ISSN: 1545-679X

Information Systems Education Journal

Volume 4, Number 19 http://isedj.org/4/19/ April 3, 2006

In this issue:

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Recommended Citation: Flynn (2006). Developing Tomorrow's Chief Technology Officers. *Information Systems Education Journal, 4* (19). http://isedj.org/4/19/. ISSN: 1545-679X. (Also appears in *The Proceedings of ISECON 2004:* §4132. ISSN: 1542-7382.)

This issue is on the Internet at **http://isedj.org/4/19/**

The **Information Systems Education Journal** (ISEDJ) is a peer-reviewed academic journal published by the Education Special Interest Group (EDSIG) of the Association of Information Technology Professionals (AITP, Chicago, Illinois). • ISSN: 1545-679X. • First issue: 8 Sep 2003. • Title: Information Systems Education Journal. Variants: IS Education Journal; ISEDJ. • Physical format: online. • Publishing frequency: irregular; as each article is approved, it is published immediately and constitutes a complete separate issue of the current volume. • Single issue price: free. • Subscription address: subscribe@isedj.org. • Subscription price: free. • Electronic access: http://isedj.org/ • Contact person: Don Colton (editor@isedj.org)

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Developing Tomorrow's Chief Technology Officers

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Abstract

This paper examines the role of the Chief Technology Officer and the competencies needed to perform the role effectively. While many of these competencies can be developed through in-house training and structured career development, a postgraduate qualification can provide Chief Technology Officers with the theoretical knowledge and skills needed to operate at the senior level. The paper describes a Programme offered at a UK institution that equips aspiring Chief Technology Officers with the skills they need to operate as business and technology strategists.

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1. INTRODUCTION

Senior IT executives' roles are changing. Research by analyst firms Gartner[i] and Forrester indicates that organisations are abolishing the IT Director or Chief Information Officer (CIO) role and dividing responsibility for IT between other senior executives (Thomas 2003). The Gartner Group predicts that Chief Technology Officers (CTO's), 'technology opportunists' and heads of the individual business units will assume increasing control of IT. Forrester sees control passing to Chief Operating, Chief Finance and Chief Technology Officers. The move follows dissatisfaction with the spiralling costs of IT and high levels of IT project failure (Vowler 2003). The trend towards outsourcing and commoditisation of IT have also made it easier for companies to devolve responsibility for IT management to non-technical specialists.

Although IT directors and CIO's face an uncertain future, both Gartner and Forrester see a continuing role for the CTO. He/she is described as having "responsibility for the delivery of all technology-based services", management of IT research and development and monitoring of emerging technology trends". The CTO requires business skills to evaluate the potential value of new technologies and their application to the organisation but the balance of skills definitely lies at the technical end of the spectrum. The decision to retain the CTO role when others are being axed casts doubt on the idea that IT has become so easy to manage that it can safely be left in the hands of non-technical executives. It would appear that companies still require a senior IT professional to ensure the corporate wide integration of IT services and advise on the complex issues that arise from the introduction of new technologies (Dickerson 2002).

If CTO's are to play a more prominent role in senior management, the question arises of how best to develop their skills. McCarthy (2003) suggests that, as most CTO's come from a technical background, and work their way through the technical ranks, attention should focus on providing courses that are usually available to aspiring business executives. In-house courses on financial and human resource management as well as practical experience of managing projects can help to broaden IT professionals' competen-

cies. Time spent in a line management position is regarded by some commentators as essential to developing the business skills necessary to perform effectively as a CTO (Gwynne 1996). For many, however, the preferred option is to return to college to study for a higher qualification. A recent survey of 2,000 senior IT professionals (which included CTO's) found that 36% favoured returning to graduate college to update their skills[ii]. There is a bewildering array of postgraduate courses on offer to aspiring senior IT professionals but executive development and Master of Business Administration (MBA) programmes have long been seen as a 'passport' to top executive jobs (Kavanagh 2002). While often excellent in developing understanding of the issues involved in running a business, these types of courses do not usually address the specific requirements of senior technical roles. To be effective, CTO's must appreciate how emerging technologies can give a company a competitive advantage and be able to take a 'global' view of technology management. An understanding of the running of a business comes into this but needs to be placed in the context of IT development and delivery.

The technical requirements of the CTO role call for a special type of Programme delivery. This paper describes the design and development of a Programme at a UK university that meets the educational needs of CTO's and those aspiring to this position[iii]. The Postgraduate Business Information Technology (BIT) Programme, as it is called, was introduced in 2002 at London South Bank University to cater for the needs of technical professionals who want to manage IT at the *strategic level* of the organisation. It focuses on (a) new and emerging technologies that will enhance business processes and create new business opportunities; (b) the impact of these technologies on new and emerging forms of organisation, and (c) the skills needed to capitalise on emergent technologies. The paper describes the background to the Programme and outlines course content and delivery modes. To place the discussion in context, the next section describes the origins of the CTO role and the responsibilities associated with it.

2. THE CTO ROLE

The CTO role dates back to the 1980's when technology started to become so integral to product and service delivery that someone with specialist technical skills was needed by the senior management team to provide advice and direct research and development (Ferdows 1990; Smith 2003). The word 'technology' in the CTO title implies any type of technology. The first CTO's came from a research and development and scientific background. In her study of CTO's carried out in 1990, Fedows notes that, of the twenty-five sampled, 'none had significant experience in Information Systems' and only a few had responsibility for IT (Ferdows 1990). The spread of telecommunications technology in the 1990's and the growth of computer and Internet companies, however, changed this and increased the need for effective management of a variety of information technologies (Smith 2003). Whatever the precise nature of the technologies they manage, therefore, most CTO's now need a broad understanding of IT and its application to the business.

With regard to the CTO's role, various studies indicate that their main responsibility is to monitor and assess new technologies (O'Neill and Bridenbaugh, 1992; Thurlings and Debackere 1996). O'Neill and Bridenbaugh (1992) state that the CTO should 'identify, assess and investigate high risk, high return technologies possessing potential application within existing businesses or for creating new businesses". This requires familiarity with the latest technologies and awareness of technology trends. Surveys and anecdotal evidence confirm that CTO's spend a considerable portion of their time reading up on technology trends and attending trade fairs (Tobias 2000). This in-depth knowledge of new and emerging trends needs to be allied to an understanding of how the business operates, key products and services and competitor behaviour, if it is to be any use. Smith (2003) emphasises the importance of the latter, pointing out that one of the things that distinguishes a CTO from a CIO is that they are much more concerned with 'external' matters such as tracking technology and its potential use by competitors.

Another key role of the CTO is strategic innovation. Smith (2003) quotes Moritz, CTO

of Symantec as saying that: "the CTO [must] provide the technical vision to complement the business vision, setting the tone and direction for the company's technologies". Achieving a synergy between the business and technology vision requires that the CTO understands the company's strategic direction; this in turn requires an understanding of the nature of corporate strategy and the strategy formulation process. CTO's need to sit at 'the senior table' if they are to learn about strategy and help formulate it. Studies suggest that they have come to play a more important role in strategy making. Ferdow's study of twenty-five CTO's found that just over half played a key role representing technology issues in the top management team (Ferdows 1990). More recent studies put the figure at 67% in Europe and 91% in Japan (Smith 2003).

Smith (2003) identifies two further features of the CTO role that are particularly important. One is managing the integration of technologies in company mergers and acquisitions. Failure to consider the problems involved in marrying the technologies of newly acquired companies has been cited as one of the reasons for the high failure rate of mergers (Linden 1998). Smith (2003) argues that CTO's can help to avert problems by strategic evaluation of the technologies used within the target company and the synergies that may result from combining their systems. The other feature of the CTO role Smith (2003) identifies is contributing to marketing and media relationships. The CTO's expertise is needed both to translate product details into terms that can be marketed and to promote products and services to the media, i.e. to have a media 'profile'. He suggests that companies should cultivate the media friendly skills of CTO's so that they can act as ambassadors for their products and services.

3. BACKGROUND TO THE PROGRAMME

The Postgraduate BIT Programme was not specifically devised with the view to helping the CTO fulfil these various roles but it does aim to develop the range of competencies necessary to perform effectively at this level. The Programme has its origins in a decision taken in 1999 to introduce an MSc in Business Information Technology in the School of Computing at London South Bank University. The aim was to extend undergraduate provision in the BIT area and cater for the perceived growth in demand for IT professionals who could manage IT at the strategic level. At the time, various reports and articles suggested that organisations were experiencing difficulties developing what Earl termed 'hybrid managers', i.e. executives with sufficient knowledge of IT and the business to harness the competitive advantages of IT (Earl and Skyrme 1990). It was particularly difficult to attract and retain high calibre senior executives. The MSc BIT was conceived as a way of plugging this gap. It was geared specifically at IT professionals who wanted to apply their technical skills in a strategic context. A degree in IT or a technical subject that contained substantial computing elements was a prerequisite for course admission. Experience within an IT environment was a desirable but not essential requirement for entry. Although the course was intended to develop strategic managers it was felt that relatively young, inexperienced people could benefit from early exposure to the strategic aspects of IT.

In its original form, the course consisted of four key units that were taught in the first semester: Strategic Management of ICT Resources, Systems Requirements Engineering, Strategic Decision Support and Expert Systems and Organisations as Complex Systems. In the second semester, students chose from a number of options, including: E-Commerce, Enterprise Modelling, Systems Dynamics, Commercial Networked Environments and Global Telecommunications and Networking. There were also compulsory courses on Research Methods and students had to produce a 10-15,000 word dissertation on an aspect of strategic IT management. Although the business/technical content varied between the units, across the course as a whole, it was weighted at 75% computing and 25% business/management, reflecting the specialist technical nature of the provision.

The 75/25 weighting was maintained when, in 2002, a new course, an MSc in E-Commerce was added to the portfolio of specialist courses within the School of Computing and, with the MSc BIT, formed the basis of the Postgraduate BIT Programme. Both courses share four core units in the first semester, have a compulsory unit in

Research Methods and require students to produce a dissertation within the relevant subject domain. In the second semester students who opt for the MSc in E-Commerce study Strategic E-Commerce Solutions, Internet Technologies and Strategic E-Marketing. The second semester units on the BIT course have been trimmed down to: Enterprise Modelling, Commercial Networked Environments and Global Telecommunications and Networking.

The Programme is now in its second year and there are plans to introduce new courses that share the same common core units but give applicants the opportunity to specialise in other areas of the strategic management of IT, notably Mobile Commerce (M-Commerce) and Managing IT Innovation. Only three other universities in the UK are offering courses in Mobile Computing and one other offering a comparable course on managing IT, change and innovation[iv]. The decision to introduce a course on mobile commerce is based on data that suggests the market for mobile technologies will take off in 2005/06 (Barnes 2002). The new course will develop an understanding of the technologies involved in developing M-Commerce solutions and consider how these should be managed strategically to deliver business benefit. The course in Managing IT Innovation will address the organisational problems that arise from the introduction of new technologies, the design of systems to encourage user acceptance and the management of change processes in an organisational and social context. As research indicates that the key barriers to IT innovation are organisational and social rather than technological, this course will deal with senior management's concern over the high failure rate of IT implementations.

Each of the new courses will be distinguished by three specialist units that will be taught in the second semester. On the MSc in Managing IT Innovation course the units are: IT Intrapreneurship, Managing Strategic IT Projects and Human Issues in Designing IT Systems. On the MSc in Mobile Commerce course the units are: Mobile Software Engineering, Business Wireless Systems and Wireless Computing Systems. The introduction of the M-Commerce course will necessitate changes in the core curriculum. The Organisations as Complex Systems unit will be replaced by one on Advanced Networking and Database Connectivity. This will provide relevant technical underpinning to the specialist M-Commerce units taught in Semester 2 and the more technical aspects of the other specialist second semester routes.

4. PROGRAMME CONTENT

The decision about what to include in the Programme was based partly on advice from industry practitioners and partly on staffs' research interests and areas of expertise. The upshot is a Programme that covers many of the areas of most concern to CTO's. Earlier it was suggested that a key role of the CTO is to monitor and appraise new technologies and emerging technology trends. Feedback from students indicates that this is one of the key reasons that they apply to join the Programme. All of the units seek to update students' knowledge about new applications. Rather than go through each in detail, it is perhaps best to illustrate with examples. In the Global Telecommunications and Networking Unit on the MSc BIT students are asked to select and critically assess a specific commercial networking product. The aim is to develop their evaluative skills but also to (a) increase their familiarity with the range of products available and (b) benefit from observing how other students approach product selection and assessment. In the Strategic E-Marketing unit on the MSc E-Commerce course students are introduced to the technique of Web Logging. The Business Wireless Systems unit of the new Mobile Commerce course will also require students to evaluate wireless technologies from the many now available on the market.

CTO's need not only to evaluate new technologies, they must also be able to determine whether they are appropriate for the organisation and likely to yield a competitive advantage. The core unit Strategic Management of ICT Resources introduces students to the techniques of evaluating systems and determining whether they are likely to meet business requirements. The Business Wireless Systems unit on the new Mobile Commerce course will provide students with practical experience of technological evaluation by requiring them, as part of their assessment, to analyse the business requirements of a real organisation and

write a report on the potential uses of mobile applications. The new MSc in Managing IT Innovation course specifically addresses the skills required to evaluate new and emerging technologies and examines the constraints on their introduction.

Smith (2003) identified strategic innovation of IT as a key role requirement of CTO's. The nature of strategy and strategy formulation and the management of innovation are covered in the Strategic Management of ICT Resources unit. Students examine the steps involved in developing corporate strategies and consider ways of incorporating IT to support product and service innovation and business process re-engineering (BPR). The role of information and information technology as sources of competitive advantage are explored together with techniques for leveraging IT to support new products/services. Although the role of IT in mergers and acquisitions is touched on in the unit, it is not dealt with in the depth Smith (2003) would consider appropriate for the CTO role. Next year, however, there are plans to offer a workshop on this very specialised topic that will be facilitated by a consultant with several years experience in the area. The new MSc in Managing IT Innovation will build on the material covered in the Strategic Management of ICT Resources unit to provide students with a more in-depth understanding of the practical problems of managing change and innovation. The IT Intrapreneurship unit of the course will be delivered by technology innovators who will provide case study examples of the strategic management of IT innovation. The Managing Strategic IT Projects unit of the course will focus on the problems of managing major technology projects and focus on techniques for improving project success rates.

Another facet of the CTO role identified by Smith (2003), supporting the Marketing efforts of an organisation, is addressed directly in the Strategic E-Marketing unit on the MSc in E-Commerce. This reviews the application of new technologies in E-Commerce to marketing and shows students how to develop Internet marketing plans and design CRM solutions. The unit includes an additional workshop, facilitated by an external consultant, on setting up and running an e-business. The other two units on the MSc E-Commerce course look at new technologies used to support Internet applications used in marketing and building Web-based solutions to promote company services and products. Smith (2003) argues that CTO's should not only possess marketing knowledge and skills, they should be able to handle media enquiries. This is not something that is addressed directly on any unit, though as will be seen in the next section, the assessed work students undertake aims to develop the professional presentation skills that would be essential to any IT professional communicating with non-specialists.

There are a number of areas covered on the BIT Programme that do not appear in any inventory of the competencies required by CTO's but which are nevertheless useful to those operating at the senior level. The Programme includes, for example, a unit on Strategic Decision Support and Expert Systems. This explores the ways in which decision support and expert systems can support decision-making in modern networked environments. Students identify and model decision support requirements and implementation strategies, develop user interfaces and examine the key issues in managing decision support and expert systems. A unit on Systems Requirements Engineering is included because the failure to ascertain systems requirements correctly is often a key factor in systems failures and therefore a constraint on change. Networking and security issues are dealt with extensively on units of all courses of the Programme because of the importance of telecommunications to modern businesses and the practical, ethical and legal necessity to maintain safe systems.

5. PROGRAMME DELIVERY

Teaching on the BIT Programme takes place in a small group environment. Recruitment is usually limited to twenty so that students can benefit from a high degree of student-staff interaction. In the second semester, when students opt to study the MSc in BIT or E-Commerce, average class size falls to about ten. Feedback from students indicates that this is a very positive aspect of the Programme. Because all students come from a technical background, mainly computing and engineering, and tend to be quiet in manner, the small group environment helps to build self-confidence and encourage peer support and networking skills. Research on the dif-

ferent learning styles of CIO's and CTO's suggests that this may be particularly valuable. A recent survey showed that CTO's are less likely than CIO's to seek advice from colleagues. This may suggest that those attracted to the CTO role are less extroverted than those traditionally recruited to the CIO role.

The assignments students that are given seek to develop their theoretical knowledge and technical skills. However, Programme tutors are acutely aware of the importance of developing CTO's and other senior IT executives who have transferable communication and management skills. Numerous surveys and studies indicate that IT professionals' lack of communication and interpersonal skills is a stumbling block both to systems implementation and personal career development (Bradley and Hebert 1997; Cougar 1998; Lyons, 1995; Zawacki 1992). The assessed work therefore aims to foster students' ability to write business reports, give professional presentations to senior management, work in mixed teams and 'talk the language of business'. Support workshops are provided in some of these areas but the ethos is to 'learn by doing' and to encourage students to help one another.

The strategic focus of the course requires practical input from industry. It is not easy to persuade busy senior executives to deliver aspects of the Programme or mentor students. However, outside speakers do contribute to the Programme on a regular basis and additional workshops are offered that address specific areas of interest to students and staff. Tutors who teach in the Programme are also active researchers and are able to use their industrial and research experience in module delivery. The advice of practitioners is always sought in new course development and in updating courses so that they reflect the real needs of industry.

6. CONCLUSION

The paper has examined the role of the CTO and competencies necessary to carry it out effectively. It has been suggested that the CTO needs to be a business and technology strategist. Traditional executive development programmes are useful in developing the business competencies necessary for the role but the need to remain technically updated calls for a different type of programme delivery. The Business Information Technology Programme at London South Bank University was offered as an example of the specialist provision graduate schools can make to developing tomorrow's CTO's. It focuses specifically on the strategic management of IT and aims to develop many of the business/management competencies that would be useful to those occupying the CTO role.

The success of the Programme can be judged partly by student feedback and whether it helps aspiring senior staff obtain a senior technical position. Unfortunately the Programme has not been running long enough to determine whether it does provide a passport to a senior role. Feedback from students, some of whom have occupied senior roles, however, has been encouraging. Most felt that it comprehensively updated their technical knowledge and approved of the strong 'applications orientation'. Because the Programme is taught on just two consecutive days a week, however, it is 'incredibly intensive and very demanding' and 'not for someone who can't handle the pressure'. Although there are drawbacks to this mode of delivery, the intensity of the course does promote student bonding and helps them to cope with the pressure of an executive role.

Many students come from overseas, some from developing countries, and intend using the skills they acquire to exploit the competitive advantages of IT in their homeland. Although this 'international dimension' was not explicitly considered when the Programme was devised, many of today's senior IT executive managers need to be able to operate in a global environment. Future development of the Programme will aim to meet this need by offering students the opportunity to study part of their degree abroad through the development of international partnerships with universities in other countries. In addition to preparing students for an international role, this will also facilitate transfer of expertise between staff and encourage international research on the strategic management of IT. It will also, hopefully, provide industry with a cadre of highly skilled global CTO's who are able to apply their knowledge of different technical and cultural environments to the strategic management of IT. As the Programme ex-

pands it may also be possible to develop it in distance learning mode whereby students spend short, intensive periods in a formal academic environment and then keep in close e-mail contact with tutors. Such provision would not only increase flexibility, it would encourage students to directly apply their learning in an industrial context, thereby making it even more relevant to real-world experience.

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[i] Source "Gartner Identifies Major Shifts in Chief Information Officer Roles" EDP's Weekly IT Monitor, 19th June 2000.

[ii] Source: "How IT Executives Learn on the Job, www.cio.com, 2nd July 2001

[iii] Structure of the Programme also described in a paper by Flynn (2003).

[iv] See http://www.postgrad.hobsons.com