A FRAMEWORK FOR ERP INTEGRATION

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Abstract: Companies try to seamlessly integrate all areas of their business by adopting technologies such as business process reengineering, supply chain management, ERP and customer relationship management in an attempt to address increasing global competition. ERP is still the most used technology for enterprise integration. This paper presents a six-level framework of ERP enterprise integration and defines the prerequisite requirements for effective integration at each level. The proposed framework should provide ground for some interesting future research directions in ERP integration.

1 INTRODUCTION

ERP is the most used technology for enterprise integration. Its primary strategic advantage is enhanced enterprise integration (Bingi et al., 1999; Saccomano, 1999) that provides a comprehensive, updated and realistic view of the business. Estimates suggest that the ERP market will grow to $60 billion by 2004 (Callaway, 2000; Mabert et al., 2000). However, 50-66% of all system projects fail (Scheer et al., 2000) because success depends on disruptive changes in business processes (Kremers et al., 2000; Soh et al., 2000) and corporate culture that are aligned with the ERP system (Hasselbring, 2000). Consequently, managers find it difficult to justify large IT expenditures when financial benefits are uncertain (Davenport, 1998; Deutsch, 1998). Nevertheless, it is widely believed that seamless integration of an enterprise improves company performance (Chalmeta et al., 2001).

Since ERP is a solution to integration, we address two primary research questions. (1) Are there different levels of ERP integration that may be appropriate for companies seeking to integrate their business? (2) What does it take to satisfy integration at a particular level? To address question one we present a framework of ERP enterprise integration and for question two we define the prerequisite requirements for effective integration at each level.

2 ERP AND INTEGRATION DEFINDED

Today's ERP systems are rooted in MRP II (Markus et al., 2000) but differ in many ways. They commonly run on client/server architectures instead of MRP II's server-based technology. ERP systems support an even broader range of business processes and functional areas than MRP II, and are used in a variety of industries including manufacturing.

Integration is the bringing together of related components to form a unified whole. It provides the foundation for coordination, collaboration, and synergy, and provides a holistic approach to decision-making, management, and control. Integration is a collection of computer information systems, manufacturing systems, engineering systems, production systems, management systems, distribution systems, financial and accounting systems, and people, that perform as a unit. When these entities are optimally combined, they perform in concert to achieve the organization's objectives (Grant, 1995). Organizations should be seamlessly integrated if they are to successfully compete in the global economy. The timely information required to run a successful agile company cannot be realized if companies avoid taking a holistic approach to integration. ERP is the technology of choice for achieving integration. However, the success and

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failure of ERP depends on how effectively companies use the system to improve integration.

An examination of companies that implemented ERP systems reveal that they are at very different stages of integration. Main (1990) has questioned whether some firms have achieved it. He thinks there is no universally accepted definition and objective measures of integration. Multiple definitions, subjective measures, and their concomitant interpretations, are testament that integration is neither static nor absolute. Therefore, we need a framework that accommodates multiple levels of ERP integration and better definitions of integration. This may aid in the understanding, managing, and implementing of ERP. This is why we propose this framework of varying degrees of integration. It provides some measure of objectivity for future deliberations on integration.

3 A FRAMEWORK FOR ERP INTEGRATION

The proposed framework of ERP integration (figure 1.) was developed after considering previous models of integration (Mathew, 1988; Bullers and Reid, 1990; Burbidge et al., 1987; Meredith and Hill, 1990; Truman, 2000).

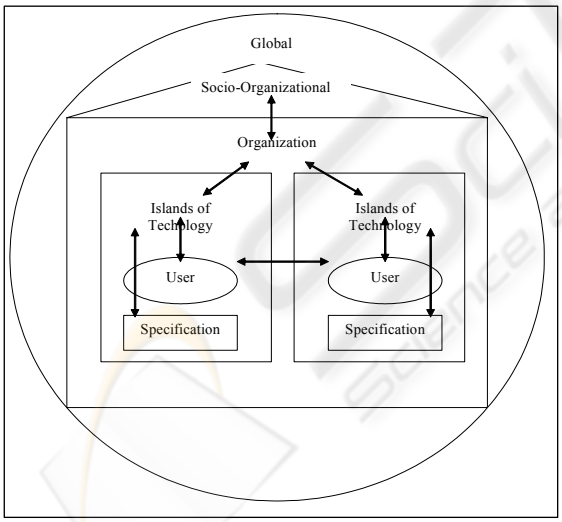

Figure1: A Framework of ERP Integration

Level-I: System-Specification Integration

Level-I is concerned with two types of integration: specification integration and compatibility integration. Specification integration must satisfy the system technical design specifications at the software, hardware, and application levels of stand-alone equipment. This is similar to middleware integration discussed by Hasselbring (2000). The primary concern is to ensure that the system performs its prescribed function as required by users in the most efficient and effective manner. Compatibility integration deals with the level of compatibility between the various components of the system. For example, application programs and the related software must be compatible with the operating system.

Level-II: System-User Integration

This level is primarily concerned with ensuring that users are integrated with the technology, both hardware and software. At this level there are two types of integration: ergonomic integration and cognitive integration. Ergonomic integration ensures that the system is ergonomically designed. This includes ensuring that computer screens, keyboards, and other hardware are ergonomically positioned with respect to the user. It also includes making sure that software is user-friendly. Cognitive integration ensures that error messages are intelligible and meaningful, and that the information returned to users is useful and consistent with their frames of reference. Integration between the user and technology cannot be achieved if users suffer cognitive dissonance. Therefore, the primary concern of integration is 'oneness' and 'harmony' between the user and the technology.

Level-III: Islands of Technology Integration

This type of integration links geographically dispersed islands of technology throughout the firm. Integration at this level concerns the ability of islands of technology to communicate with each other. Two types of integration are required: technical horizontal integration and technical vertical integration, both of which are necessary for sharing information between the islands. Horizontal integration is the passing of data between islands to facilitate coordination, collaboration, decision-making, and task performance. Vertical integration is required for the passing of data for management control. The data that are shared consist primarily of technical instructions used to monitor and control technology.

Level-IV: Organization Integration

This level ensures that organizations are integrated and not just the technology. The focus of integration is the ability of islands of technology to support the organization's objectives. There are four types of integration at this level: (1) internal vertical integration, (2) internal horizontal integration, (3) strategic integration, and (4) internal temporal integration. This level of integration is different from Level-III because it focuses on the speed, quality and quality of information being passed, the way information is presented, and the ability to analyze and disseminate information, rather than simple technical data format compatibility. The Business

Intelligence (BI) modules of ERP play an important role here.

Level-V: Socio-Organizational Integration

Level-V integration extends beyond the brick and mortar of companies. It seeks to integrate customer relationship management, supply chain management, and the coordination of the task environment (Truman, 2000). There are five types of integration at this level: (1) Domestic government and legal, (2) external horizontal, (3) external vertical, (4) external temporal, and (5) shared vision integration. Local governmental and legal issues must never be underestimated. Firms typically have to satisfy government reporting requirements in very specific format. External horizontal integration is similar to internal horizontal; the difference is that it takes place outside the firm. It measures the level of integration of one company to other companies in the industry. External temporal integration measures how well companies coordinate their activities with external constituencies on a timely basis. External temporal must also consider the effect of doing business in different time zones. Shared-vision integration is the extent to which business partners share a common vision because it is extremely important for collaboration.

Level-VI: Global Integration

Level-VI is integration across national and cultural boundaries, the highest level of integration (Rochester & Douglass 1992). Global integration must consider six types of integration: (1) international horizontal integration, (2) international vertical integration, (3) International temporal integration, (4) cultural integration, (5) international governmental & legal integration, and (6) shared vision integration. International horizontal and vertical integration are concerned with the effectiveness of doing business across national borders and refer to all data and information that cross those national borders. International temporal integration is the effectiveness of doing business in several countries where different time zones exist. Cultural integration forces companies to recognize the differences and nuances of other cultures. Different cultures pose unique language, cultural, legal, economic, and political problems. The ability to adjust to these situations determines the success of global companies. The international governmental and legal integration may well be the biggest issue for companies doing business in a multi-national setting. International trade laws of different countries may dictate the level and type of knowledge and technology sharing across countries. International shared vision integration refers to the extent to which multinational business partners (vertical or horizontal) share a common vision in terms of short-term goals, long-term strategy, market orientation, product quality standards, and corporate culture.

4 DISCUSSION AND FUTURE RESEARCH DIRECTIONS

Insufficient research on ERP and integration motivated the discussion of this topic. Given the limitations of existing models of integration, we decided to develop our own. The integration framework builds on the discussion from the literature. It requires that each succeeding level of integration builds upon lower levels. One example is that level-I integration is necessary for the successful linking of ERP islands of technology at level-III. This is why companies that claim level-IV integration while level-III remains elusive are really at level-II. Global integration is the highest level but it may not be appropriate for all firms.

ERP is very capable of satisfying integration at level-I, but by itself, cannot achieve Level-II integration. For this to happen, developers must address the people and ergonomic issues. For example, users require extensive training and technical support on the use of the newly implemented ERP systems. Failure to provide it often leads to ERP implementation failure. According to Bhatt (2000), ERP is a good solution to level-III integration. However, he argues against a piecemeal approach to implementing ERP because it could lead to isolated islands of ERP technologies. Therefore, we recommend an enterprise-wide roll out of ERP (Markus et al., 2000; Markus et al., 2000b). Success at Level-IV is more difficult to achieve because the technology by itself is not enough. It requires additional change management initiatives like BPR. Moreover, successful ERP implementation at level-IV requires satisfying four types of integration. The most difficult type is strategic integration that supports the organization's strategic objectives and mission. Current and earlier versions of ERP do not support level-V integration because they are grossly inadequate when it comes to markets, competitors, industries, and distribution-channels support. There is speculation that future releases of ERP may attempt to overcome these limitations. Another type of integration that must be satisfied is shared-vision integration. There has been no public announcement that future releases of ERP will satisfy this type of integration (Markus et al., 2000). We believe that ERP does a satisfactory job at achieving integration at levels one, two and three, but is severely challenged at levels four through six.

Future research should address several questions:

(1) The usefulness of the framework for furthering the discussion on the relationship between ERP and integration. We need to investigate how the six levels of integration may aid decision makers in recognizing the level of ERP integration companies have achieved and provide insight into the requirements needed to attain higher levels.

(2) Identify, refine, and characterize important issues, problems and success factors associated with each of the levels of integration.

(3) Test the existence of each of the six levels in practice. This will help to validate and legitimize the model, and its potential for research and practice.

(4) Develop measurement criteria to analyze the implementation success of particular levels of ERP integration. This will help to determine critical success factors for achieving particular levels of ERP integration.

(5) Identify and develop appropriate management techniques, methods, and frameworks for managing the various stages of integration. We believe that different levels require different management philosophies, strategies, training, and education. For example, Global integration requires employees to be knowledgeable and sensitive to cultural issues. Diversity is also an important issue.

REFERENCES

Bhatt, G.D. (2000). An empirical examination of the effects of information systems integration on business process improvement. *International Journal of Operations & Production Management*, Vol. 20, No. 11, pp. 1331-1358.

Bingi, P., Sharma, M.K., and Godla, J.K. (1999). Critical Issues Affecting an ERP Implementation. *Information Systems Management*, Vol. 16, No. 3, pp. 7-14.

Bullers, W. and Reid, R. (1990). Towards a Comprehensive Conceptual Framework for Computer Integrated Manufacturing. *Journal of Information and Management*, North-Holland, Vol. 18, pp. 57-67.

Burbidge, J.L., Falster, P., Riis, J.O., Svendsen, O.M., (1987). Integration in Manufacturing. *Computers in Industry*, Vol. 9, pp. 297-305.

Callaway, E. (1999). *Enterprise Resource Planning: Integrating Applications and Business Process Across the Enterprise*. Computer Technology Research Corp., Charleston, SC.

Callaway, E. (2000). *ERP - The Next Generation: ERP Is Web Enabled for E-Business*. Computer Technology Research Corp., Charleston, SC.

Chalmeta, C., Campos, C., Grangel, R., (2001). References architectures for enterprise integration. *The Journal of Systems and Software*, Vol. 57, pp. 175-191.

Davenport, T., (1998). Putting the Enterprise into the Enterprise System. *Harvard Business Review*, Vol. 76, No. 4., pp. 121-131.

Deutsch, C., (1998). Software that can make a Grown Company Cry. *New York Times*, November 8, 1998.

Grant, D., (1995). Six Levels of Integration. *International Association for Computer Information Systems*, Toronto, Canada.

Hasselbring, W., (2000). Information System Integration. *Communications of the ACM*, Vol. 43. No. 6, pp. 32-38.

Kremers, M., and Van Dissel, H., (2000). ERP System Migrations. *Communication of the ACM*, Vol. 43, No. 4. pp. 52-56.

Mabert, V., Soni, A., Venkataramanan, M., (2nd Qtr, 2000). Enterprise Resource Planning Survey of U.S. Manufacturing Firms. *Production and Inventory Management Journal*, pp. 52-58.

Main, Jeremy, (1990). Computers Of the World Unite. *Fortune Magazine*. Sept. 90.

Markus, M. L. and Tanis, C., (2000). Multisite ERP implementations. *Communications of the ACM*, Vol. 43, No. 4. pp. 42-46.

Markus, M. L. and Tanis, C. (2000b). The enterprise system experience-Form adoption to success. In R. Zmud, Ed. *Framing the Domains of IT Research: Glimpsing the Future Through the Pact*. Publ. Pinnaflex educational Resources Inc., Cincinnati, OH:,.

Mathew, P., (1988). Integration for Manufacturing Growth.*Third International Conference on Manufacturing Engineering*, Newcastle, August 4-6.

McGowan, Williams, (1989). Why Global. *Telecommunications*, April 89.

Meredith J. and Hill, M. (1990). Justifying New Manufacturing Systems: A Managerial Approach. ref. in *MIS Readings and Case* edited by Boynton, A.C., and Zmud, R.W., Scott, Foresman/Little & Brown Higher Education Publishing, London.

Saccomano, A. (1999). ERP Lives. *Traffic World*, Vol. 259, No. 10. pp. 38-39.

Scheer, A., Habermann, F., (2000). Making ERP a Success. *Communications of the ACM*, Vol. 43, N0. 4, pp. 57-61.

Soh, C., Kien, S., Cultural fits and misfits: Is ERP a universal solution? *Communications of the ACM*. Vol. 43, No. 4. pp. 47-51.

Truman, G.E. (2000). Integration in Electronic Exchange Environments. *Journal of Management Information Systems*, Vol. 17, No. 1, pp. 209-244.

Zheng, S., Yen, D.C. and Tarn, J.M. (2000). The New Spectrum of the Cross-Enterprise Solution: The Integration of Supply Chain Management and Enterprise Resource Planning Systems. *Journal of Computer Information Systems*, Fall, pp. 84-93.