW development. Design, retrieval, and assembly in CBSD offer an effective approach to constructing software products. CBSD can help the software industry realize quality and productivity gains similar to those achieved in the hardware and manufacturing industries [17, 18]. As an increasing number of software projects miss schedules, exceed budgets, and deliver defective products, industry experts have turned to component-based solutions to
overcome the current software crisis [19]. This subject should be incorporated into modern emerging educational models for SW Engineering courses.

The recent emergence of the Web services model for delivering component-based solutions over the Internet further underscores the importance of CBSD. The CBSD approach seeks to develop the components required to support various functions and processes for a particular domain or area, especially for n-tier Web-based information systems and EBT solutions [20].

### 3.6 Computer networks

An important subject related to Computer Networks course is the emerging high speed and wireless technologies for e-science and e-business. The past few years have seen 1Gb and 10Gb Ethernet (GigE) technology in research and education networks, and several hundred Mbps for wireless devices. “As 10GigE and Mbps wireless technologies, available in metro areas today, becomes more widely deployed, exponential penetration in the market will likely occur, and prices will drop...Today, a 10Gbps lambda between major cities in North America and across the Atlantic Ocean costs about $120/hour ($1 million per year). A Nationwide, 20-year, multi-10Gbps capability can be built for the cost of a typical university building or two... Government-funded science programs and university research projects can afford to experiment, but these economies are realizable today if, and only if, the communities of e-scientists themselves provide all the services and manage them, as was done at iGrid 2002.” [21]. It clearly implies that the high speed and wireless network technologies within iGrid should be incorporated into our Computer Networks courses as soon as possible.

### 4 Conclusions

The next wave of the e-business and m-business development and utilization is predominantly for middle-size and small businesses, small universities, local government institutions and NGOs.

The post secondary education system should produce a number of qualified specialists, who should be able to break developments into appropriate categories such as B2B and B2C. These specialists should be able to make appropriate electronic business implementations inexpensively.

To overcome the various obstacles that have presented themselves to the new economy throughout recent global economic crises, we should make appropriate changes to Computing Science and Informational Technology (CS&IT) courses of the Colleges, Technological Educational Institutions and Universities. As described in this paper, these changes revolve around e-business and m-business technologies, Web-based Information Systems and Database Systems, XML, Java programming languages (including J2EE, EJB, and BC4J), n-tier information systems, mobile devices and mobile technologies, wireless protocols and operating systems for mobile and wireless devices, GRID systems
and database systems, e-business centric programming, and component based SW development.

In our preliminary model in this paper, we propose that an e-business component as a small part of several important CS&IT courses should teach students e-business technology elements and how to build an e-business with the existing technologies. Consequently, the e-business technology (EBT) should be one area of many specialization areas within CS&IT departments. This area of specialization can be used by itself to improve effectiveness of the education as well through distance and remote learning, on-line conferences and seminars, professional chat rooms and list-groups.

We are facing a big SW development crisis, which can be faster overridden, if we include modifications for some CS&IT courses proposed in this paper. We believe that the students educated with our proposed modifications will be able to face modern business and SW challenges much more efficiently.

One of the original contributions of this paper is that the authors have coined two new terms to reflect the latest technological developments and proposed educational changes: the “mobile PC telephone”, and the “e-business centric programming”.

In this paper, we have described the possible changes to these six CS&IT courses: Database Management Systems, Web-based Information Systems, Programming Languages, Operating Systems, Software Engineering, and Computer Networks. Possible changes to other CS&IT courses will be included in our future papers as we enhance this preliminary model.

References


