Preface

In the not too distant future, the Web will be everywhere in the world. By the year 2003, the explosion of Web-enabled electronic business (e-Business) will be worth more than US $1 trillion and the Web users will be more than 600 million. This is offering organizations previously unheard of opportunities. To be successful or survive, industry leaders have made strategies towards e-Business, and others, sooner or later, more or less, will have to become certain kinds of e-Business.

Web technologies play a critical role in today's Web-enabled e-Business. A key to success in applying the Web-based technologies to real world problems lies in understanding the architectural issues and developing the appropriate methodologies and tools for building e-Business systems. The main purpose of this book, therefore, is to provide the e-Business professionals with a holistic perspective of this field that covers a wide range of topics.

At the very outset of this project, we realized that it is impossible for any one author to write a book of this type and cover all the important aspects of this rapidly emerging field, maintaining the same depth, width and consistency. With this in mind, the main philosophy that was followed in organizing this handbook was to invite experts around the world to contribute their knowledge. Therefore, we identified some of the key topics in this area and invited a wide range of professionals across the globe to contribute a chapter in the area of their expertise to this handbook. This had an overwhelming and enthusiastic response from authors in different parts of the world: Australia, Canada, Germany, Singapore, the United Kingdom, and the United States. We also tried to avoid a hasty approach in the compilation of this book and gave adequate time for it to grow over months of preparation and consultation with the publishers, authors, and reviewers.

The success of this book is to a large extent, due to the collective effort of a great team consisting of the authors and other reviewers. The blind review process included the authors besides other reviewers. The inclusion of the authors in the blind review process improved the quality of the book and also served as an incentive to each author to strengthen his/her write-up. Although the editors initially received many proposals and manuscripts, the stringent quality control measures taken permitted us ultimately to include only 26 chapters, contributed by 51 professionals from 27 universities and five industry organizations in different parts of the world.

READERSHIP

The primary readers of this handbook are professionals, executives and undergraduate/postgraduate students in IT and Computer Science-related areas. Professionals will be able to use this book as an informative technical introduction to areas of their interest in Web-based technologies and architectures. The references provided in each chapter provide additional background to the reader to pursue a more detailed study of any particular aspect.

ORGANIZATION

This handbook is organized in nine sections, with the following major themes:

1. Globalization of E-Business
2. Intelligent Portal Architecture
3. Scalability and Performance
4. Web-based Distributed Data Mining
5. Web Search and Data Retrieval
6. Web Information Systems (WIS) Development: Design, Environment and Standards
7. E-Marketing and Virtual Marketplace
8. Security Architecture
9. E-Business Applications

Each section is organized into chapters. Therefore, the chapters are numbered by Section number followed by the Chapter number in that section.

OVERVIEW

As the book is devoted to a very diverse range of topics written by a large number of professionals and academics, it is felt necessary to provide a bird's eye view of the contents of the chapters at the expense of a longer than a usual preface.

Section I deals with **"Globalization of E-Business"** and consists of two chapters.

Chapter 1 by Daniel Brandon on **"Issues in the Globalization of Electronic Commerce,"** presents globalization aspects of e-Business. While "Globalization" is the marketing and selling of a product outside a company's home country, "Localization" is the process of customizing Web content so that it is most understandable and usable to a person residing in a particular locale. That process involves several aspects, including Language, Culture, Laws/Regulations, Payment/Currency, Dates/Units, and Logistics. This chapter describes the key issues in each these areas and then analyzes approaches that could be used to address these issues.

Chapter 2, **"Electronic Architectures for Bridging the Global Digital Divide: A Comparative Assessment of E-Business Systems Designed to Reach the Global Poor,"** by Nikhilesh Dholakia and Nir Kshetri, presents a comparative view of e-business systems designed to extend the benefits of e-business to the poor demographic segments of the developing world and to reach populations that are on the "wrong side of the digital divide." It aims to fill the research gap by providing a comparative assessment of the architecture of four e-Business networks, across various network architecture dimensions. The architectures discussed in this chapter are designed to provide such services as telemedicine, international trade, e-government, environmental protection, and entertainment to the people in developing countries.

Section II is concerned with **"Intelligent Portal Architecture"** and consists of two chapters.

In Chapter 3 **"Intelligent Business Portals,"** Xue Li describes how portals can be regarded as an information gateway for exchanging business information over the Internet and for delivering the right information to the right user, at the right time, to the right place, to make the right decisions. In order to implement Intelligent Portals, this chapter introduces

a three-layer architecture that reflects the usage of the modern information technology infrastructure. At the development layer, Portals are packaged according to the needs. At the deployment layer, Portals are allocated to their applications. At the top control layer, Portals become knowledgeable and knows how, where, and when to deliver their services. An Information Broker is the key component responsible for implementing the three-layer Intelligent Portal architecture.

In Chapter 4, **" Expert Database Web Portal Architecture,"** Anthony Scime outlines the components of an expert database Web portal, its design, and population. The creation of such a database requires an architecture that captures the expert's domain knowledge and finds and evaluates applicable Web pages from which data is extracted. With expert database Web portals, searchers will be able to locate valuable knowledge on the Web and to access information that has been organized by a domain expert to increase accuracy and completeness. This chapter also discusses a Web page miner architecture.

Section III deals with **"Scalability and Performance"** and consists of two chapters.

Chapter 5, **"Scheduling and Latency—Addressing the Bottleneck"** by Michael J. Oudshoorn, addresses the growing need to distribute the server side of the application in order to meet business objectives and to provide maximum service levels to customers. It focuses on two performance bottlenecks: scheduling and communication latency. Then it discusses an adaptive scheduling system to automatically distribute the application across the available resources such that the distribution evolves to a near optimal allocation tailored to each user, and introduces the concept of ambassadors to minimize communication latency in wide-area distributed applications.

Chapter 6, **"Integration of Database and Internet Technologies for Scalable End-to-end E-commerce Systems"** by K. Se1çuk Candan and Wen-Syan Li, describes the state of art of e-commerce acceleration services and points out their disadvantages, including failure to handle dynamically generated Web content. More specifically, it addresses the two questions faced by e-commerce acceleration systems: (1) what changes do the characteristics of the e-commerce systems require in the popular content delivery architectures and (2) what is the impact of end-to-end (Internet + server) scalability requirements of e-commerce systems on e-commerce server software design. It also introduces an architecture for integrating Internet services, business logic, and database technologies for improving end-to-end scalability of e-commerce systems.

Section IV is concerned with **"Web-Based Distributed Data Mining"** and consists of two chapters.

Chapter 7, "**Internet Delivery of Distributed Data Mining Services: Architectures, Issues and Prospects**" by Shonali Krishnaswamy, Arkady Zaslavsky and Seng Wai Loke, presents on-going research and the operations of commercial data mining service providers. It evaluates different distributed data mining architectural models in the context of their suitability to support Web-based delivery of data mining services and describes emerging technologies and standards in the e-services domain and discusses their impact on a "virtual marketplace of data mining e-services." This chapter is a useful resource for the construction of systems that support Web-based delivery of data mining services and facilitates enhanced understanding of the architectural models, the operational semantics and the underlying technologies.

Chapter 8, **"Data Mining For Web-Enabled Electronic Business Applications"** by Richi Nayak presents data mining concepts and issues that are associated with Web-en-

abled e-business applications such as: (1) analysis of the pattern of user behaviour that reflects the acceptability and satisfaction with a Web site, (2) correlation analysis between Web contents, be it products or documents, and (3) analysis of Web usage data to assist e-business in real-time personalization and cross-marketing strategies. The data mining techniques can provide companies with previously unknown buying patterns and the behaviour of their online customers and other meaningful information.

Section V deals with **"Web Search and Data Retrieval"** and consists of four chapters.

Chapter 9, **" Intelligent Web Search Through Adaptive Learning From Relevance Feedback"** by Zhixiang Chen, Binhai Zhu, and Xiannong Meng, deals with the machine learning approaches to real-time intelligent Web search. The goal is to build an intelligent Web search system that can find the user's desired information with as little relevance feedback from the user as possible. The system can achieve a significant search precision increase with a small number of iterations of user relevance feedback. A new machine learning algorithm is designed as the core of the intelligent search component. With the new algorithm, three intelligent Web search engines, *Websail*, *Yarrow* and *Features,* are built that are able to achieve a significant search precision increase with just four to five iterations of real-time learning from user relevance feedback. It also describes the performances and characteristics of the three search engines and discusses the future research issues regarding real-time intelligent Web search.

Chapter 10, **"World Wide Web Search Engines**" by Wen-Chen Hu and Jyh-Haw Yeh, provides an overview of the current technologies for Web search engines with an emphasis on non-traditional approaches. Numerous search technologies have been applied to Web search engines; however, the dominant search method has yet to be identified. The major reason for this is that the amount of information posted on the WWW is huge and the page formats vary widely. This chapter classifies existing technologies for Web search engines into six categories: 1) hyperlink exploration, 2) information retrieval, 3) metasearches, 4) SQL approaches, 5) content-based multimedia searches, and 6) others. Also it provides a comparative study of major commercial and experimental search engines and some future research directions for Web search engines.

Chapter 11, **"Retrieval of Multimedia Data on the Web: An Architectural Framework"** by Mohammed Moharrum, Stephen Olariu and Hussein Abdel-Wahab, proposes a general architectural framework for a broad array of retrievals of multimedia data required by various applications. This framework has three objectives: (1) proposing a layered architecture to facilitate design and separate different issues, (2) covering a large number of multimedia applications, and finally, (3) making use of existing and well-established technology, such as Mobile Agents, SQL databases, and cache managements schemes. The framework separates issues involved in multimedia retrieval into five layers, namely: keyword searching and data servers, proxy servers, domain and department archives, mobile user agents, and the users. Through these five layers, various customized solutions to a large array of problems will be proposed and applied. The chapter also offers solutions for different problems that arise in retrieval of multimedia data and identifies critical issues involved in multimedia retrieval over the Internet.

In Chapter 12**, "Navigation in e-Business Web Sites,"** Roland Hübscher, Tony Pittarese, and Patricia Lanford focus on certain aspects related to content and usability, two of the most important keys to successful Web sites. They discuss existing problems and point out a series of important user and task characteristics that need to be considered when designing an online store. They concentrate on usability issues of content organization and navi-

gation that are inherently intertwined. Also they discuss the checkout process, an important element of many e-Business, whose design requires not only the usual usability guidelines but also trust issues.

Section VI is concerned with **" Web Information Systems (WIS) Development: Design, Environment and Standards"** and consists of six chapters.

Chapter 13 by V.K. Murthy on **"E-Business Transaction Management in Web Integrated Network Environment"** describes the Operational Models, Programming Paradigms, and Software Tools needed for building a Web-integrated network computing environment. Various interactive distributed computing models (client server- CS, code on demand, remote evaluation, mobile agents, three and N-tier systems) and different logical modes of programming (imperative, declarative, subjunctive, and abductive) are described. Also, transaction and workflow models (that relax atomicity, consistency, isolation, durability, and serializability properties), and new protocols and software tools (PJava/JDBC) are described. Some important application areas of these models are for telediagnosis and cooperative problem solving.

Chapter 14 on **"System Development Methodologies for Web-Enabled E-Business: A Customization Framework"** by Linda V. Knight, Theresa A. Steinbach and Vince Kellen, explores the fit between typical Web-based information system characteristics and existing development methodologies, from the traditional System Development Life Cycle (SDLC) to some of the newer rapid response models. It concludes that, contrary to common practice in most organizations, one standardized development methodology is not best suited for all, or even most, e-business projects. Fifteen variables that are key to identifying the best methodology for a given e-business project are distilled, and a framework is constructed to aid development teams in the process of formulating a customized development methodology to serve as a basis for project management and control. This framework provides a storehouse of options from which project managers can select and tailor methodologies to suit their organizational needs including the unique nature of Web-enabled e-business.

An important key in achieving more effective Web system development within the rapidly changing environment will be a design approach that facilitates the creation of architectures that actively encompass both functional and informational elements, and links it to the business model creating a strong cohesion. This requires an appropriate architectural modeling language and a process for carrying out the architectural design. Chapter 15 by David Lowe and Brian Henderson-Sellers on **"Characterizing Web Systems: Merging Information and Functional Architectures,"** discusses the above aspects, looking at a model of Web systems that emphasizes the links between the various architectural elements and process level support for design activities.

In Chapter 16 , **"Customisation of Internet Multimedia Information Systems Design Through User Modelling,"** Sherry Y. Chen and Marios C. Angelides attempt to incorporate cognitive and interpersonal styles into the design of Internet multimedia information systems. Based on the findings of previous studies, this chapter presents a user model to customize the design of Internet multimedia information systems for different cognitive and interpersonal styles. This model can help designers to decide which levels of navigation support and presentational structures work best for different types of users; it can be applied for providing personalization for users with different preferences. Also, this chapter discusses the implications for the design of Internet multimedia information systems.

Chapter 17, **"A Software Model, Architecture and Environment to Support Web-Based Applications"** by David Kearney and Weiquan Zhao, describes a model, an architecture and

an associated Web Application Support Environment (WASE) that hide the low-level complexity of the existing Web infrastructure and at the same time empower enterprise Web application programmers in their objective of writing modular and easily maintainable software applications for electronic commerce. WASE is not a compiler and does not completely abstract away the unique features of Web infrastructure. It is being constructed using XML documents in its API to allow the function and configurability of applications to be defined in a Web-like fashion.

Chapter 18, **"XML - Digital Glue for the Modern World—Electronic Business Standards Fuelling Intra- and Inter-Enterprise Interoperability for Global Collaboration,"** by Frank Jung, provides information about current XML-related standards for the electronic interchange of business documents. It introduces the principles of the major standards in this area, such as XML, DTDs, XML Schema, XSL, XSLT, XPath, XPointer, DOM and SAX. Also it explains why XML is not only an ideal data interchange format, but is very likely to earn its merits as a very effective format for persistently storing XML-based documents required in the modern e-business world. Finally, the chapter provides a brief introduction to industry initiatives aimed at optimizing the standardized exchange of business documents, such as BizTalk, and others.

Section VII deals with **"E-Marketing and Virtual Marketplace"** and consists of four chapters.

In Chapter 19, **"Designing Agent-Based Negotiation For E-Marketing",** by V.K. Murthy describes how to design agent-based negotiation systems in E-marketing. Such a negotiation scheme requires the construction of a suitable set of rules, called a protocol, among the participating agents. The use of AI planning and the logic and algebra of specifications to devise multi-agent-based negotiation protocols are explained. The construction of the protocol is carried out in two stages: first expressing a program into an object-based rule system and then converting the rule applications into a set of agent-based transactions on a database of active objects represented using high-level data structures. Also it describes an algorithm to detect the termination of the negotiation process.

Chapter 20, **"Virtual Marketplace for Agent-Based Electronic Commerce"** by Chuen Hwee Ng, Sheng-Uei Guan, and Fangming Zhu, proposes an architecture for a mobile agent-based virtual marketplace. As the Internet grows, the potential for conducting electronic commerce grows as well. However, given the explosion of online shopping, searching for particular products amongst the sea of commercial content could become a fundamental obstacle for electronic commerce. Hence, an agent-based virtual marketplace is designed to facilitate agent negotiations by providing a trusted and secure environment. A novel dynamic pricing mechanism has also been implemented in the context of the airline ticketing industry and found to be rather successful.

In Chapter 21**, "Integrated E-Marketing—A Strategy-Driven Technical Analysis Framework."** Simpson Poon, Irfan Altas, and Geoff Fellows propose a framework that addresses the issue of real-time objective-driven E-marketing. They also present approaches that combine real-time data packet analysis integrated with data mining techniques to create a responsive E-marketing campaign. Finally, they discuss some of the potential problems facing E-marketers in the future. This chapter has only explored some preliminary concepts of objective-driven E-marketing, and the challenge is how to integrate the business and technology strategies to maximize the understanding of E-marketing in a dynamic way.

Chapter 22**, "An Agent-Based Architecture for Product Selection and Evaluation under E-Commerce"** by Leng Woon Sim and Sheng-Uei Guan, proposes the establishment of

a trusted Trade Services entity within the electronic commerce agent framework. A Trade Services entity may be set up for each agent community. All products to be sold in the framework are to be registered with the Trade Services. The main objective of the Trade Services is to extend the current use of agents from product selection to include product evaluation in the purchase decision. To take advantage of the agent framework, the Trade Services can be a logical entity that is implemented by a community of expert agents. Each expert agent must be capable of learning about the product category it is designed to handle, as well as the ability to evaluate a specific product in the category. An approach that combines statistical analysis and fuzzy logic reasoning is proposed as one of the learning methodologies for determining the rules for product evaluation.

Section VIII is concerned with **"Security Architecture"** and has two chapters.

Chapter 23, **"An Architecture for Authentication and Authorization of Mobile Agents in E-Commerce"** by Wee Chye Yeo, Sheng-Uei Guan, and Fangming Zhu, describes the design and implementation of agent authentication and authorization schemes. By combining the features of the Java security environment and the Java Cryptographic Extensions, a secure and robust infrastructure is built. Public Key Infrastructure (PKI) is the main technology used in the authentication module. In developing this module, care was taken to protect the public and private keys generated. To verify the integrity of the agent, digital signature is used. The receiving party would use the public keys of the relevant parties to verify that all the information on the agent is intact. In the authorization module, the agent is checked regarding its trustworthiness and a suitable user-defined security policy will be recommended based on the level of authentication the agent has passed.

In Chapter 24,**"Security and Trust of Online Auction Systems in E-Commerce",** P.W. Lei, L.K. Lo ,C.R. Chatwin , R.C.D. Young , M. I. Heywood and N. Zincir-Heywood offer some architectural solutions for reducing online auction fraud in online auction trading.. The discussion herein is restricted to those factors that are deemed critical for ensuring that consumers gain the confidence required to participate in online auctions and hence a broader spectrum of businesses are able to invest in integrating online auction systems into their commercial operations.

Section IX deals with **"E-Business Applications,"** and consists of two chapters.

In Chapter 25 **"E-Commerce and Digital Libraries,"** Suliman Al-Hawamdeh and Schubert Foo discuss a number of outstanding issues, such as those of access control, content management, information organization, and challenges confronting digital libraries in their adoption of e-commerce, including e-commerce charging models.

Chapter 26**, "Electronic Business Over Wireless Device: A Case Study"** by Richi Nayak and Anurag Nayak, presents the basic concepts necessary to understand e-Business over wireless devices (mobile-business or m-business). This paper also presents a case study of the voice-driven airline-ticketing system that can be accessed at any time and anywhere by mobile phones. This application offers maximum functionality while still maintaininga high level of user convenience in terms of input and navigation. Many optimists see m-business as a technology that is just one step before it becomes an everyday occurence.