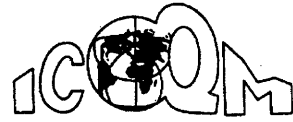


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**Information Technology and Operations Management
*Relationships and Synergies***

**Proceedings of the Third International
Conference on Operations and Quantitative Management
Sydney, December 17-20, 2000**

Editors

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PREFACE

Globalisation of markets, inter-linked business environment, decreasing product/service life cycles, increasing customers' expectations, and rapid changes in process and product technologies, have added complexity to the management of business operations in the 21st century. The usage of ever-changing information and communication technologies as enablers of these changes and their integration with the processes and strategies poses biggest challenge to the operations managers. Understanding the relationships and synergy between information technologies and the operations, and developing appropriate management processes, tools and strategies is critical to succeed in the new business environment. The business in general and the operations managers in particular, must change gears for this shift in paradigm and prepare themselves with the necessary skills and knowledge. The Third International Conference on Operations and Quantitative Management is an attempt to synthesize this multi-faceted knowledge into a meaningful and coherent form that will be useful to operations managers and academics to succeed in rapidly changing global competitive environment. This Conference is organized jointly by the School of Business & Industry Operations Management, University of Western Sydney, Australia, International Journal of Operations & Quantitative Management and Nirma Institute of Management, Ahmedabad, India.

The Conference proceedings consist of 54 papers organized in twelve categories: Information Technology, Operations Management, E-Commerce, Management Information Systems, Supply Chain Management, Manufacturing Strategy, Analytical Hierarchy Process, Multi-Criteria Decision Making, Management Systems in Developing Countries, Optimization Models, Marketing and IT, and General Management. These papers were peer reviewed by a panel of referees. The purpose of this publication is to serve as a valuable reference for operations managers and academics for many years to come after the Conference is over.

We would like to thank Mr. Chris Bennert, CEO & Managing Director, SAP Australia & New Zealand for agreeing to deliver the keynote address and for his support to the Conference. We also acknowledge the support given by Mr. Brian McDonough, General Manager - Atosorigin Australia to the Conference.

Several people have worked hard behind the scenes to organize this Conference and to produce the proceedings. We offer special thanks to Prof. Chris Duke, former President of University of Western Sydney, Nepean, Australia for allowing the School of Business & Industry Operations Management to host this Conference in Sydney. We offer special thanks Dr. Rakesh Agrawal, the Chair of the School of Business & Industry Operations Management for providing necessary facilities, infrastructure and administrative support. We are also grateful to Professors K. Ramanathan, V.

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We would like to specially thank Mrs. Debbie Davis for coordinating the Conference activities from Sydney and Mr. Vipin Goyal from Ahmedabd, India. We also thank Aaron Fung, Rita Soiland and Shayami Karunaweera from Sydney and Celine, Manoj, Prasanta, Anand, and Carmine from Ahmedabad for their valuable support. Our special thanks to several graduate students from both institutions for giving their valuable time in making this Conference a success. We also thank Mr. H. Anil Kumar, the librarian of Nirma Institute of Management, for doing the necessary liaison work with the Tata-McGraw Hill for ensuring timely and quality publication of the proceedings. Finally, we are extremely grateful to Onward Education Pvt. Ltd. for providing partial financial support towards publication of the proceedings.

We gratefully acknowledge the support given by the academic colleagues all around the world by sending their papers and participating in this Conference. We believe that this book of proceedings published by Tata McGraw-Hill contains useful knowledge and information for managing the operations in this new information age.

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E-Commerce in Action: An Educational Response to Re-engineer Today's University Model for the Internet Age



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This paper investigates how the recent developments in electronic commerce on the Internet, could be channeled to re-engineer the predominant (Wilhelm von Humboldt's) university model today. We discuss the difficulties currently faced by universities in general, and suggest the possibilities being created by the emerging Internet technologies. Specifically, we describe a business model with which universities could re-orient themselves as providers of quality education in the digital economy, through re-engineering their fundamental services of knowledge development and transfer. In the paper, we also describe the pedagogic requirements of a digital learning environment whose information strategy may have tremendous implications on electronic commerce, in the area of organizational knowledge management. The paper concludes by bringing forth the challenges behind the re-oriented university model, especially for professors and administrative personnel working in institutions of higher education.

1. Introduction

Today, the predominant university model is still the combination of traditional teaching and academic research as mapped out by Wilhelm von Humboldt, the founder of the University of Berlin in 1809 [6]. But, change is unavoidable in the 21st Century. This change is mainly driven by the new technological possibilities, and the new learning environments [21]. We have witnessed the convergence of computing, communication, and document management technologies, as well as certainly the computer networks, pervading in the Internet. Such technologies have an enormous potential for transforming education to meet the growing need for customized, on-demand learning. Yet, a new model of knowledge production, delivery, and presentation, is needed to combine an individualized approach, flexibility, and ease of dissemination without sacrificing the effectiveness of learning. This model must also offer the learners (or clients), the technological and pedagogical possibilities to collaborate with participants and experts all over the world via the World Wide Web (WWW or Web), and to access online resources integrated into the study materials. However, it is well understood that if our universities were to absorb this model and to retain the longstanding position as our intellectual watering holes, the university today must be redefined with new concepts. And this paper attempts to expound the re-engineering required through looking at university education as an information industry, the prime candidate for being the put of application of today's electronic commerce.

2. The Predicament of Today's Universities

Most universities around the world have financial and structural crisis [5, 6, 21]. They are largely dependent on public financing, but educational and research funding are drying up due to the general tightening in governmental budgets. Also, governments frequently question the economic value of academic research. And the academics in computer science and engineering departments are in an

especially sensitive position. They are aware of the new possibilities that Information Technology (IT) offers, but lacking resources and a clear mandate to effect the necessary changes, they are often playing career academics disillusioned with the general climate and isolated from real changes in the world around them. We agree that universities should master their own expertise and encourage their people to embark in new directions. If we consider the central role of universities as providers of quality education through the process of content generation, courses packaging, and lectures delivery, it is legitimate to ask such questions as: Are they providing a quality service? Are they providing it efficiently? It has been commented that universities are used to operating on live performances, and they seldom store and reuse their contents generated almost every day through their courses and seminars, let alone importing materials from the best possible sources, say, live lectures and discussions from distinguished professors and scientists operating elsewhere. And they hardly have an institutional memory for performance evaluation and amelioration. Further, packaging knowledge in universities takes a very conservative stance. The various faculties package courses in programs with degrees; professors package teaching material in courses with their specific, often compartmentalized, educational and research backgrounds. And degrees and degree requirements make course programs inflexible and programs reflect the university structure, which is often difficult to change. But, we are entering an era when existing knowledge, student interest and generally the world are undergoing so much rapid change. How can our universities continue to package knowledge statically? The dilemma is that new ways of packaging courses will surely affect the current program coordination, degrees, and examinations, and thus accreditation.

3. Education as an Information Industry

To date, universities have to find ways to obtain financial rewards through reusing the content they produce or import. They customarily generate content locally, and dispense courses only regionally to their students. The global market, nevertheless, offers the possibility for content import and course export. Importing materials from the best possible sources, say, specialists or distinguished scientists, could enhance a better quality service. Exporting courses renders a good chance for universities to amortize their costs over a higher volume of students. However, the main purpose for a course must be re-oriented not merely to provide students with a closed set of existing knowledge (soon to be obsolete), but to teach them how to find and correlate knowledge. And, students need to participate in seeking relevant material and learn to learn. It is believed that the universities, which respond the fastest with the best programs, will have a tremendous advantage, particularly in life-long learning where the needs of the students evolve with their careers. Nowadays, instruments for the global delivery of teaching content exist over the Internet. The critical problem is to set up the proper organization within the university. Educational programs are usually structured in years or semesters for organizational reasons. The new model requires that programs should be organized as webs of logically coherent courses for pedagogic reasons. And courses could also be organized as series of logically complete modules, which in turn are serial sets of sessions. In this fashion, teaching material is component-based and is ready for reuse [21]. Besides, each program and all its components need to be dynamic: programs can change their courses; courses can change their modules, and modules their sessions. More importantly, modules can be used within different courses and courses within different programs. Understandably, it is important to have good coordination, evaluation and evolution of all these instructional units. And these activities require some meticulous preparation in personnel and the management structure. Most importantly, universities require insight to decide the areas for which they will be global content providers, based on the judgement that there is a wide demand for that service.

4. Universities as Virtual Organizations

With the rapid advances in networking technologies and the commercialization of the Internet today, universities are well poised to deliver customized educational content worldwide for life-long learners. But this vision often requires establishing an electronic infrastructure within the physical university, to take advantage of the new technologies and opportunities. We call this the *virtual university* (VU) [3], an electronic entity based on the working model of a virtual organization [13], to enable a re-engineered vision of a university's educational process. Typically, the VU have electronic workspaces and digital libraries that provide richer functionality and features than their physical analogs. And it focuses on developing skills and expertise by mass customizing content on demand rather than merely providing terminal degree programs with predetermined curricula. A VU normally comprises an administrative body, instructors, content providers, content reviewers, validation supervisors, and students connected electronically with appropriate control mechanisms. And the VU's electronic infrastructure is generally equipped with a repository for reusable educational components for course development, a document filtering system, an electronic payment system and a user-centered digital learning environment. Operationally, a VU takes educational material from many content providers and from educators on demand, customizing it to student needs and interests, thereby providing the benefit of learning customized knowledge and skills minus the opportunity cost of time and other resources incurred by students. Technically, a VU uses Internet surveys to determine demand for various types of content, then uses software agents to search for content providers. The latter submit their material to reviewers or validators for evaluation as to accuracy, timeliness, relevance, and match with demand areas. These contents are classified as components and sub-components to be assembled later into a full course. When the material is accepted and processed, the administration assigns instructors to various components. When a student makes a request to learn about a certain topic, relevant materials can be gathered and one or more instructors assigned to interact with the student. Given the open nature, global scope, and availability, the Internet and the Web are respectively the ideal platform and client application to support a VU's operations.

5. Opportunities for Electronic Commerce

The re-oriented VU model looks at education as a business and the students as customers [7]. A typical business transaction starts when customers, on approaching the VU, submit their learning needs, specifying the general or exact topic they are interested in. They will give their preferences for language, length of course, time, and medium of delivery. They will also supply the VU with personal profiles detailing their backgrounds and proficiency levels and outlining their professional goals. The students will then use some specially adapted approaches and unique resources in taking the course designed for them. Normally, course delivery, accessible via a Web-based learning environment, comprises of such elements as: *digital libraries*, representing repositories of course elements and other relevant information resources used in the production of *electronic books*, which are study materials customized to the needs of homogeneous groups of learners. Also available are the *learning and collaboration tools*, denoting applications to assist in the learning process for collaborative work, which enables asynchronous and synchronous communication between students and instructors, as well as among students. Moreover, there should be *assessment and feedback tools*, for self-evaluation and for instructors' assessment and feedback.

In practice, a VU is expected to draw on the standard electronic commerce (e-commerce or EC) methods [11] to deliver information over the networks. These could include ensuring the security of this information; carrying out transaction processing and electronic payments; and routing the traffic to the appropriate Internet servers. Security and authentication mechanisms are of high priority because they are needed to guarantee the integrity of the learning materials and to ensure that only authorized

customers have access to the materials and examinations and receive credit on completing the requirements. Besides, development of electronic payment systems based on an efficient and flexible payment scheme is of utmost importance from the suppliers' perspective. When courses combine material elements originating from several sources, it might be necessary to develop a system that can reward the original suppliers based on the rates at which students access their elements, in order to enable seamless alliances among various providers. Certainly, it is in the interest of both the providers and the customers for VU's to establish standards and quality requirements that apply to the electronic educational product and define procedures for the certification and assessment of the learners' progress and achievement.

6. The VU's Digital Framework for EC

It is important to note that e-commerce in the VU's includes not only buying and selling the electronic educational products, but also various processes within and outside the VU that support that goal. Kalakota and Whinston [10] state that four different types of information technology (IT) are commonly involved. These include electronic messaging, sharing the organizational digital library to promote collaborative work; electronic document interchange; electronic funds transfer; and electronic publishing to promote marketing, advertising, sales and customer support. To understand the VU's framework in identifying e-commerce applications, we distinguish the IT applications both inside and outside the system firewall. The former often termed intra-organizational (*intranet*) applications, are internally focused to enhance the existing relationship between parties within the organization, typically by promoting the efficient exchange of information. The latter called Internet (*extranet*) applications, are externally focused to facilitate new business relationships and attract new customers via the organization's Web site.

In electronic markets, the VU's, acting as suppliers of education, will have to adapt to meet the specific needs of a diverse, globally distributed customer base. New players will certainly enter the education and training markets. The competitive business climate often requires a team of separate business partners working together to meet the diverse, complicated market demands. Moore [12] calls this team of cooperative partners the *business ecosystem*, which is suited to assemble the creative ideas to develop complex new products, achieve production agility, and attain a long term customer focus. And the term *extranet* [17] has come to mean a collaborative network using Internet technology to link businesses with their suppliers, customers, or other businesses that share common goals. Alternatively, an *extranet* can be viewed as part of an organization's intranet made accessible to other business partners (customers included) for data mining and processing services.

On the other hand, the term *intronets* [17] presently refer to extranets where external trading partners receive controlled access behind the initiator's firewall and into the initiator's internal networks. They are essentially inter-organizational decision support systems where an external partner uses a Web browser to drill down and pull the desired information into the client application. If the initiator (VU) is able to provide unique, up-to-date valuable information and if the intronet results in changes at the user's organization, the initiator may be in a position to lock-in the trading partner and create a dependency on the intronet. This is a business opportunity sought after. In contrast, the term *supranets* [17] refer to extranets, which are inter-organizational collaborative networks providing seamless communication services among member organizations to engage in cross-application information messaging. Typically, the goals of the supranets are overall efficiency and reduced time to market of business-to-business deliverables, say, new product or service, and increased competitiveness of the entire consortium versus other ecosystems. Under the VU context, the consortium could include cooperative partners in the form of another university, a research center, major publishers, product-tools vendors, or other education brokerages.

7. The VU's Commerce Value Chain

Today, although the convergence of the global Internet with commerce brings some new information technology to support business processes and the exchange of goods and services among businesses (b-b EC), between businesses and consumers (b-c EC), and among consumers (c-c EC), the fundamental business problems remain the same. Namely, we must have something to sell, make it known to potential buyers, accept payment, deliver the goods or service, and provide appropriate service after the sale. Also, we want to create a customer relationship that will bring repeat business. Actually, when a customer buys a manufactured item in a retail outlet, one is enjoying the result of our *commerce value chain* [16]. At each step in that chain, something of value is added along the way in creating and delivering the product. When applied to the VU context, the value chain could include: selecting the educational products (programs + courses) that will be offered; purchasing the course elements from content providers for course packaging; arranging an attractive electronic display; advertising to attract potential students; assisting customers with their selections; taking electronic payments for the product; and delivering the course to the customer. Each of these links in the chain is important to the business, and if any of them breaks down, the whole business is affected.

Indeed, the VU's business can be conceptualized as a basic combination of four core customer-oriented activities: *Attract*, *Interact*, *Act* and *React*. These are considered by Treese and Stewart [20], as the generic value chain in developing a business system for Internet commerce:

Attract Customers: This is the marketing effort to get and keep customer interest. It refers to whatever steps the company takes to draw customers into the primary site, whether by paid advertising on other Web sites, email, television, print, or other forms of promotion. The idea is to make an impression on customers and pull them into the detailed catalog or other information about products and services for sale.

Interact with Customers: This is the sales effort to turn interest into orders. It is generally content-oriented and includes the catalog, publication, or other information available to the customers over the Internet. Technically, the content may be static or dynamic, depending on the respective editorial requirement to change it infrequently or frequently. Static content typically comprises prepared Web pages that must be recreated whenever the information on them changes. Dynamic content is generated on demand, drawing on one or more information sources to produce an appropriate page for the client. It is often used when the natural storage medium is a database, or when the information is used for multiple purpose.

Act on Customer Instructions: This is the function of order management. Once a buyer has searched through a catalog and initiates to make a purchase, there must be a way to capture the order, process payment, handle fulfillment, and other aspects of order processing. An example is to provide the shopping cart convenience for customers to modify purchase content, to discard items, to add new ones, to change the quantities, and to compute additional charges, such as sales tax, and shipping charges.

React to Customer Requests: This is the function of customer service in the form of technical support. After a sale is complete, the customer may have some questions or difficulties that require service. Usually, companies provide the facilities of help desk or service center to handle customer inquiries. Though many questions require a person to answer immediately, often-time many can be handled with an appropriate information system, like a Web-based learning (course support) environment in the VU context.

Although the key components of the value chain can be very different for different industries, and even among different businesses within a specific industry, it is believed that the four core customer-oriented activities would constitute a preliminary approach to organize business online.

8. The VU's Digital Learning Environment

It is intended that the VU's learning experience is not an erratic response to technical advances, but rather it is a genuine attempt to achieve specific educational goals (knowledge development and transfer). In contrast to traditional 'direct transfer' model in which the instructor is assumed to be the sole source of knowledge and skills, the VU's learning model could be an interactive, collaborative knowledge building process [9]. Students actively participate in generating, accessing, and organizing the information. They construct knowledge by formulating their ideas into words and then develop these ideas as they react to other students' or experts' responses to their formulations. The instructor's role is to carefully structure the learning activities, to focus on particular content, and to monitor student work and progress. Knowledge construction can be considered as the process of progressive problem solving, which encourages students to be innovative, create intellectual property, and develop and acquire expertise. Admittedly, this model requires instructors to expend great effort to reformulate their traditional classroom activities. And it involves substantial administrative, organizational and pedagogical challenges. Technically, we need a digital environment that could provide such features as [8]: a standard way to organize course material; tools to support basic instructional activities, including course design, organization of group spaces and personal space, assessment, and easy integration of multiple media files; and models to support learning strategies that involve collaborative learning, knowledge building, and multiple representations of ideas and knowledge structures. In fact, there are implications between electronic commerce and the information strategy underlying the digital learning environment, an important element of the VU.

So far we have been discussing how the Internet technology can be deployed in the market place to extend the reach of organizations (VU's) and to facilitate business-to-business (b-b) and business-to-customer (b-c) transactions. An equally important and related issue is the use of the same technology within an organization (commonly called the *Intranet*) [22]. That is for integrating the internal value chain, managing organizational knowledge, facilitating cross-functional teamwork, and in the case of the VU, enabling collaborative learning between students and instructors and among students themselves. Indeed, a coherent information strategy over the Intranet, is crucial for exploiting the Internet technology for business activities outside the organization, i.e., for electronic commerce. For example, deploying an Intranet for the VU's digital environment, involves such application related issues as: identifying the business objectives for the Intranet, measuring payback, devising data ownership policies, content management, and establishing information sharing mechanisms for knowledge development and transfer. Today, knowledge sharing across functional (and academic) domains is considered as an important and core organizational competence [4]. It is about leveraging the expertise of people and making the most effective use of the intellectual capital of a business. When applied to the VU context, it is important to wire together the brains of appropriate personnel (professors + students + other knowledge workers) so that their sharing, reasoning, and collaboration become almost instinctive and a part of everyday work. According to [4, 14], knowledge management encompasses two components: the process of knowledge creation, and the product of knowledge repository. An Intranet can support both components with the VU's digital learning environment. Namely, on the one hand, it facilitates knowledge management by offering organization members a unifying platform for collaboration, interaction and real-time sharing of information across functional, academic, and geographical boundaries. On the other hand, it serves as a knowledge base to capture and handle unstructured and implicit knowledge embedded in the social relations, surrounding work group processes. Moreover, the ability to search for information based on different criteria, to find linkages between different types of information, to relate information with people, are some of the key aspects of knowledge management that an Intranet can potentially support through the VU's digital environment. Nevertheless, besides the hardware and software which enables electronic contacts among network members, the VU still needs an information strategy. This is to provide a clear vision on how the

various knowledge elements in the organization will be integrated so as to serve the business objectives, and on the specific role the Intranet will play in management [2, 19].

9. The VU's Business Model for EC

Undeniably, EC over the Internet, often termed *Internet commerce* [1], has changed the ways that companies do business. It offers new markets, new ways to get close to customers, and new ways to work with business partners. According to Tapscott [18], the commerce *value chain* is being transformed into a commerce *value network*, as new relationships become possible between organizations and people over the commercial Internet. Thereby, e-commerce refers to improving the value network of suppliers, manufacturers, partners, distributors and customers. Today's EC can support ample electronic business opportunities, of which b-b EC and b-c EC are the most obvious examples. When applied to the VU context, the latter distributes to customers, digital goods such as course (knowledge) products and services online with continuous fulfillment over the Internet. The former, with online catalogs, buys and sells electronic products (course elements) from and to other businesses, forming a supply-chain. And they both deal with digital products and services, whose production cycle constitutes the VU's business model for e-commerce.

According to Porra [15], a digital production cycle refers to a value network of businesses, which together offers value-generative possibilities through creating, marketing, selling and distributing digital concepts in an all-digital business environment. Typically, the cycle is composed of a number of phases which may all be digital: *concept, content creation plan, digital acquisition, manufacturing, product/service versioning, repository, e-commerce policy, electronic distribution, electronic markets, and strategy*. The concept phase is to define the digital product or service to be introduced to the market and the way revenues could be created. Once the digital concept is defined, the creation of the content of the planned product or service is considered. Here we need to identify the digital components of the concept, which make up the digital product and its infrastructure. Actually, behind the digital content, a potentially elaborate set of software applications exists to process the business transaction. They may include applications for browsing, security, catalogs and storefronts, researching products, ordering, payments, online customer support, licensing, royalty accounting, royalty distribution, and online distribution. Next comes the digital acquisition of components. This phase decides whether to make the digital components or to buy them. It will also determine whether it is necessary to make, buy or rent the supporting software applications, or whether to partner with an Internet service provider (ISP) in such areas as online payments or security. As for the digital manufacturing process, it is to employ an iterative approach to rapidly develop the product prototypes using the previously created digital components and supportive services and applications. The purpose of manufacturing is not to perfect the product or the service on the first iteration, but rather it is to create a digital product or service version that can be used to test the concept in the digital market. Hence, we come to the versioning phase where the feedback from customers, is used to enhance the next version of the product or service. All the versions of digital product or service are then put into the public or private repository accessible from the organization's Intranet or Internet. Yet, before the digital product or service is released to the public, it must be shown to conform to the current e-commerce policy established for controlled distribution. Electronic distribution refers to the different ways the digital product or service version can be distributed privately over the Intranet or publicly over the Internet. This delivery may be on-demand based on a retail order, periodical based on a user subscription, or even unsolicited. Finally, it is time to try establishing the Internet markets for the products and services in the digital marketplace. And regardless of the effectiveness of the electronic marketplace, the market feedback will continue to drive the e-commerce strategy of the business.

The cycle model described above demonstrates that the interplay between phases requires continuous reinvention and reconstruction. In a fully digital world, simple changes in one area propagate quickly

throughout the entire product cycle. We are convinced that as we move to Internet commerce, the best performers will be those that can quickly execute their versioning cycles. We agree that the importance of the processes outlined above are not their sequence but their recurrence. Failure to acknowledge this recursive cycling through the processes will result in products and services that become brittle and stagnate easily. We believe that this EC business model is applicable in the VU context, especially for its knowledge products and services. Yet, it only offers a starting point for a tentative solution for digital commerce because so much of the necessary research and real world experimentation of what works and what does not work has yet to be done.

10. The VU's Digital Challenge

The turbulence generated by the integration of IT into higher education has provoked much wishful thinking among educational planners, faculty members, and university administrators, regarding promising projects, such as Web-based course management, groupware for faculty/students, and cooperative environments for teaching, research, administration and system support. Unavoidably, it will be necessary for academics to adjust their teaching, and for administrators to re-examine the business of running a university in the Internet era. Yet, collaboration matters. As Sir Ron Dearing [5] notes: "It may, in some case, make the difference between institutional success and failure. But it needs to apply throughout institutions, from individuals to management teams. There needs to be more encouragement within institutions, for example to support faculty teams to develop their ideas and evaluate the costs and potential of collaboration, and incentives to staff. At the governmental level, there should be scope for more imaginative funding arrangements which would help institutions to get over the initial costs that can sometimes arise from collaboration before the longer term economies arise." We are just at the beginning of creating successful digital universities. The discussion around the e-commerce related issues of the VU, in this paper, represent some preliminary steps into developing a standard approach to reinvent the academy in the digital world. Much work remains to be done, especially in conducting practical experimentation and effective multi-level evaluations of the emerging Internet technologies and the creative business and educational philosophies.

11. Remarks for Continuing Challenges

It may be tempting for universities to consider their current financial situation as temporary and defend the existing structures and roles. Yet, in the inevitable global competition, universities will be exposed to tremendous pressures. Rapid change in economic activity and the great progress of science and technology demand life-long learning. Universities are, thus, compelled to choose and redefine their roles very carefully and concentrate on what they consider their key sectors. In this regard, the Dearing Report [5] has a considerable amount to remind us of the impact that the communications and information technology (C&IT) is having on our academic life, especially related to teaching and administration (quoted from Chapter 13 of the Report):

11.1 Concerning Teaching

- 13.3 "We believe that, for the majority of students, over the next ten years the delivery of some course materials and much of the organization and communication of course arrangements will be conducted by computer. Just as most people will come to expect to be connected to, and to make use of, world communications networks in their daily lives, all students will expect continuous access to the network of the institution(s) at which they are studying, as a crucial link into the learning environment."
- 13.7 "Over the next decade, higher educational services will become an internationally tradable commodity within an increasingly competitive global market. For some programmes, United Kingdom (UK) institutions will rely heavily on C&IT to teach across continents. Within the UK,

by the end of the first decade of the next century, a 'knowledge economy' will have developed in which institutions collaborate in the production and transmission of educational programmes and learning materials on a 'make or buy' basis. We must expect and encourage the development and delivery of core programmes and components of programmes, and sharing and exchange of specialist provision, to become commonplace."

- 13.8 "The development of a world market in learning materials, based on C&IT, will provide scope to higher education institutions to become major participants in this arena. This in turn might lead to the formation of trading partnerships between institutions for the provision of infrastructure, services and content. Such partnerships could include major companies in the communications, media and publishing industries."
- 13.43 "Over the next ten years, all higher education institutions will, and should, progressively move significant aspects of administration and learning and teaching to the computer medium. They should be planning for this now. The development of powerful paperback-sized 'notebook' computers, capable of sending and receiving e-mail and accessing the Internet, is envisaged within the next few years. We expect that this technology will be harnessed by students and institutions for learning and teaching and administration through the development of a Student Portable Computer (SPC)."

11.2 Concerning Administration

- 13.9 "As in other industries and businesses, C&IT is affecting the management and administration of higher education institutions, and is assisting institutions to manage increasingly complex activities and services such as finance, personnel, admissions, time-tabling, data collection, estates management, catering and conferencing. Progress in the successful use of C&IT for these purposes has been mixed but higher education institutions should aim to improve their economy and efficiency by making more effective and extensive use of C&IT."
- 13.10 "While the effective adoption of C&IT in higher education requires appropriate technology, adequate resources and staff development, success depends on the effective management of change. The development and implementation of an integrated C&IT strategy will be one of the main challenges facing managers of higher education institutions."

It is clear that there is a high-level view that teaching is likely to become internationalized, partly as a result of and partly as a driver for the use of our Internet infrastructure and the adoption of both the synchronous and the asynchronous collaborative techniques. Besides, from industrial experience, to achieve the successful deployment of Internet-based collaboration systems, there must be an appropriately conceived networked infrastructure, say, the Intranet/Extranet, a clearly defined C&IT policy, and high-level will, effort, and understanding to make it happen. Also, we need to afford a significant amount of software development, which will allow non-computer-expert academics/administrators to capture their knowledge and interact with their students/colleagues in a relatively straightforward manner.

12. Conclusion

In this paper, the author has presented his perspectives of what transforming effects the ongoing developments of Internet commerce might have on the Humboldtian university model today. Humboldt did the most to spread the notion that universities are places of research [6], whose ultimate value, according to Tschritzis [21], lie in innovations. And an innovation occurs when the standard practices of a community of people shift, so that they are more effective at what they do. Consequently, we are optimistic that the new EC practices outlined here will become the working reality of most universities around the world.

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