Preface

I am not sure exactly when the importance of enterprise architecture (EA) dawned on me. What is clear is that it wasn’t a “one fine day” realization, rather a result of numerous conversations with CIOs, IT managers, CFOs, process managers, and multiple research studies that convinced me that EA is perhaps the most important and the most misunderstood idea in information technology (IT) and a critical emerging discipline to elevate the role of IT organizations in enterprises. Metaphorically, an EA is to an organization’s operations and systems as a set of blueprints is to a building. This handbook, unlike any other available today, aims:

• To provide a comprehensive and unified overview of practical aspects of EA.
• To integrate EA theory and concepts to field-tested methods, practical strategic issues, and implementation challenges.
• To illustrate development methods and the process cycle through case studies and detailed examples.
• To provide insights into the impact of effective EA on IT governance, IT portfolio management, IT risks, and IT outsourcing.
• To demonstrate the criticality of EA economics and its role in the strategic value of IT.

This handbook is a compilation of 26 chapters on enterprise architecture written by practitioners and practicing academics from countries including Australia, France, Germany, India, Israel, Norway, Netherlands, Singapore, South Africa, South Korea, Switzerland, Portugal, United Kingdom, and the United States of America. The authors of these chapters were included in the review process in addition to having their submissions reviewed by a panel of independent reviewers. The handbook has been “foreworded” by John Zachman, the “father” of the Zachman Framework; undoubtedly the first formal framework in the discipline of EA and Dr. Scott Bernard, an accomplished EA practitioner who is now also an academic being associated with the Carnegie Mellon University.

The chapters in the handbook have been selected with the intention to address professionals with a wide variety of interests and with different levels of EA knowledge. The handbook has a very strong practical orientation and is primarily targeted at:

• CIOs, IT/IS managers, architects, analysts, and designers seeking better, quicker, and easier approaches to respond to needs of their internal and external customers.
• Line-of-Business managers concerned with maximizing business value of IT and business competitiveness.
• CTOs of business software companies interested in incorporating EA to differentiate their products and services and increasing the value proposition to their customers.
• Consultants and practitioners desirous of new solutions and technologies to improve the productivity of their corporate clients.
• MIS and IT educators interested in imparting knowledge about this vital discipline.
• Researchers looking to uncover and characterize new research problems and programs. IT professionals involved with organizational technology strategic planning, technology procurement, management of technology projects, consulting and advising on technology issues, and management of total cost of IT ownership.
The handbook is structured logically into five parts. Section I on frameworks and methodologies focuses on approaches and mechanisms that organizations use to develop their architecture blueprints. Section II on governance and management shows how organizations initiate and sustain their EA practices. Section III provides insights into how organizations employ EA to drive their transformation programs, gain tighter business-IT alignment, and realize business value out of their IT investments. Section IV consists of descriptions of the adoption of EA in large and small organizations with insights on key practical challenges they face and how the whole EA programmes are sustained. Finally, Section V demonstrates the role of technology, especially service-oriented architecture (SOA) in EA implementation.

Section I: Frameworks and Methodologies
Section I is a collection of chapters describing approaches and methods used by organizations to plan and develop their EA blueprints.

Chapter I: A Synergistic Assessment of the Federal Enterprise Architecture Framework against GERAM (ISO15704:2000), by Pallab Saha of the National University of Singapore, evaluates synergies between the comprehensive FEAF against the generalized enterprise reference architecture and methodology (GERAM) framework. The federal enterprise architecture framework (FEAF) is perhaps the most adopted EA framework, especially within the U.S. Government agencies. Either FEAF has been adopted as-is or other frameworks derived from FEAF have been used. FEAF today continues to be the most comprehensive framework available for guidance by agencies. It consists of a full-fledged methodology, several reference models, target architectures, and even a toolkit that facilitates adoption across all agencies. The chapter discusses the level of completeness in the FEAF based on GERAM requirements and additionally identifies areas where the FEAF goes well beyond GERAM requirements.

Chapter II: Extreme Architecture Framework: A Minimalist Framework for Modern Times, by Phil Robinson of Lonsdale Systems, Australia and Floris Gout, an Independent Consultant based in Australia, presents an EA framework that is lightweight and selective to meet the needs of the organization. The chapter uses the “agile” approach to develop architectural artifacts. It starts with the need for frameworks and some of the currently popular frameworks. Then it argues why interoperability both at systems and human level is critical followed by a discussion on the relevant architectural views that is derived from the XAF matrix and elements that need to be created. The chapter concludes with a comparison of the proposed framework with other established frameworks from the point of view of simplicity and ease of use.

Chapter III: Discovering and Modelling Enterprise Engineering Project Processes, by Ovidiu Noran from Griffith University, Australia, provides a meta-methodology based on existing architecture frameworks that facilitates organizations to assess and select architectural elements and artifacts within the context of specific EA program requirements. The proposed approach in the chapter allows organizations to configure their EA programme, instead of “doing the whole nine yards” for every situation. The chapter illustrates the proposed approach with a real-life case study.

Chapter IV: Enterprise Architecture Framework for Agile and Interoperable Virtual Enterprises, by Tae-Young Kim, Sunjae Lee, Jeong-Soo Lee, and Kwangsoo Kim of the Pohang University of Science and Technology, South Korea and Cheol-Han Kim from Daejeon University, South Korea, presents a modeling framework that business architects and domain specialists can use to build and configure architectural elements and models specifically for virtual enterprises (VE). The chapter uses and improves upon existing modeling standards and practices (like BPMN, UML, MDA) and applies concepts of service-oriented architecture (SOA) to make organizations more responsive to change.
Chapter V: Activity-Based Methodology for Development and Analysis of Integrated DoD Architectures, by Steven J. Ring and Dave Nicholson from the MITRE Corporation, USA and Stanley Harris, Lockheed Martin Corporation, USA, presents the DOD defined methodology that uses DODAF to create architecture outputs. Activity-based methodology (ABM) discussed in this chapter is presented as a step-by-step approach that allows a common reference point for all architectural assets in terms of scope, breadth, depth and intensity. Several DOD entities have adopted or are in the process of adopting ABM, thereby providing credence to its applicability in practice.

Chapter VI: Business Process Modeling as a Blueprint for Enterprise Architecture by Joseph Barjis of Georgia Southern University, USA and Isaac Barjis of City University of New York, USA, presents a Petri-net-based methodology, transaction-oriented Petri-nets (TOP), to enterprise process modeling. The chapter starts with a brief background of existing architecture frameworks and discusses the role of business architecture. Then it presents the details of the TOP notation, following which the complete TOP methodology framework is discussed in a step-by-step manner with examples provided to illustrate each step and their respective output.

Chapter VII: Enterprise Architecture in the Singapore Government by Tan Eng Pheng and Gan Wei Boon from Infocomm Development Authority of Singapore, Singapore, is a discussion of the role of enterprise architecture in the Singapore’s e-government programmes. The chapter discusses the evolution of the country’s e-government action plans and policies and examines the linkages and role that EA plays including IT governance and investment planning. The chapter briefly presents the currently ongoing efforts within the government to define reference models that are intended for use by agencies to develop their own EA in alignment with the overall Government-wide EA. Within the current e-government plan, the iGOV 2010, EA is one the three key pillars of programme success.

Section II: Governance and Management
Section II of the handbook comprises of chapters that are useful to institute and sustain the EA practice within the organization.

Chapter VIII: Understanding and Communicating with Enterprise Architecture Users, by Steven Thornton from the National Institutes of Health, USA, discusses current best practices and provides guidelines in communicating EA to the users. The recommended approaches and practices presented in the chapter are derived from the United States National Institutes of Health (NIH) EA programmes. The intent of this chapter is to educate CIOs and chief architects about the need to communicate EA, recommended approaches, and its key benefits to the EA programme.

Chapter IX: Improving Stakeholder Communications and IT Engagement: A Case Study Perspective, by Gail L. Verley of the Federal Deposit Insurance Corporation, USA, continues on the theme of architecture governance and management. This chapter begins with a discussion on the need to improve stakeholder communications and enhance engagement with the users in an EA programme. The chapter presents five steps to involve stakeholders in EA programmes, followed by ten strategies and mechanisms to institutionalize stakeholder involvement. The application of the steps, strategies, and mechanisms presented in the chapter are illustrated through a detailed case study of United States Federal Deposit Insurance Corporation (FDIC). The chapter concludes with a set of lessons learned that organizations can refer to.

Chapter X: The Role of Change Management in IT Systems Implementation, by Ron S. Kenett of KPA Limited, Israel and Sebastiano Lombardo from the Foundation for Scientific and Industrial Research at the Norwegian Institute of Technology (NTH), Norway, presents an integrated holistic approach to IT systems implementation called the better enterprise systems implementation (BEST). The chapter treats IT systems implementation as an organizational development issue and positions the BEST methodology as an approach to manage IT driven organizational change. The chapter then illustrates the application of the methodology through three case studies in Norway and Israel.

Chapter XI: Managing Enterprise Architecture Change, by Tim O’Neill, Mark Denford, and John Leaney of the University of Technology Sydney, Australia and Kyle Dunsire from Avolution Pty. Limited, Australia,
is a description of an approach that allows organizations to simulate, predict, and control the emergent properties of enterprise systems from an architectural perspective. The chapter argues that existing methodologies and toolsets are by nature bottom-up and often fail to take into consideration the non-functional requirements of the IT systems from an architectural viewpoint. The chapter begins with a brief discussion of the key non-functional requirements that most IT systems are expected to fulfill. It then presents a five-step methodology that organizations can use to build and evolve their architectures. The chapter concludes with the benefits of the proposed methodology.

Section III: Transformation and Value Realization
This section of the handbook focuses on how organizations use EA to facilitate and drive their organizational transformation objectives seeking to enhance alignment between their business and IT functions. Business value of IT being a key point in today’s IT organizations is covered in this part by way of how EA is used to realize economic value.

Chapter XII: Architecture Driven Business Transformation, by Chris Lawrence of Old Mutual South Africa, South Africa, presents an approach where EA is viewed as a business issue. The chapter starts with a discussion on business transformation that is triggered through EA. The chapter argues that EA is an imperative irrespective of the business condition that an organization might be in and places forth business diagnostics as a key element of any architectural initiative. The chapter illustrates the application of the proposed approach in a financial services organization and discusses process driven business transformation. The chapter then concludes with a discussion on non-process driven business transformation and why process architecture based transformation was used as an example.

Chapter XIII: Maturity of IT-Business Alignment: An Assessment Tool, by Nel Wognum of the University of Twente, The Netherlands and Fan Ip-Shing from Cranfield University, United Kingdom, presents such an approach based on better enterprise systems implementation (BEST). In doing this, the two key questions addressed are what problems can be pre-empted and what can be done about them. The chapter then continues to illustrate the proposed approach through several mini-cases derived out of real-life scenarios. The chapter concludes with a discussion on areas for further research. Most large IT system implementation initiatives are plagued by several factors that often make implementations less than desirable. While factors leading to failure for large IT implementations have been documented and analyzed, the intriguing issue is that organizations seem to repeat the same mistakes over and over again. This necessitates the need for a mechanism that allows planners and managers to evaluate the start-up situation in such projects, including capturing the project dynamics in a coherent manner.

Chapter XIV: The Integrated Enterprise Life Cycle: Enterprise Architecture, Investment Management, and System Development, by Frank J. Armour from Armour LLc, USA, Chris Emery and Jonathan Houk of the U.S. Architect of Capitol, USA, Stephen H. Kaisler from SET Associates, USA, and John S. “Stan” Kirk from the U.S. National Science Foundation, USA, explores and discusses the linkages that EA has with IT investment management and system development processes and hence the need for a holistic approach. In doing so, it proposes an integrated enterprise life cycle (IELC). The chapter starts with a discussion of the IELC and its various components. The chapter positions IELC as a key IT governance mechanism and presents several governance archetypes that are part of the IELC. The chapter concludes with a brief discussion on the proposed move towards IELC by the U.S. Office of Management and Budget (OMB) and U.S. General Accounting Office (GAO) under the Federal Enterprise Architecture (FEA) program.

Chapter XV: Promoting Netcentricity through the Use of Enterprise Architecture, by Supriya Ghosh from Lockheed Martin Corporation, USA, presents U.S. Department of Defense (DOD)’s goal of net-centric transformation as an implementation of EA. The chapter argues that to achieve net-centricity the existence of an integrated architecture provided by the DOD Global Information Grid (GIG) is a key imperative. The chapter then provides an overview of the key performance parameters to support net readiness. It details the adoption of net-centric transformation through the use of net-centric data strategy, net-centric IA strategy, service-oriented
architecture (SOA), and communications transport strategy. The chapter concludes with a discussion on upcoming and future trends to enable DOD’s move towards net-centricity.

Section IV: Implementation and Deployment
Section IV of the handbook looks at EA from an ongoing implementation and transition perspective through cases both in large and small organization scenarios.

Chapter XVI: Enterprise Architecture as an Enabler for E-Governance: An Indian Perspective, by Raghunath Mahapatra of Ernst & Young India, India and Sinnakkrishnan Perumal from the Indian Institute of Management Calcutta, India, is a case study on application of EA to develop an efficient and effective e-governance system for citizen services administration by the Government of India. The chapter starts with a background on various e-government initiatives, including a brief discussion on the administrative structure in India. The chapter then puts forth key imperatives that are required for successful e-government programs, keeping in mind the Indian context. EA is then presented as one the critical success factors. The chapter continues with a detailed discussion of a proposed framework (derived from the Zachman Framework) that facilitates the application of EA in the context of e-government in India. The chapter concludes with a mapping of the earlier presented imperatives to the key elements of the proposed framework.

Chapter XVII: Federated Enterprise Resource Planning Systems, by Nico Brehm from the Carl-von-Ossietzky-Universität Oldenburg, Germany, Daniel Lübke from the University Hannover, Germany, and Jorge Marx Gómez from the Carl-von-Ossietzky-Universität Oldenburg, Germany, presents enterprise resource planning (ERP) system architecture that makes individual business modules reusable through the use of Web services based on shared and non-monolithic architecture. The chapter is based on a practical challenge that enterprises currently face wherein systems (especially the ERP tools) have proprietary data models, thus limiting their usage and in conflict to their claim of being positioned as “enterprise systems.” This leads to vendor lock-in. The chapter begins with a background on existing ERP systems with a discussion of their limitations as real enterprise systems. The chapter then presents the federated ERP system approach and discusses how the federated approach addresses the shortcomings of existing “siloed” ERP systems. The chapter concludes with a discussion on the kind of adoption challenges that the federated approach might face along with a short brief on future trends and research.

Chapter XVIII: A Network Based View of Enterprise Architecture, by Bala Iyer of Babson College and David Dreyfus of Boston University, USA and Per Gyllstrom, PFPC Worldwide Inc., USA, moves away from the traditional four sub-architecture-based view of EA and takes a network-based view that is based on understanding and capturing the dependencies between the elements of the EA. The proposed approach asserts that such dependencies are a factor of time and typically emerge as the architecture evolves. Dependencies that emerge during the design, deployment, and operations of the EA are based on both technical and social factors. The chapter presents a case study of the application of the proposed approach in a financial services company. The chapter concludes with a discussion of the limitations of the proposed approach and presents pointers to how the limitations can be addressed.

Chapter XIX: Enterprise Architecture by a Small Unit in a Federated Organization, by Roger Sliva from the State of Nevada, USA, presents experiences and best practices in developing EA by a small team for a federated organization. A federated structure is typical in many governments where the administrative structure is organized into national/federal entities followed by states, districts, or provinces. Given the federated structure, developing EA presents several practical challenges. The chapter discusses factors to be considered in such a scenario when developing EA in terms of scope, intensity, use of tools, open standards, shared business services, and programme governance.

Chapter XX: The Syngenta Architecture Story, by Peter Hungerford from Syngenta AG., Switzerland, presents the experiences of development and evolution of EA at Syngenta. The key drivers in Syngenta’s architecture programme are business efficiency, growth, and innovation. The chapter shares the experiences and insights from several business areas. The case studies presented in the chapter includes EA initiatives like server
rationalization and development of global infrastructure services, integrated “go-to-market” platform, providing an unified research platform, and building an enterprise-wide business intelligence. The chapter then presents a simple framework for EA and discusses the case studies in the context of the framework. The chapter concludes with future trends and discusses a few plausible areas of research.

**Chapter XXI:** The Use of GERAM for Design of a Virtual Enterprise for a Ship Maintenance Consortium, by John Mo from the Commonwealth Scientific and Industrial Research Organization, Australia, describes the application of the generalized enterprise reference architecture and methodology (GERAM) in analyzing the ANZAC ship alliance (ASA). The chapter discusses the details of the use of GERAM in developing and studying a virtual enterprise, especially issues relating to logistics and information architecture management needed to support the operations of ASA as a virtual enterprise. The chapter starts with a brief overview of the GERAM including the key reasons of why it was selected for use. The chapter then describes ASA as a virtual enterprise including the peculiarities and nuances of a virtual enterprise. The chapter concludes with a description of enterprise engineering programme at ASA, the artifacts and models developed based on GERAM requirements.

**Chapter XXII:** Information Systems Architecture for Business Process Modelling, by Michel Spadoni of the Ecole Nationale d’Ingénieurs de Metz & Laboratory for Industrial and Mechanical Engineering, France and Anis Abdmouleh from Metz University and Laboratory for Industrial and Mechanical Engineering, France, is a description of business process modeling capabilities within the CIMOSA application server (CAS). The CAS is an information system for enterprise modeling and designing. The chapter starts with a brief overview of the problems that is faced by organizations in integrating their disparate systems. Then it describes the CAS project, its goals and objectives and the primary reason for selecting CIMOSA as the reference architecture. Following this, the chapter describes the CIMOSA modeling framework and conceptual model. The chapter then describes the business process modeling aspects with an example of a manufacturing organization including the views and artifacts needed to support the requirements of enterprise systems.

**Section V: Technology and Service-Oriented Architecture**

This section of the handbook is a compilation of chapters on the role technology plays in an architectural initiative.

**Chapter XXIII:** Enterprise Architecture within the Service-Oriented Enterprise, by Scott J. Dowell of Shirnia & Dowell LLC, USA, elaborates the role of EA in a service-oriented enterprise (SOE). Driven by the need to the adaptable, agile, and responsive to change, organizations are now adopting the SOE paradigm where organizations view themselves as a bundle of services that are available for use through technology enablement. The chapter begins with the issues that enterprise architects need to grapple with, namely, business services, service-oriented solutions, infrastructure services, and IT organization changes. It goes on to compare a traditional enterprise with a SOE. The chapter then discusses the development of strategy in a SOE and its peculiarities. The chapter provides real-life examples on various aspects of service orientation adopted by various organizations.

**Chapter XXIV:** A Fundamental SOA Approach to Rebuilding Enterprise Architecture for a Local Government after a Disaster, by Zachary B. Wheeler of SDDM Technology, USA, is a case study of the reestablishment of EA for the local Government following Hurricane Katrina in Louisiana. The chapter presents an approach to address areas in EA that have not received much attention as part of preparedness, response, and recovery phases. The chapter proposes the use of SOA paradigm to address some of the key issues. The chapter starts with a brief background of the underlying EA framework that was used in the given situation, followed by a detailed description of the conceptual data model and how a critical portion of the EA was developed. The chapter concludes with a discussion on other technologies that can be used to extend the current solution.

**Chapter XXV:** Business Networking with Web Services—Supporting the Full Life Cycle of Business Collaborations, by Diogo R. Ferreira from the Technical University of Lisbon, Portugal, proposes to use the Web services paradigm as a way to deal with all aspects of business collaborations. The chapter starts with an overview of Web services as an integration platform, followed by a description of the criticality of the life cycle approach in integration. The chapter demonstrates with examples the use of Web services in extending its support of
operational aspects alone to the full life cycle of business collaborations, thereby enabling seamless e-business collaborations and trading.

Chapter XXVI: Enterprise Integration Architecture for Harmonized Messaging, by Dat Cao Ma, Belinda Carter, Shazia W. Sadiq, and Maria E. Orlowska, University of Queensland, Australia, presents a rule-based enterprise integration approach enabled through messaging technology. The chapter begins with the challenges of large-scale collaborative systems and the evolution of technology solutions to address some of the challenges. The chapter then presents the proposed enterprise integration architecture and an overview of related technologies. Following this, the chapter elaborates the steps in rule design, validation, and deployment and its adoption within the proposed integration architecture. The chapter concludes with a discussion on future developments in the proposed area.

In conclusion, I hope that this handbook makes its contribution to the emerging discipline of EA, which is only going to gain importance in organizations. I would like to invite readers to share their comments about the handbook in addition to their success stories that may well spawn of future editions of this Handbook.

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