CONNECTIVITY OF ERP SYSTEM

Vatchraporn Esichaikul, Piyanan Nuankhieo
School of Advanced Technologies, Asian Institute of Technology, Pathumthani 12120, Thailand

Keyword: Enterprise resource planning, connectivity, integration

Abstract: The study is an attempt to propose the criteria for determining the appropriate connectivity of ERP systems. The result of this study provides a framework assisting ERP adopters in selecting integration approach which are appropriate to their needs. A survey was conducted to obtain information from ERP users to learn about their opinions on factors and criteria affecting connectivity of ERP systems. Findings from the study revealed that data oriented approach and application integration oriented approach are the most preferred integration methodologies. Opinions on criteria for evaluating ERP connectivity are nature of business process of organization, availability of technologies and service supports, nature of information system of organization, system flexibility, degree of integration, transaction volume, implementation cost, ease of maintenance, implementation time, security, and budget. Finally, the study proposes a framework to determine appropriate connectivity of ERP systems.

1 INTRODUCTION

In a highly competitive world, accurate and reliable information is crucial for an organization to stay competitive. An organization must be able to capture the whole picture of its own business operations. Therefore, an uninterrupted flow of information within the organization is required. With this in mind, companies invest millions of dollars in developing or acquiring computing systems. However, these systems never talk to each other, each business unit in an organization has its own computing system. What companies really need is integrated, enterprise-wide system which automates core cooperate activities such as manufacturing, human resources, finance and supply chain management. The Enterprise Resource Planning (ERP) system can fulfil this business requirement.

An ERP system helps to streamline the flow of information among the business units that are unable to perform in traditional computing systems. It ties up all business functional units together. What one unit does also has an impact on the others because different departments share the same system and operate on the same data. Therefore, an ERP system allows business decisions to be made quickly and confidently in the knowledge that data is accurate and up-to-the-minute.

Currently, a lot of companies turn to the ERP system to increase efficiency and productivity which allows companies to respond to customers' demands more accurately and efficiently than before. Major improvement results from adopting an integrated information system. Though the benefits of implementing ERP systems are many, these cannot be realized easily. The implementation of an ERP system consumes millions of dollars and many years before the system can be bedded down. Success or failure depends on many factors including technical and managerial matters.

Ideally, most organizations hope ERP systems will replace legacy systems. However complete systems replacement is not practical, economical, or even feasible. An organization has to bear in mind that each organization is unique and no ERP application is suitable for every organization. Moreover, no ERP application offers every function that is required by every organization. Implementing ERP systems requires the customization of software to suit each organization. Degree of connectivity and integration determine how easy the ERP system will be integrated to other systems. The desired degree of connectivity and integration with other systems has to be decided before customizing an ERP application. This involves tradeoffs: a higher level of connectivity is expensive and hard to create and maintain while a lower level of integration does not support a smooth flow of data. Though the highest level of connectivity is preferable, it does not mean it guarantees success. Each organization needs to consider which level is worthwhile and suitable. To

Esichaikul V. and Nuankhieo P. (2004).
CONNECTIVITY OF ERP SYSTEM.
In *Proceedings of the Sixth International Conference on Enterprise Information Systems*, pages 37-44
DOI: 10.5220/0002593900370044

assist a potential organization in investigating an ERP system and the preparation of an organization for ERP implementation, the appropriate criteria and a framework covering connectivity issues need to be developed.

2 SURVEY

In this study, a survey was conducted to determine ERP driving forces, and current problems associated with connectivity and to identify the critical factors of connectivity that an organization should consider when implementing ERP. The survey is based on in-depth interview with selected organizations, which are all current ERP users in the government and business sectors. Interviews were designed to cover several sectors of businesses such as banking and finance, telecommunications, entertainment, automotive manufacturing, high technology and electronics, and power and energy. Interviews were focused on personnel who were responsible for or involved in ERP implementation projects in organizations or personnel who are currently responsible for ERP systems such as an ERP project manager and IT manager or IS manager.

The interviewees were limited to organizations in which ERP systems went live and are currently implementing ERP systems, not including planned users. With information available from ERP vendors and ERP consulting firms, some current ERP users could be identified. The interview was conducted through twenty two organizations. Organizations were selected by judgment sampling to make sure that the organizations contacted were the real users and the right population.

3 ERP DRIVING AND FORCES IMPLEMENTAION

The survey results revealed ERP driving forces and ERP implementation as followed:

3.1 ERP Driving Forces

There is a variety of reasons or driving forces to use ERP systems, but the most important one is the need for integration of process and information. The appeal of an integrated information system resulting from implementation of an ERP system is clear. For example, the sales force enters an order on a computer, the transaction processes through out the entire company. Inventory lists and parts' supplies are updated automatically. Production schedules and balance sheet reflects changes. By making organization's information more readily available and shortening the business cycle, organization can get many benefits resulting from increased competitiveness, reduced inventory, cost reduction and increased customer services.

For international companies, driving force of using ERP mostly comes from their headquarters that pushing ERP system to their branch offices. This is because of success and benefits of ERP implementation they have realized from the practice of headquarters and of other countries' branch offices. Besides the standardization of business practices of all branches is developed, so it is easier and faster to retrieve information and analyze data globally.

Other driving forces include:

- Following the trend
- Media influence
- Inefficiency of legacy system
- Pressure from clients and/or suppliers
- Need a software that can fulfill business functions

3.2 ERP Implementation

Although ERP is evolved from and developed for manufacturing, it is feasible for service sector to use ERP, but not all modules that come with ERP package can be used. Currently, ERP vendors also provide solution for different industries such as healthcare, banking, education, and public sector.

It was shown that the basic or fundamental functional modules that most organizations in manufacturing industries have implemented are financial accounting, material management, production planning, sales and distribution, and controlling. These modules associate with the core activities of organization, which are the processes from manufacturing to distribution and preparing financial information. Although the nature of service industry is different from manufacturing some functional modules still can be used. In any types of organization the financial module is the first module to be implemented because it provides the basic pulse of an organization. It also impacts on all other modules.

In order to implement an ERP system, business requirements must be identified and then the requirements are mapped with ERP package. The decision about customizing an ERP application to fit with business's needs or changing business practice to suite ERP software must be made. Based on the study, there were very few cases that organizations chose these two end approaches. Most organizations chose the middle way by adapting business process

that they viewed it would be better to follow the standard of ERP applications and customizing the some functional modules that were not practical for organizations to change the business practices. Successful implementation requires the knowledge of the existing system from in-house team and experience and expertise of ERP from the external consultant. Because ERP is still a new concept to some organizations and it takes a lot of effort for the organization to have an expertise in ERP, ERP consultants play a major role in implementation of ERP systems.

Although there are many choices, such as big-bang approach and accelerated method, to implement ERP, many companies choose phrased-roll out as an implementation strategy by implementing the modules that are the most critical, and have the most links with other modules first. Then the modules that are involved with the modules of previous implementation phrase are implemented accordingly.

4 ERP CONNECTIVITY

Although the full benefit of an ERP system will accrue if all the ERP modules are implemented together, many organizations implement ERP modules only in those functions that are considered to be of strategic importance. Implementation only of functional modules of ERP application will benefits to organizations in the term of integration and connectivity, but it is not practical to do so because sometimes the functions that are needed by organization do not provide in ERP application. Although the functions are provided in ERP applications, they tend to be too general and the functions are not deep or specific enough to meet the requirement of business process. In addition, some organizations need to interface ERP systems with legacy systems because they contain the critical business data that sometimes cannot be extracted from legacy systems and converted into new systems.

Other driving forces towards interfacing ERP systems with legacy systems/third party applications include:

- Lack of analytical capability of ERP systems
- Follow the application using by headquarter
- To increase efficiency in term of operation
- No budget to buy more ERP application user license
- The existing application is good enough

Based on the study, it was found that many organizations threw away legacy systems after ERP systems went live. It was perceived that legacy systems were inadequate information systems. Other reasons were information required by management was not available immediately; data of various systems was inconsistent; application could not be integrated; frequent lack of documentation; and costs of running both ERP systems and legacy systems are high.

4.1 Obstacles to Interface ERP with Legacy Systems/Third Party Applications

The major obstacles are as followed:

- *Data structure of ERP is very complex*

ERP application is a proprietary system and each ERP vendor has its own data structure standard. Schema of ERP contains hundreds of tables inside which users do not know when one transaction occurs and which tables are updated. In addition, customizing a certain table would affect many other tables which may not know to user.

- *Third party application cannot directly interface with an ERP system*

The nature of ERP is proprietary. The degree of proprietary differs from application to application. Therefore, the available options for interfacing other applications to ERP applications depend on ERP application. However, ERP venders provide opportunity for integration through published integration framework, application program interface, or middleware.

Although integration framework is available, organizations require understanding of ERP native and enabling technologies, which is time consuming. Another easier way of interfacing third party applications is using the applications that are the partners or certified to ERP application. However, this limits the choices of third party applications because some organizations have to use applications that being implemented before the implementation of ERP systems.

- *Lack of knowledge about ERP*

From the study, it shows that organizations rarely have knowledge about ERP systems. They also lack of computing personnel who experience on ERP. Besides, the training fee of ERP is quite expensive and after training personnel only knows about ERP in term of usage not the technical aspect about ERP application. Therefore they need helps from consultants. Consultants are not always the solution. In some cases, organization wants to interface certain third party application which ERP consultants do not have knowledge about that

application. So far some consultants are still lack of knowledge about application integration technology.

4.2 Integration Technologies

Currently many ERP vendors and third party application vendors start adopting interface standard like CORBA, Microsoft's Component Object Model (COM), Object Linking and Embedding (OLE), Enterprise JavaBeans, and the XML. However, methodologies those employ for interfacing ERP systems with legacy systems/third party applications can be grouped into data oriented and application integration oriented.

In data oriented approach, information move in and out of ERP's relational databases to external applications or systems which can be accomplished with database-oriented middleware products, message brokers, data migration software packages, or even with the replication and data link features in most popular relational databases.

It found from the study that most organizations that employ data orientation approach wrote code to move data from ERP to external application. Employing this approach, programmers need to understand the details of database schema of both systems. The databases provide the best point of integration as long as there is no need to access the business processes encapsulated within the application.

In application integration oriented approach, the ERP application integrates with other applications by using well-defined application interfaces. Based on the study, organizations employed this approach enjoyed the benefit of middleware products rather than developing themselves.

Many ERP and EAI vendors have released tools that can move data between ERP packages, on the basis of an understanding of the APIs and data mappings that are implemented by the ERP packages being linked together. This eliminates the need for customized coding to integrate the packages. However, not all packages are supported, and it is unclear who will be the eventual winners in this emerging product category.

5 CRITICAL FACTORS OF CONNECTIVITY THAT COMPANY SHOULD CONSIDER

5.1 Critical Factors

Based on the survey, the following are the critical factors of connectivity that company should consider when implementing ERP.

- *Open/Closed System*

The nature of system being connected and existing system is important. If one the systems is closed, it is very difficult to interface or connect with other systems. Therefore, organization should select an ERP application that is quite open and has various means of integration with other applications. This also applies to the selection of third party applications.

- *Degree of Customization*

Whenever the processes represented in an ERP application differ significantly from the processes used by the organization, the following options can be performed by an organization. The options are to build the organizational process into the ERP software by customizing ERP application or changing the organizational practice to suit the process native to the ERP application. Traditional common sense would force people to customize application to meet the demand of organization. However, too much customization will raise the problems. This first problem arises out of the fact that any customization done locally is outside the core ERP application. Then the next release of ERP application would not support local customization. They have to be redone by the end user for the new release. Secondly, by over customizing, the implementers would deprive the benefit of best practice in industry that embedded with ERP applications.

According to the survey, organizations try to minimize customization by adjusting the business practice that is able to change. If organization wants to replace any manual work with computerized system, the functional modules that provide with the ERP application is taken into consideration first since the functional modules that come from the same application vendor posses the high degree of connectivity and integration.

- *Existing Infrastructure*

If a legacy system is interfaced with an ERP system, existing infrastructure (such as databases) play a significant role, especially if data oriented approach is the choice of integration. If a legacy system is abandoned after ERP system comes, attribute of existing system (such as databases) determines the degree of difficulty of data extraction and conversion. This is true if the database of existing system is different from of ERP system. Problems resulting from not having the right infrastructure can result in poor system performance or unacceptable downtime at a time when users and management tend to have the highest expectations that will affect effectiveness of the flow of data.

- *Similarity of both system infrastructures*

This would result from the existing infrastructure of legacy systems and of ERP systems. From the study, it was shown that infrastructure of ERP system is always different from legacy system. Many databases of legacy system are in-house developed and database structure was not up to standard.

- *Standard of software employed*

The key to enabling different vendors' software packages to interoperate is industry wide standards, both business and technical. If ERP vendors employ the same standard, it is possible and easy for one vendor's software component to replace another vendor's without forcing a new round of reengineering. Besides, there are more choices for third party applications selection if all ERP vendors employ the standard.

Technical standards are necessary because there has to be a way for different vendors' packages to communicate with one another. By employing standard, it lessens and eases customization requirement, and implementation time of connecting third party applications with ERP system, and improves connectivity.

- *Security*

Security must be present as a service across all tiers of the ERP core infrastructure to obtain the necessary granularity expected of enterprise applications. It is critical that data be exposed only to applications and users that have the proper credentials.

- *Third party support*

Since organizations are lacked of expertise about ERP systems, support from the vendors then is the major consideration. The level of support from third party vendors depends on whether they are partners of the ERP applications or not. If they are, it reduces the problem of integration, update and maintenance the software. Troubleshooting service is another issue that should be considered when selecting third party applications. Users require that consultant can help them solving problems when they arise in timely manner with minimal interruption of their businesses. Besides user training and documentation should be provided from third party support.

- *Installation*

As mention earlier, the success of ERP implementation is not just like integrating it to other systems in organization but it has to mirror the business of organization. Installing ERP system is not an easy task like installing Microsoft word. It has to map the current state of organization and its business processes to the ERP system. Data is extracted and transferred to new system. Although it sounds simple but it is not that easy. Implementation time is about one year as a minimum and for some organization it takes about two or three years. The way you configure the ERP systems will affect the way and choices you can interface ERP systems with other systems, and how effective the flow of data between interconnected systems.

5.2 Criteria to Determine Appropriate Connectivity

The survey showed the interviewees' opinion towards the criteria that should be used to determine the appropriate level of connection as follows:

- *Nature of business process of organization*

The most important criterion is the nature of business process. The success of implementing ERP system depends on how much business process of organization can be mirrored by an ERP system. To smooth the flow of information, the selected integration methodology should facilitate business process of organization.

- *Availability of technologies and service supports*

Before selecting the integration approach, organization should study what technologies and supports are available in local market and understand what is needed for the organization. Advantages and disadvantages should be weighted thoroughly. Organizations should choose the technology that service supports are locally present and ensure that the technology is not outdated from the support since technology changes rapidly. Selecting knowledgeable consultant can help organization solve this issue.

- *Nature of information system of organization*

Information system of ERP includes hardware, operating system, database, and ERP application. The most important component when talking about integration issue is database if organization choose database as a point of integration. The database of system being integrated with ERP like legacy system can come from the same vendor, different vendors or even the databases that employ different data models. The solution after weighting cost and benefit can be database replication and data federation.

- *System flexibility*

The architecture and integration approach of an ERP system should be selected carefully since it becomes IT backbone of organization. A system should be planned for future changes, such as more applications will be connected to ERP system, or users of ERP system will be increased. Then addition of more users and applications should not affect or have least effect to the existing system. If many different type of applications will be interfaced with ERP system, organization should choose the approach that is efficient for interfacing many different type of applications such as application integration oriented approach.

- *Degree of integration*

Although tight integration is an ideal solution, other factors like cost and budget may affect the decision about degree of integration. For example, it is cost effective to choose the less tight integration approach for a system that does not require tight integration like human resource system. However, tight integration is appropriate for the system in which transactions occurring have a critical effect on other systems, such as material management and production planning.

- *Transaction volume*

Transaction volume determines the necessity of real-time processing. If the data being transfer among ERP and other systems is less, it may not be worth for investment. Batch processing may be the option for this one. If the volume of information you need to move from one application to another is low and is moving between two databases, it is generally easier to use some form of data-level integration tool.

- *Implementation cost*

Typically, costs involved in ERP implementation include cost of ERP application, cost of hardware (host and workstations), training cost, consulting cost, and maintenance cost. Actually the cost of ERP is generally 30 percent of total cost of implementation. A user should examine needs and available technologies to estimate costs. User may compare costs charged by each ERP consultant and choose the most beneficial one.

- *Ease of maintenance*

Ease of maintenance should be taken into consideration when selected certain approach of integration since ERP system becomes IT infrastructure for organization. Although certain approach is easier to implement, you have to consider whether it is worth to maintain because the system stays with you as the age of organization.

- *Implementation time*

Time to implement can range from one to five years or more. Time to implement whatever integration approach should keep at minimum because ERP involves the core activities of organization.

- *Access control and data security*

Security must be present at all tiers of the ERP system (presentation, application, and database server). It is critical that data be exposed only to applications and users that have the proper credentials. Only authorized users can gain access to data through identification code and password. Authentication and encryption techniques should be provided in ERP network. They protect transmitted data from being disclosed and changed.

- *Budget*

Each integration approach has different costs and benefits. However the selection of appropriate integration approach should be considered on the basis of efficiency rather than cost. Money should not limit what is the best for your organization. So the management should provide support in the term of budget.

6 CONCLUSION

The study presents critical factors of connectivity that organizations should consider and a framework to determine appropriate connectivity of ERP systems and legacy systems/third party applications that will be used for making decision on ERP implementation. To successfully interface ERP systems with legacy systems or third party applications, eight important factors should be taken into consideration. These factors include open/closed system, degree of customization, existing infrastructure, similarity of both system

infrastructures, employment of standard, security, third party support, and installation.

Figure 1 presents the framework for organization to determine the appropriate connectivity of ERP systems and legacy systems/third party applications. In the case that organizations start their computing systems by implementing ERP systems, selecting third party applications that are partners of ERP vendors is the best solution for connectivity among systems. However this may be not possible for the organizations that have long establishment of computing systems in their organizations. Then, the criteria should be taken into consideration when analyzing the appropriate connectivity approach of ERP systems.

The results and conclusions of the study mainly concern with intra-organizational connectivity of ERP systems. The further study of an ERP-to-ERP system can be focused on the selection of integration methodology that can eliminate the differences in ERP systems of business partners.

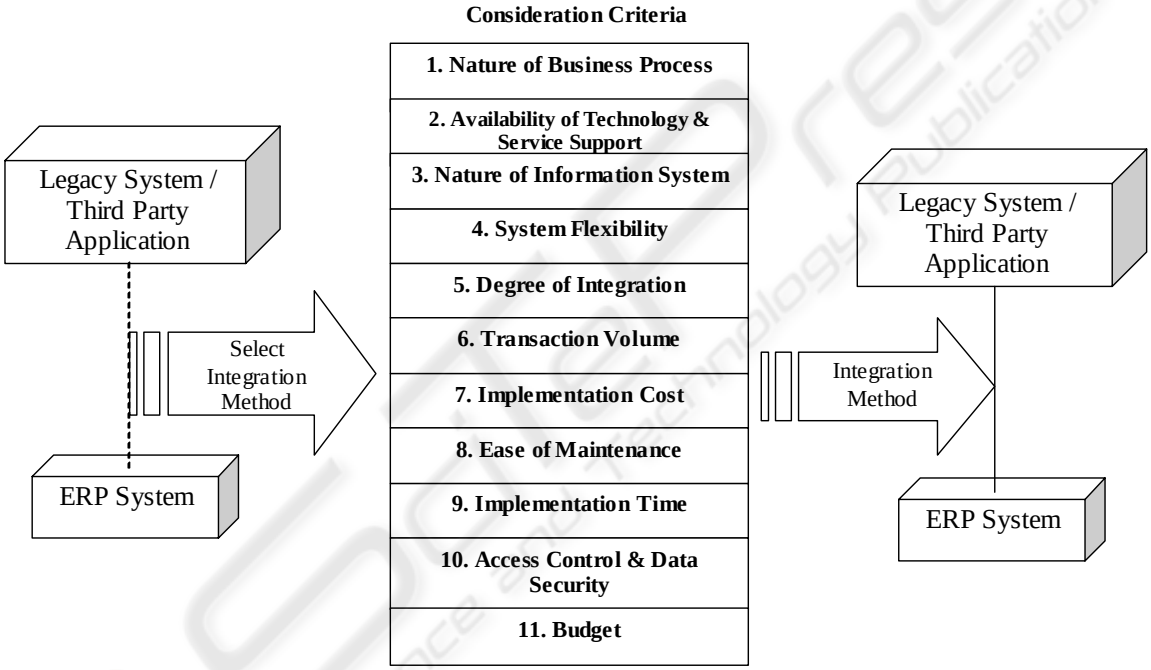

Figure 1: A Framework to Determine Appropriate Connectivity of ERP Systems

REFERENCES

Adhikari, R., "The ERP-To-ERP Connection", InformationWeek. <URL:http://www.planetit.com/techcenters/docs/enterprise_apps/product/PIT199811001>

Cummins, F. A. , 2002. Enterprise Integration: An Architecture for Enterprise Application and Systems Integration. New York: John Wiley & Sons.

Fall, S., 2000. "Draft Lecture Notes on Connectivity & ERP systems", School of MIS, ECU, Perth Western Australia.

Hewitt, J. and Roets, C., "Common Object Request Broker Architecture". <URL:http://www.whatis.com/WhatIs_Definition_Page/0,4152,213865,00.html>

Edwards, J. D., "OneWorld and Interoperability: A White Paper". <URL:http://www.jdedwards.com/technology/apiswp.pdf >

Korzeniowski, P., "EAI Tools Ease ERP Integration Woes", EAI Journal. <URL:http://www.eaijournal.com/ERPIntegration/EaiTools.htm>

Message Oriented Middleware Association, "Middleware". <URL:http://www.moma-inc.org/education/taxonomy.html>

Pan, A., "Enterprise application integration -- message broker style". <URL: http://www.sunworld.com/sunworldonline/swol-08-1999/swol-08-itarchitect.htm>

Pardi, W., 1999. *XML in Action*. Washington: Microsoft Press.

Ravindra, M.P., and George, J.V, 1999, *ERP Managerial Perspective, A World Class ERP: Ramco Marshal*. New Delhi: Tata McGraw-Hill Publishing Company Limited.

Ross, J., 1999, "Surprising Facts About Implementing ERP", IT Pro, August 1999.

Sadagopan, S., 1999. *ERP: A Managerial Perspective*, The World of ERP. New Delhi: Tata McGraw – Hill Publishing Company Limited.

Wallace, T.F. and Kremzan, M. H., 2001. ERP:Making It Happen: The Implementers' Guide to Success with Enterprise Resource Planning. New York: John Wiley & Sons.