Preface

The fast advancement in distributed computing and interconnected networks over last two decades or so has extraordinarily increased the role and power of information technology (IT), which consequentially has transformed the ways how the business and public world works and people live around the world. In the commercial and public service world, regardless of types of businesses and services, organizations have unceasingly improved their operational productivities since a variety of applied IT-based systems in support of business operations have dramatically and effectively linked people, isolated systems, computing resources, and information across business constituent units in the organizations. Indeed, as the world has witnessed, the enabled powerful links through enterprise information systems, or simply termed as enterprise systems or IT systems, have continuously increased the flexibility, responsiveness, and capability of business operations, and thus remarkably made business leaner and production faster.

Regardless of the functionality and complexity of a given IT system, it is usually designed and deployed for a predefined business domain need in an organization. It is quite common in an organization that the deployed IT systems were gradually invested over long periods of time. As a result, they are most likely distributed, disparate, heterogeneous, and complex. However, they usually complement each other by playing leading or supporting roles during business operations across business domains. From time to time, their roles are interchangeable and essentially vary with business activities across the organization. For an organization in today’s information era, it becomes a norm that the employed business operations derived from its adopted corporate best practices are largely executed by its employees with the full support of the deployed enterprise systems across the organization.

In business operations, enterprise integration is indispensable for the consistence of the adopted best practices and the realization of agile adjustments for the continuously evolved best practices in an organization. Therefore, for an organization to stay competitive, integrating its deployed disparate, heterogeneous, and complex enterprise systems surely becomes a necessity. More specifically, well integrated enterprise systems facilitate efficient coordination and collaboration in business operations by providing the needed IT services and delivering the right data and information in the right context to the right user (e.g., people, machine, device, software component, etc.) at the right time, in the right place across organizations. From a business perspective, thus it is the effective enterprise integration in an organization that results in the substantial increase of the degree of business process automation, the continual increment of production productivity, the reduction of lead time, and the improvement of product and service quality and end users satisfaction.

Under the pressure of globally intensified market competitions, an organization has to be capable of offering and delivering products or services faster and more cost-effectively than ever before. However, enterprise systems as a whole to support the end-to-end business operations in organizations could gradu-
ally become inefficient, non-adaptable, and hard to make changes as business environments unceasingly change. It is well recognized that the following factors have contributed to the noticeable degradation of enterprise systems as a whole in an organization:

- As time goes, the existing operational support functions in domain-specific enterprise systems that have been deployed over the years cannot be coordinated at the desirable business velocity with the needed operational flexibility in support of the productivity required for a competitive edge in the changing marketplace.
- Best practices evolve along with the changes of business environments, including meeting new customer needs, the introduction of new operations and systems, policy, regulations, etc.
- Business acquisition & merger, or other organizational changes aim to strive for a competitive advantage in business.

Indeed, unless applying smart enterprise integration organizations cannot maximally capitalize on their investments by fully leveraging all the available IT supports enabled by individual applications. Thus, smart enterprise integration is needed for an organization to stay agile and competitive. Business-oriented thinking must be applied in enterprise integration, with a focus on the enablement of rich, flexible, and responsive information linkages in support of the changing business operations across the organization.

Technically, integrating distributed applications across an organization is extremely challenging. Because distributed applications are quite often found to be disparate and heterogeneous in many aspects, there exist many integration methods, patterns, architecture, and corresponding integration technologies. Different technical approaches to implementing enterprise integration result in different outcomes in light of decision-making and/or operation supports in an organization. The following three main categories of outcomes and corresponding technical approaches are summarized from a business operation perspective:

- **Common Data View**: Data-level integration is commonly adopted as a technical approach to synchronizing data across an organization. Because the underlying enterprise integration is purely data-driven, business tasks and activities across business units might not be well coordinated. Delayed actions, irresponsible supports, and human errors frequently contribute to the unsuccessful manufacture of products or unsatisfactory delivery of services. However, the data-driven common view of ongoing business statuses is surely enabled.

- **Functionality Sharing**: Method-level and/or application programming interface (API)-level integration are commonly adopted as technical approaches to enabling business coordination to some extent. The businesses activities are selectively and rigidly coordinated as the sharing requests are frequently triggered by predefined sets of business events. It is essentially task-driven and coordinated in a predefined logic manner. Hence, a business activity might be sitting in a limbo state if an unusual event occurs, e.g. deadlock situation or undefined business activity. In summary, in addition to synchronizing the involved data across enterprise applications, many business activities are rigidly coordinated through functionality sharing.

- **Process Coordination and Business Collaboration**: Process-level integration is commonly adopted as a technical approach to empowering business collaborations. Business activities and tasks can be monitored and coordinated based on designated business rules and logic from end to end in an organization. A successive task can be triggered and executed only if all the preconditions are satisfied, which is warranted by its business flow logic and supporting workflow or
process engines. Frequently, the executed business rules and logic can be dynamically adjusted to reflect the dynamic needs of changing business operations. Business goals are realized through well-coordinated and fully-collaborated business activities across the organization. Essentially, it is business-oriented and goal-driven, in support of the needed business and organizational agility for an organization to stay competitive.

Indeed, implementing effective enterprise integration to meet the business and organizational agility need in larger organizations can be an exceedingly complex and challenging endeavor. There are just too many possibilities as organizations usually have different business foci strategically and tactically at a given time. Different approaches might be taken under different circumstances. Regardless of technical approaches applied in enterprise integration, an applicable enterprise integration solution in practice must be viable, managerially, technically, and financially; it would vary with the enterprise systems, competitions, and business needs and must evolve as time goes.

There are many admirable enterprise integration books focusing on specific integration patterns and technologies, or providing general discussions on enterprise integration from a managerial or architectural perspective. Many vendor-specific books are remarkably good, too. Different from these books, the author of this volume bears in mind that an organization has different integration needs from time to time and must implement business-oriented enterprise integration to realize the needed organizational agility in the long run. As there is no one-size-fits-all solution in conducting effective enterprise integration for all organizations, the evolving trend of business-oriented enterprise systems integration and relevant technologies and patterns is fully explored. Thus, this book uses a systematic and evolutionary approach to present the fundamental understanding and knowledge of enterprise integration. As a result, with or without prior knowledge of enterprise integration, readers can learn both traditional and state-of-the-art integration approaches to cost-effectively architecting and implementing enterprise integration. Step by step, this book succinctly elucidates how enterprise information systems can be practically and effectively integrated by taking advantage of the enabled technologies and the latest advancement in enterprise computing. Ultimately, readers learn and understand that business-oriented thinking must be always applied in enterprise integration so that agile adjustments for the continuously evolved best practices in their organizations with the full support of integrated enterprise systems can be optimally realized.

**BOOK AUDIENCE AND UNIQUENESS**

This book focuses on technical challenges in applying enterprise computing in enterprise integration, with a focus on identifying a managerially, technically, and financially viable solution in support of the evolution of best practices in light of business operations in organizations. Professionals, students in college or graduate schools, professors, and researchers who have certain information technology backgrounds will be the core audience. In general, this book can be used as a textbook in college and professional training. It can also be used as a reference book for integration practitioners or general IT professionals who are interested in information systems integrations in practice.

As discussed earlier, with or without prior knowledge of enterprise integration, readers can learn both traditional and state-of-the-art integration approaches to cost-effectively architecting and implementing enterprise integration. Using practical approaches with a variety of examples is the unique characteristics of this book. Disparate and heterogeneous systems in two fictional organizations are presumably cre-
ated. Accordingly, integration needs are identified; integration programming modules and codes using relevant technical approaches are sequentially provided in corresponding chapters. Hence, readers with appropriate technical backgrounds can easily follow the discussions chapter by chapter and learn the difference made when different technical approaches are applied in enterprise integration. Of course, readers can also skim through them. A programming level understanding of the module or code in a given section is not needed for its following sections or chapters.

**BOOK ORGANIZATION AND THREE RECOMMENDED READING SEQUENCES**

In general, an organization has deployed IT systems incrementally over the years. Most likely distributed, disparate, heterogeneous, and complex IT systems coexist in support of business operations. Because of different integration needs from time to time, different enterprise integration approaches might be justified at different periods of time, technically, financially, and managerially. However, an organization must have a long-term enterprise integration roadmap defined strategically and tactically, focusing on implementing business-oriented enterprise integration to realize the needed organizational agility to stay competitive today and tomorrow.

Bearing the above discussion in mind, the author uses a systematic and evolutionary, yet comprehensive approach to present the fundamental understanding and knowledge of enterprise integration. Specifically, this book mainly presents 1) a comprehensive review of information systems integration patterns, 2) a unified description of the software application integration issues, and 3) an appropriate approach to integrating enterprise information systems so that enterprise systems will be flexible and responsive.

More specifically while technically, this book discusses enterprise integration by fully elucidating the concepts and technologies of computing and networks, approaches to achieving data and functionality sharing, and means to leveraging application programming interface, service computing, service-oriented architecture, service bus, and business process management. More importantly, this book explains how enterprise businesses can be well aligned with information technology to realize business goals while improving business and organizational agility. The book is essentially organized as follows (see Figure 1 for a depiction).

- **Chapter 1:** Providing the necessary background information on the evolution of computing and networks technologies.
- **Chapter 2:** Using a fictional retailer’s enterprise systems to discuss the business needs for enterprise integration and the grand challenges with which integration practitioners could confront.
- **Chapter 3:** Presenting the technical foundation of enterprise integration by focusing on the basic integration mechanisms, patterns, and technologies that have been applied in integrating enterprise systems over the years.
- **Chapter 4:** Explaining how middleware technologies emerged for managing distributed computing and services across enterprise systems. Standard integration mechanisms, patterns, and technologies have evolved for managing distributed computing and services in a heterogeneous computing setting, emphatically introducing the efficiency, effectiveness, and transparency of common shared integration infrastructures.
Figure 1.

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Three Recommended Reading/Teaching Sequences

- Chapter 1 - Evolution of Computing and Networks Technologies
- Chapter 2 - Importance and Challenge of Enterprise Integration
- Chapter 3 - Enterprise Integration Technical Foundation

Dotted boxes: chapters can be skimmed through
• **Chapter 5**: Showing how Web services are readily deployed, published, located, and invoked over the heterogeneous networks by fully taking advantage of the quick development of the service concept and modeling with the support of the Internet-based standard protocols.

• **Chapter 6**: Articulating the evolution of middleware technologies. Middleware has been widely considered as a facilitator that provides passive and universal connectivity across enterprise systems and takes an active role in promoting and supporting the practice of service-orientation principles and enterprise service computing technologies in achieving agile enterprise integration.

• **Chapter 7**: Elucidating four levels of hierarchical integration approaches, data-, method-, API-, and process-levels. They are essential for meeting the different enterprise needs under different circumstances, technically, financially, and managerially.

• **Chapters 8, 9 and 10**: Advocating the necessity of aligning enterprise systems and business objectives through fully leveraging disparate and distributed enterprise systems, global connectivity, and integration technologies in organizations. The latest advancements of service-oriented architecture, enterprise service computing, and business process management should be smartly and effectively applied in the design, development, and management of enterprise integration.

This book can be used several ways. The following three reading sequences are recommended to three different groups of readers.

• **Technical implementation and management track**: Chapter by chapter, a systematic and evolutionary while comprehensive presentation of enterprise integration will be learned. Readers will understand that different enterprise integration approaches are necessary and might be justified under different circumstances, technically, financially, and managerially. Readers will surely learn that an appropriate approach must be applied in the design and development of integrated enterprise systems, so that the resultant and integrated enterprise systems are flexible and responsive.

• **Service-oriented architecture, services, and process management track**: Without delving into too many technical details in computing and legacy systems, readers can focus on the state of the art in enterprise integration, aimed at architecting and implementing Web services, service-oriented architecture, and business process management in organizations.

• **Systems reengineering, architecture, and management track**: Readers would like to reengineer their legacy systems, define enterprise integration architecture, and manage enterprise integration projects. This track is not a short-cut of the first track. This track fulfills an immediate need when reengineering legacy systems is in urgent.

This book never intends to cover the recent emerging hot topics, such as big data, business intelligence, business analytics, cloud computing, social computing, and mobile computing. They are surely beyond the scope of this book. Some of these concepts are briefly mentioned in Chapter 10, aimed at assisting readers in understanding that emerging IT services in support of more business and organizational needs can be readily included through well-done enterprise integration. Once again, this book simply intends to provide readers a systematic and evolutionary while comprehensive approach to recap or learn the fundamentals of enterprise integration using practical and technical examples. Ultimately, this book helps readers understand how to enable rich, flexible, and responsive information links in support of the changing business operations across organizations.
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