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# **Enterprise Information Systems and Advancing Business Solutions**

## **Emerging Models**



**Madjid Tavana**

# Enterprise Information Systems and Advancing Business Solutions: Emerging Models

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## Preface

This book is dedicated to emerging models in enterprise information systems and advancing business solutions. The book is divided into three sections. The first section presents seven papers that focus on emerging enterprise resource planning strategies. ERP systems are complex, computer-centric systems designed to carry out the most common business functions in organizations, including finance, accounting, human resources, and operations. Such systems enable companies to move from an isolated functional view to a process view of both information system development and business activities. Given their flexibility and applicability to organizations of varying sizes and industrial sectors, and that such systems come embedded with best business processes, ERP systems have become the technology of choice for organizations attempting to reduce waste in their value chain and better integrate functional areas within their organization and members of their supply chain. Much of the value of ERP systems lies in the infrastructure foundation they created for future growth based on information technology. The first part of this foundation is common data. To make an ERP system work in an enterprise, everyone must enter data into ERP systems using the same format. As a result, the data becomes transparent and easy to compare. The second element of this foundation is standardized business processes. ERP requires standardization to reduce the number of process variants that must be supported. Drastic changes are normally needed so that orders can be fulfilled consistently throughout the enterprise. The third part of the foundation is an unconventional leadership structure. Companies implementing ERP systems often learn the need for leadership the hard way in information technology initiatives, rather than conventional line structures.

The second section presents five papers focusing on emerging enterprise information technologies such as enterprise architecture, cloud computing, and autonomous information systems. These papers look at the perceived ability of information technology infrastructure integration and supply chain process integration and show how some new technologies such as cloud computing will take the enterprise architecture discipline a step forward towards the integration of advanced enterprise information technologies.

In the third section, the authors present eight papers that focus on the emerging software development technologies. The Semantic Web is the leading Web development, and domain ontologies are the most important part of semantic Web applications. In recent years, many mainstream and evolutionary methods have been proposed for using software engineering techniques to bring ontology development process closer to wider practitioners' population. This section provides insight into the field of the semantic Web and ontology engineering.

An ERP system is an integrated set of software packages that help organizations integrate their information flow and business processes by using a single database that collects and stores data with a standardized user interface. The implementation of ERP systems by organizations has grown rapidly

world-wide in anticipation for achieving better business performance and sustaining competitive advantages. ERP systems can benefit organizations by enabling faster information transactions, increasing productivity, maintaining tightened supply chain links, reducing inventory costs, improving business processes, and increasing customer responsiveness. Researchers have developed different models to study users' perception of information systems. One of the most frequently employed models is the technology acceptance model, which is an adaptation of the theory of reasoned action with a focus on the user acceptance of information systems. Mouakket, in his paper entitled "*Extending the Technology Acceptance Model to Investigate the Utilization of ERP Systems*," extends the technology acceptance model to investigate employees' utilization of ERP systems. In his proposed model, computer self-efficacy and ERP systems design features affect perceived usefulness and perceived ease of use, which in turn affect ERP system utilization. The goal of this study is to explore these relationships and determine whether the addition of ERP system design features to the technology acceptance model increases its predictive or explanatory power. This study makes valuable contributions to the ERP research and practice. First, Mouakket incorporates computer self-efficacy and ERP systems design features as exogenous factors affecting ERP systems utilization through technology acceptance model's core constructs. Technology acceptance model has been considered a valuable model for tracing the indirect effects of external factors on information system acceptance behavior. Therefore, the results of this study provide further evidence to technology acceptance model's ability to mediate the influence of exogenous factors. Furthermore, most previous research has focused on common and well-known technologies such as spreadsheets, while the present study investigates the utilization of a rather complex and difficult technology, namely ERP systems. Finally, since computer self-efficacy has demonstrated positive direct effect on perceived ease of use and indirect effect on ERP systems utilization, managers should enhance employees' self-efficacy towards the utilization of this technology to improve the perception of ease of use and lessen the perception of system complexity and difficulty. He concludes that managers need to focus on ease of use and emphasize the simplicity of an information system to obtain more favorable attitudes towards system utilization. Providing user support methods such as training sessions can significantly improve users' perception of the information system ease of use.

ERP solutions support general business technology of a certain business sector. Jakupovic et al., in their paper entitled "*A Proposition for Classification of Business Sectors by ERP Solutions Support*," illustrate the results of their analysis of business sectors covered by ERP solutions. They answer the question of which business sectors are supported by ERP solutions and provide a list of supported business sectors. They use statistical analysis and answer the question whether there are any business sectors supported by large number of ERP solutions, and whether it is possible to classify business sectors based on the occurrence of the support. They study the following characteristics in the existing ERP solution analyses: the average solution implementation cost, the average number of users, the coverage of application areas, the coverage of a certain market segment, applied technology, stability, flexibility, security, documentation, adaptability of the ERP solution, the level of support, upgrade reliability, improvement continuity, and return of investment. They propose unique classifications of business sectors. The first classification suggests that the number of newly supported business sectors increases faster than the number of business sectors where the support is increasing. The second classification shows that the larger number of business sectors are either weakly or excellently supported. The third classification suggests that there is constancy in higher classes of business sectors ERP support, which opens up the problem of maintaining the constancy. The fourth classification illustrates the existence of dynamics between middle classes of supporting business sectors by ERP solutions; i.e. business sectors do not stay long in the second class.



They either go back to the first class or move up to the third class. Each business sector in a class can go through four scenarios: it stays in the same class for an extended period of time (which means that the number of ERP producers supporting it is not changed), it moves up to a higher class (which means that the number of ERP producers supporting it is on the increase), moves down to a lower class (which means that the number of ERP producers supporting it is on the decrease), or completely vanishes from the classification (which means that all ERP producers have renounced their support of this particular business sector). They argue that there are several reasons for classification changes or vanishing of a business sector. Some of these reasons include: (1) non-profitability of business software development, which is the reason why some business sectors never enter the classification (e.g. only a few organizations belong to the particular business sector); (2) business sector is far too complex for supporting it by an business software (gathering knowledge on the business sector is a time-consuming process); (3) business software for a business sector fails (renouncement of the solution happens); and (4) business software for a business sector is profitable so most ERP producers support it (then the business sector moves up to a higher class).

Peslak and Boyle, in their paper entitled "*An Exploratory Study of the Key Skills for Entry-Level ERP Employees*," explore a series of key information technology skills and determine what skills organizations view as important for entry-level ERP employees. With the critical ERP skills identified, employers can focus on these key areas in recruitment and development activities and improve their success rate for ERP implementation and support. In addition to examining the relative importance of these key skills, they elicits a number of factors that can be used for summary proficiency analysis and help organizations quickly assess employee qualifications for entry level ERP positions. To explore the key skills required for entry-level ERP positions, they develop a Web-based survey. The results of their study suggest that there are four key areas that practitioners view as vital for recent ERP graduates to possess prior to joining their organization. These skills, in order of importance, are: team skills, business and application understanding, project management, and systems analysis and integration. One of the surprising and interesting findings of this study is that technical skills are not found to be the most important skills for ERP graduates, and they do not become of part of the significant factors. Support hardware, networks, operating systems, and support of existing portfolio of applications all are found to be at the bottom of key skills and are not a part of the significant factors. They conclude that it is imperative for the ERP curricula to meet the needs of today's practitioners. They propose that the educators and practitioners together should prepare future ERP knowledge workers and optimize their business implementations and improve organizational performance.

The blending of Internet technologies and traditional business concerns is impacting all industries. The Internet drives the current industry goals of a shorter order-to-delivery cycle, global reach, and personalization. However, without connecting order delivery, manufacturing, financial, human resources, and other back office systems to the Internet, even companies with long track records of innovation are not likely to succeed. Srinivasan, in his paper entitled "*E-Business and ERP: A Conceptual Framework towards the Business Transformation to an Integrated E-Supply Chain*," argues that the most successful companies will be those that leverage their investment in Web based technologies by implementing e-Business solutions supported by sound existing infrastructures based on well-functioning ERP systems. He argues that today, companies need to forge tighter links up and down the supply chain, from raw materials to customers. Web-based technology puts life and breadth into ERP technology that is large, technologically cumbersome, and does not easily reveal its value. At the same time, ERP allows e-Business to come into fruition, putting real substance behind that flashy webpage. While ERP orga-



nizes information within the enterprise, e-Business disseminates information far and wide. In light of the fact that ERP and e-Business technologies supercharge each other, he: (1) presents a framework for understanding e-Business opportunities within the context of a traditional enterprise and its infrastructure; (2) examines the evolving relationship between e-Business and ERP to understand how companies can move ahead to gain competitive advantage (using ERP to leverage and take advantage of the business opportunities opened up by the Internet and e-Business); (3) examines and discusses the role of ERP today and in the context of new business models enabled by e-Business and associated technologies, and that represent the next step in organizational evolution; (4) discusses recent developments in the area of e-supply chain, supply chain integration, and other technological developments; and (5) addresses the issues and challenges faced by organizations in moving to an e-Business environment. This paper is useful to both the research academician and the practicing manager who are interested in understanding the issues, opportunities, and challenges in the ERP and e-Business relationship and how these link to the e-supply chain transformation. More importantly, the paper provides a comprehensive discussion of the factors involved in the complete e-Business enterprise transformation.

Zarei and Naeli, in their paper entitled "*Critical Success Factors in Enterprise Resource Planning Implementation: A Case-Study Approach*," study the ERP critical success/failure factors by using case study methodology. They aim at recognizing the critical success factors for ERP implementation by reviewing the most critical and relevant literature, examine the level of adhering to the identified success factors in a case study, and investigate the impacts of each critical success factor on ERP implementation and on the other factors in a selected company chosen for the case study. They select five most critical factors from the literatures and show the impacts of each factor on other factors and ERP success in the selected company. They conclude that ERP implementation is a very challenging and risky project for organizations and confirm the impacts of the five selected factors on the success of ERP implementation as mentioned in the literatures. Their results reveal that the five critical success factors are highly interdependent, and the strengths and weaknesses of each of them influence the quality of ERP implementation to a large extent.

The implementation of ERP systems requires huge investments. In spite of that, a considerable number of ERP implementation projects fail or take longer than initially planned. Previous studies have shown that the aim of rapid implementation of such projects has not been successful and the failure of the fundamental goals in these projects has imposed huge costs to investors and shareholders. These failures have reduced overall profits and resulted in skepticism among the managers and investors about the overall benefits of ERP systems. Hence, it is important to understand the factors that determine the success or failure of ERP implementation. Hanafizadeh et al., in their paper entitled "*The Core Critical Success Factors in Implementation of Enterprise Resource Planning Systems*," study the critical success factors in implementing ERP systems and develop a conceptual model, which can serve as a basis for ERP project managers. These critical success factors, that are "core critical success factors," are extracted from 62 published papers using the content analysis and the entropy method. They verify their conceptual model in the context of five multinational companies.

Sankar, in his paper entitled "*Factors that Improve ERP Implementation Strategies in an Organization*," presents an exploratory research aimed at identifying factors that led to the success of the enterprise resource planning (ERP) implementation at Robert Bosch GmbH during the period 1992-2004. He records snapshots of the implementation process at two points in time: 2000 and 2004. On each occasion, the Chief Information Officers in Stuttgart, Germany (corporate headquarters) and in Broadview, Illinois (the headquarters of Robert Bosch US) were interviewed. Sankar highlights (1) improving effectiveness

of implementation, (2) identifying specific activities that impact the mass of resource endowments, (3) identifying activities that accelerate resource commitment, and (4) identifying the forceful activities that result as the findings of his study. These findings are useful for both academicians who teach and conduct research on ERP implementation strategies, and the practitioners who design and implement them. For practicing managers, he stresses the importance of leadership and communication. He argues that once an organization makes a choice to implement an ERP system, it is easy to make the assumption that the processes in the organization will be automatically streamlined and efficiencies improved. He shows in his case study that the choice of a system is only a part of the equation. Leadership, effective communication, and commitment of the information technology staff are essential to make the system deliver the expected results. He concludes that committing large resources to the project, adopting corporate standards that promote process harmonization, making a few lumpy important decisions that are irreversible, and obtaining support from top management are essential factors to consider when implementing ERP systems.

Outsourcing has become a major trend in various industries and business processes due to globalization and the development of information technology. This trend is not an exception to supply chain management. As logistics service providers become more experienced and sophisticated in their offerings, more and more firms are turning to logistics services providers for such activities as warehousing, packaging, order fulfillment, and transportation. However, the role of information technology and information systems in these outsourced activities is not very clear. In general, there is an agreement that information technology and information systems are the enablers of outsourcing; they help firms control outsourced activities, communicate with outsourced product and/or service providers, and eventually collaborate with third party logistics providers. Sometimes, however, information technology and information systems themselves are subject to outsourcing. What will happen to information technology and information systems when firms outsource supply chain processes? Joo et al., in their paper entitled “*Future State of Outsourcing Supply Chain Information Systems: An Analysis of Survey Results*,” attempt to answer this question by utilizing a survey approach. They show that some firms may utilize internal systems, some may outsource to the provider, while still others may outsource to supply chain management information systems providers. The purpose of their study is to acquire knowledge that will help clarify the direction of outsourcing from an information systems utilization perspective. Their study helps both practitioners and researchers understand outsourcing trends by industries, and in particular, the relationship between outsourced supply chain processes and information technologies/information systems. Their study is especially valuable to the firms that plan on outsourcing supply chain processes and/or information systems. They conclude that the future state of outsourcing supply chain information systems looks promising. They show that as the level of globalization increases, supply chain leaders will emerge, and the necessity for new robust information systems will follow. As outsourcing of supply chain processes grow at an approximate rate of twenty percent annually, outsourcing information systems will increase at about half that (ten percent annually). They argue that all functional areas will need information system support to provide the visibility of supply chain to all participants in the supply chain. The supply chain as a whole will increase in collaboration and communication in the future. Thus, information technology support will be needed to interface supply chain functions with other cross-functional areas, which will call for internal and external system support and maintenance.

Angeles, in her paper entitled “*Effects of Reciprocal Investments and Relational Interaction in Deploying RFID Supply Chain Systems*,” looks at the perceived ability of information technology infrastructure integration and supply chain process integration to moderate the relationship between business process

specificity and domain knowledge specificity, and two dependent variables, reciprocal investments and relational interaction using the moderated regression procedure. Her results show that information technology infrastructure integration moderates the relationship between both business process specificity and relational interaction, and domain knowledge specificity and also, relational interaction. Her findings affirm the importance of both the information technology infrastructure integration and supply chain process integration elements that undergird RFID system implementation. She argues that managers need to be aware that current developments directly relate to these elements of the infrastructure environment as their firms seek either or both operational efficiency and market knowledge creation. She also emphasizes that planning for the design or reengineering of business processes to achieve cross-functional process integration and supply chain process integration is a very involved activity as well and one taken seriously by cutting-edge firms. She describes the five levels of business process integration identified in the literature for RFID systems: goal setting assessment, slap and ship, application integration, business process improvement, and collaborative business intelligence. She shows that cross-functional application integration and supply chain process integration are both clear issues in application integration and business process improvement levels. She further argue that managers should be aware of new technologies such as the use of smart RFID networks that would allow the use of event-driven RFID business applications and react to real-time information and assist the movement to business process improvement level. She confirms that complex RFID services could be delivered using real-time events such as pushing alerts to a retail store manager when inventory for a particular product is aging or has reached “stale” status. Finally, considering the scale and scope of RFID systems within a supply chain context, she concludes that managers need to anticipate the processing of the escalating numbers of events created by RFID technologies that will eventually lead to the generation of increasingly complex business rules that will govern the routing and analysis of signals included in the event stream.

The rush to technology has created several flaws when it comes to managing computers, applications, middleware, and information systems. As a result, organizations struggle to understand how all these elements are behaving. As enterprise architectures grow in significance and are acknowledged as advantageous artifacts to help manage change, their benefit to the organization has yet to be fully explored. Duarte and Vasconcelos, in their paper entitled “*Evaluating Enterprise Information Systems: Constructing a Model Processing Framework*,” focus on the challenge of real-time information systems evaluation, using the enterprise architecture as a boundary object and a base for communication. They present a parallel between the field of phenomenology (which studies human and group experience and phenomena) and the acts of judging the behavior of architectural components by transforming their observable variables. They further propose an automated cycle of evaluation using the enterprise architecture as the standpoint and communication medium between all parties to help modelers, analysts and every participant in the enterprise community. Their solution is comprised of five major steps: establishing a strong conceptual base on the evaluation of information systems, defining a high level language for this activity, extending an architecture creation pipeline, creating a framework that automates it, and finally, implementing this framework. Their conceptual framework avoids imprecise definitions of quality and quality attributes. This conceptualization is materialized in a model-eval-display loop framework, and is implemented using model driven software development practices and tools. Finally, they apply prototype to a real-world scenario in order to verify the conceptual solution in practice.

The evolution of networks and large scale information systems has led to the rise of data sources that are usually distributed, heterogeneous, and autonomous. Yu, in his paper entitled “*Message-Based*

*Approach to Master Data Synchronization among Autonomous Information Systems,”* presents a novel message-based approach to the synchronization of master data among multiple autonomous information systems. Different from traditional approaches based on database triggers, they adopt the optimistic bidirectional strategy with the process of two synchronization phases. By means of data service buses, they propagate synchronized master data through messages passing along star-like cascading routes. They show that their approach could resolve possible data conflicts automatically using predefined attribute confidences and deducible current value confidences respectively. Finally, they present a real-world case study about synchronizing datasets among four separate but related systems based on their novel message-based approach. They summarize that the message-based data synchronization framework is configured with shared data centers and service buses. It resolves master data conflicts with the help of attribute confidences and current value confidences, respectively. In other words, those from the system with higher confidence values are allowed to overwrite those from the system with lower ones. By means of data service buses, their framework propagates master data through messages passing along star-like cascading routes, and dumps master data in the shared centers. Their approach could ensure the reliable synchronization by message buffering under poor networking condition. They conclude that unlike the traditional trigger-based approaches, their approach is more flexible, extendable, and easier to provide the global data view.

Cloud computing has spread within the enterprise over the last five years much faster than many past information technology innovations. In cloud computing, computer services are accessed over the Internet in a scalable fashion, where the user is abstracted in varying degrees from the actual hardware and software and pays only for resources used. While the technology is increasingly well-understood by the enterprise, few know how to deploy cloud-based systems in the most effective and appropriate way within their specific organization. Arinze and Anandarajan, in their paper entitled “*Factors that Determine the Adoption of Cloud Computing: A Global Perspective,*” study the adoption of cloud computing worldwide. They examine the potential of cloud computing to significantly impact computing in developing countries. They also review factors such as privacy rules, technological infrastructure, and regional laws to understand if there are latent factors that determine what types of cloud computing are adopted in various industries and regions. They propose that patterns of cloud computing adoption will vary by industry and by company type. They also suggest that cloud computing offers varying benefits and will appear differently in various regions across the world, enabling many users to obtain sophisticated computing architectures and applications that are cost-prohibitive for many to acquire locally. They scrutinize issues of privacy, security, and reliability of cloud computing and discuss the outlook for firms and individuals in both developing and developed countries seeking to utilize cloud computing for some or all of their computing needs. They conclude that the key to cloud computing is the software that handles user access and resource allocation among user applications, in a transparent manner, to many users, via a mix of computing devices. These devices are shared by multiple users, enabling higher server utilization rates and correspondingly lower user prices than is typically the case in dedicated server environments. They also suggest that such service elasticity and instant provisioning of new resources is a distinguishing feature of cloud computing, as well as increasing levels of reliability for provided services. Users need only pay for services used, so new applications can begin at a price point far lower than would be the case with dedicated private, or even hosted servers. Finally, they propose that cloud services can be brought online much quicker than would be the case in internal computing environments, often in a matter of minutes. This enables firms of all kinds to minimize their involvement in building and maintaining computing infrastructures, and instead, focus on their core competencies.



Ontology languages are emerging as the standard for capturing semantics on the Web. Over the past decade, the research community has focused on addressing how to define reusable ontologies or ontology parts or how to construct ontology from possibly independently developed components. Pradel et al., in their paper entitled “*A Good Role Model for Ontologies: Collaborations*” argue that ontologies are often not engineered in a component-based manner due to a lack of appropriate constructs in current ontology languages. This hampers reuse and makes creating new ontologies from existing building blocks difficult. They propose to apply the notion of roles and role modeling to ontologies and present an extension of the web ontology language for this purpose. Ontological role models allow for clearly separating different concerns of a domain and constitute an intuitive reuse unit. In this article, Pradel et al. introduce role modeling to ontologies. They show how role modeling can bring several benefits to ontologies and ontological modeling including: (1) more natural ontological modeling by separating roles from classes; (2) an appropriate notion and size of reusable ontological components - role models; and (3) separation of concerns by capturing a single concern in a role model. They make the case that role models constitute useful and natural units for component-based ontology engineering. Role models are developed as components and intended to be deployed as such, in contrast to existing approaches aimed at extracting ontological units from ontologies not necessarily designed to be modular. While they argue that modeling with roles is beneficial to ontological modeling and provides a new kind of component not previously considered for ontologies, the transition from object-orientation is not straightforward. Pradel et al. introduce modeling primitives to support roles in ontologies and a discussion of the main differences for role modeling between ontologies and object-oriented models. To convince the research community of the usefulness of role models, they demonstrate their use on two examples. The first example shows separation of concerns, and the second example demonstrates reuse of role models in different contexts. In conclusion, they argue that role models provide an interesting reuse abstraction for ontologies, and roles should be supported as an ontological primitive.

Developing new software based on requirements specifications created by business analysts may lead to misunderstanding because of the different backgrounds of the people involved in the systems analysis and design phase of systems development life cycle. Due to the multidisciplinary nature of systems development, in times of offshoring there are different cultures involved, there are always people with different apprenticeships (business analysts, software engineers, documentation engineers, etc.), which hinders a common understanding of the terms used. This obstacle can be resolved if requirements specifications have a clearly defined structure and comprehensive semantics. Only with the application of linguistics-based modeling methods and a semantic annotation of the terms adopted in requirements specifications can these obstacles be overcome. Lautenbacher et al., in their paper entitled “*Linguistics-Based Modeling Methods and Ontologies in Requirements Engineering*,” propose to structure the requirements specifications using existing linguistics-based modeling methods and annotate the used terms with ontologies to enhance the understanding and reuse of these documents during the software engineering process. In their article, Lautenbacher et al. describe the challenges of current documents and the difference of understanding some data between sender and recipient. They describe their definition of data and how the communication between different persons takes place. They also show how different linguistics-based modeling methods can be used to clarify the underlying meaning of terms. They evaluate several linguistics-based modeling methods and show a summary of their evaluation. They use an example to clarify the application of the modeling methods as well as introduce the process and benefits of semantic annotation through the usage of ontologies. They conclude with the benefits of using linguistics-based modeling methods and ontologies.

Semantic user interfaces are sets of interrelated, static, and domain specific documents with layout and content, whose interpretation is defined through semantic decoration. Semantic user interfaces are declarative in nature as they allow program composition by the users themselves at the user interface level. The operation of semantic user interface-based applications follow a service-oriented approach where their elements referenced in user requests are automatically mapped to reusable service provider components, whose contracts are specified in domain ontologies. This assures semantic separation of user interface components from elements of the underlying application system infrastructure. Tilly and Porkoláb, in their paper entitled “*Semantic User Interfaces*,” present the architecture and components of a semantic user interface framework along with the basic elements of semantic user interface documents and their relevant properties of domain ontologies. They also explain the representation and operation of semantic user interface applications through a motivating example. They conclude with the following important advantages of the semantic user interface documents: (1) separation of concerns between stakeholders; (2) platform and device independence; (3) user interaction simplification; (4) learnability; and (5) reusability.

Standards play a major role in a firm’s operational effectiveness and often make the difference between success and failure. A new class of compatibility standards known as vertical standards has emerged in the last decade. Vertical standards focus on business processes and data formats specific to individual industries and are generally implemented using the eXtensible Markup Language (XML) due to its flexibility and extensibility. Mendoza and Ravichandran in their paper entitled “*Drivers of Organizational Participation in XML-Based Industry Standardization Efforts*” explore the motivation for participation in the development of vertical standards for supply-side (i.e. vendors) and demand-side (i.e. end-users) organizations in the face of these linked dilemmas. They test two linear regression models using constructs that explore the effect of resource and interest heterogeneity in the participation of supply-side and demand-side firms in XML-based vertical standards development activities. Their results provide evidence of the existence of passive adopters in vertical standards development activities, and highlight the need for further work to understand the extent of supply-side influence in development activities. Their results also show there may be greater vendor influence in vertical standards development than previously understood, even as end-users retain strategic control of the development path. While supply-side participation seems driven by commercial business interests, demand-side participation is motivated by protecting compatibility with existing investments in business processes and data formats, while minimizing investment. Their data provides an empirical confirmation of the presence of passive adopters in vertical standards development. This is an important finding for supply-side organizations, because it confirms their participation in standards development efforts can generate business opportunities before standards completion. Suppliers can become sources of expertise to demand-side organizations to help them understand the applicability and functionality of the emerging standard and reducing barriers to later diffusion. Confirmation of the existence of passive adopter behavior is also important for demand-side organizations, because passive adoption may allow supply-side firms to take control of the strategic direction of vertical standards development activities, or to manipulate vertical standards compatibility to introduce switching costs, as has been observed with physical products. They conclude that these findings should be of interest to standards-developing organizations, because they show that it is possible to exploit industry standards based on open technologies, such as XML, for competitive advantage during the development cycle, and not only during or after the adoption stage. They propose that additional research is necessary to determine how standards-developing organizations solve resource

problems when faced with passive adopters. It is possible passive adopters withhold participation and resources in exchange for a commitment to adopt the end result, without which the adoption stage may fail.

In a follow-up paper, entitled “*An Empirical Evaluation of the Assimilation of Industry-Specific Data Standards Using Firm-Level and Community-Level Constructs*,” Mendoza and Ravichandran show that vertical standards are complex technologies with an organizational adoption locus, but subject to inter-organizational dependence and network effects. They argue that understanding the assimilation process for vertical standards requires that both firm- and industry-level effects be considered simultaneously. They develop and evaluate a two-level model of organizational assimilation that includes both firm- and industry-level effects. The study was conducted in collaboration with OASIS, a leading cross-industry standards-development organization, and with ACORD, the principal standards-development organization for the insurance and financial services industries. Their results confirm the usefulness of incorporating firm-level and community-level constructs in the study of complex networked technologies. Specifically, their reconceptualization of the classical diffusion of innovations theory concepts of relative advantage and complexity are shown to be appropriate and significant in predicting vertical standards assimilation. Additionally, they show community-level constructs such as orphaning risk and standard legitimation to be important predictors of assimilation.

Many different Web development methodologies have been proposed to address different aspects of Web application development. Applications involving Semantic Web service technology require the inclusion of new components. Therefore, Web development methodologies must be tailored to support the systematic development of such new components. Sánchez et al., in their paper entitled “*Toward UML-Compliant Semantic Web Services Development*,” focus on the study of object constraint language as a tool to refine the unified modeling language profile in order to represent the axiom definition using a language closer to the perspective of software developers. As part of unified modeling language family, they consider object constraint language to be a good choice as a means to represent logical expressions. They also validate the adoption of object constraint language for the representation through several case studies.

Several systems integration proposals have been suggested over the years. However, most of these proposals have do not allow users to take advantage of services offered by Web portals. Most of them only provide a set of design principles to build integrated systems and lack in suggesting a systematic way of how to develop systems based on the integration architecture they propose. Acuña et al., in their paper entitled “*Integrating Web Portals with Semantic Web Services: A Case Study*,” review a Web portal integration architecture called PISA, and a Web portal integration architecture for data and services, called MIDAS-S. They present a case study to show how both architectures fit together integrating Web portals.

The utilization of version control systems is a prerequisite in successful collaborative software development. Over the past decade, a multitude of pessimistic as well as optimistic version control systems has emerged for model artifacts. Pessimistic approaches follow the lock-edit-unlock paradigm, whereas optimistic approaches allow parallel editing of one resource. The optimistic approaches are preferred to the pessimistic ones. Such tools should be independent of the modeling environment and applicable to various modeling languages to be flexible for the ever increasing variety of modeling environments and languages. Those version control systems characteristics may implicate a lack of information for the conflict detection method by virtue of firstly receiving solely the state of an artifact without concrete editing operations and secondly due to unavailable knowledge about the semantics of a modeling language. However, in optimistic version control systems concurrent changes can result in conflicts and inconsistencies. In environment and language independent version control systems inconsistencies



would even arise more often due to information losses. Therefore, accurate conflict detection methods are indispensable for the realization of such version control systems. Altmanninger et al., in their paper entitled “*Semantics for Accurate Conflict Detection in SMOVer: Specification, Detection and Presentation by Example*,” tackle this task by proposing the semantically enhanced model version control system (SMoVer). They show that With SMOVer it is possible to specify the semantics of a modeling language, needed for conflict detection in order to provide more accurate conflict reports than other current environment and language independent version control systems. They show how semantics of a specific modeling language can be specified in SMOVer, how those specifications can improve the accuracy of conflict reports, and finally how those can be presented to modelers.

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## Section 1

# Emerging Enterprise Resource Planning Strategies