CHOOSING THE RIGHT SYSTEMS INTEGRATION

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Abstract

The paper examines systems integration and its main levels at higher levels of control. At present, the systems integration is one of the main aspects participating in the consolidation processes and financial flows of a company. Systems Integration is a complicated emotion-consuming process and it is often a problem to choose the right approach and level of integration. The research focused on four levels of integration, while each of them is characterized by specific conditions. At each level, there is a summary of recommendations and practical experience. The paper also discusses systems integration between the information and MES levels. The main part includes user-level integration where we describe an example of such integration. Finally, we list recommendations and also possible predictions of the systems integration as one of the important factors in the future.

Key words

systems integration, data integration, application integration, process integration, user integration

Introduction

Companies use a great variety of information systems. There are many internal software systems which are used to manage and coordinate resources, departments and areas of business sectors. Other systems include specific systems which cover only a close area of business process, such as management and control systems for specific processes in a company. Companies spend large amount of money to secure and maintain information systems. Besides, information systems are usually implemented in different technologies from multiple vendors containing a heterogeneous data model, and they also have a different way of operation. This is due to the historical and operational reasons. Consequently, there are isolated informational solutions created without links to the rest of IT.

High isolation of the existing systems and applications increases requirements for management activities and control of business processes. For example, there are problems such as inconsistency, redundancy, duplication of functional systems and many others. We can solve this problem by using good systems integration. There are many definitions of systems integration in the scientific literature. We chose two recent definitions which perfectly explain this term based on the latest knowledge.

Systems integration is the merging of different systems or their parts, removing unsatisfactory isolation on order to satisfy information needs of companies for the optimal use of modern technology. Major system integration efforts are being performed in almost every organization, as the private and public sectors attempt to become more competitive (1).

On the other hand, there are some systems which assume integration and they have a platform or components prepared for integration. For example, SAP with the SAP NetWeaver is a typical representative of such systems. SAP NetWeaver is the SAP's integrated technology computing platform and the technical foundation for many SAP applications.
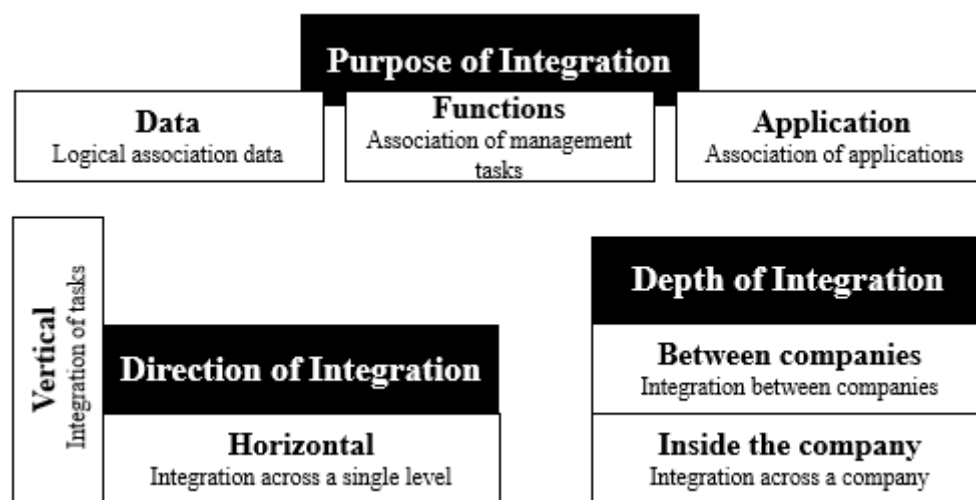

Fig. 1 *Views of Integration*

Moreover, systems integration can be horizontal or vertical at all levels of the company control according to the company´s requirements (Fig. 1). This paper focuses on horizontal integration on the information level of company as well as vertical integration between information level and MES level. ERP and MES systems are the main systems at these levels.

Levels of integration

Systems integration can be accomplished on four levels. This distribution integration at four levels is typical for SAP.
The levels of integration:
  • Data Level Integration
  • Application Level Integration
  • User-level Integration
  • Process Level Integration

Data Level Integration
Data integration involves data from several disparate sources, which is stored by various technologies. Common database is indispensable to data integration because all systems work above it. The main advantage of data integration is that the data is entered into the system

only once at the place of occurrence and it provides for all systems, respective modules and users with appropriate access rights. Data integration is usually performed by ETL (Extract, Transform, Load) solution what means the creation of a single data source. It is a tool to extract data from the database and then place them in a common database. Data integration uses a data warehouse as a centralized storage. There is data concentrated by ETL. It is suitable for complex analysis, dependence and allows multidimensional view of data (2).

Data integration by ETL is only one of many used data integration and many alternatives there have been developed for decades (3).

Data integration can be accomplished on three levels. The first one is the integration at the level of the database servers, data formats and data flows. The second level of data integration solves the data models and data structure. The third level deals with the importance and denomination of data and its attributes.

Managers in the top management realize how difficult it is to implement data integration. They usually postpone it indefinitely (4).

For example, assurance of data consistency in the central ERP system and prevention of data corruption are examples of data integration in practice. A higher degree of data consistency and accuracy of the system after integration allows you to produce accurate analysis and control outputs from the system.

Application Level Integration
The basis of data integration is the integration platform on which systems can cooperate by exchange of messages or enable using custom services to external systems. The main objectives of application integration are elimination of the inconsistency of data, elimination of the duplication in application's functionality and provision of a complete view of the data.

The main problems of a complex system without the integration concept are that integration is based on the confused spaghetti architecture that is principally vulnerable and difficult to maintain. In such case, a simple modification of one system requires access to many components and interfaces. Thus, platforms and architectures which use application integration were developed.

EAI is a business integration platform or middleware which assumes development of a common infrastructure for communication and information exchange between applications which provide their services. There are two basic architectures which are called the star architecture and bus architecture.

EAI development costs are higher than the traditional approach according to studies. Implementation takes more time and consumes more resources (5).

EIA and application integration are closely related. Integration platform of EIA does not cover only the application level, but it can be applied on other levels (6).

SOA Service Oriented Architecture is a tool for the integration of different systems. It is based on services. The service is functionality in the information system and it can be accessible to users or technologies through standard interface. Every single information system can provide more services. XML and Web services, a set of standards for communication and data exchange in a heterogeneous environment, form the basis of SOA. SOA has done a great expansion in recent years and it is becoming the main element of application integration.

Currently, SOA provides a cost-effective, reusable and time-effective solution for the company. SOA and EIA coexist in modern societies. Nowadays, large-scale integration is EIA used with SOA is the primary choice for large-scale integrations is EIA used with SOA.

SOA deployment is not easy in company. It is like long-distance race. Real experience and knowledge such as how to do it or how to manage and control the process are missing. There are also missing quality specialists. What is more, integration platforms often include errors.

Company respectively their IT departments are not ready personal and mentally for the concept of SOA. Many existing systems allow access to their functionality for external systems or technology very difficult (for various reasons) (7).

ESB Enterprise Service Bus is an infrastructure that focuses on simplification of SOA. It provides API which can be used to develop services and makes the services interaction reliable. Technically, ESB is a messaging backbone providing protocol conversion, message format transformation, routing, accepting and delivering messages from various services and applications which are linked to ESB (8).The main advantages of ESB infrastructure are the platform's structure of standard and lower cost than the EIA.

As an example of the classic application integration is a current project to improve the operational management of the airport in Shanghai. It is necessary there to integrate twelve different systems. The study commissioned by the University of Science and Technology in Shanghai and the Shanghai airport IT department comprises advice and recommendations about application integration (9).

Process Level Integration
A key element of the integration process is the recognition that the traditional vertical functional organization of human activities was transferred to the horizontal organization of integrated processes that extend across the organization of human activities. The focus is on business processes and services that implement these processes. Deployment of integrated business models (BPM) in conjunction with a service-oriented architecture (SOA) has caused the emergence of a new phase of process management which is called automated execution of dynamic business processes. Finally, controlled processes allow incorporating the changes and continuously improving the effectiveness of processes within an organization (3).

Process integration means coherence and automation of processes across different functional modules. The benefits are better processes and lower output error, and therefore external and internal customers are satisfied with it.

Moreover, it is necessary to mention standard for BMP which is the standard executable language BPEL. It uses to describe and automate processes as well as integration of Web services.

User-level Integration
It creates single user interface that allows the user to simultaneously operate multiple systems from a single interface. The ideal situation is if the user does not know that he is working on multiple systems. User integration provides a single user access to IT systems, initial upload and periodic synchronization of user's information from external sources.

The upper levels of management trend towards the implementation of portals where the only purpose is a uniform way to convey various types of information to the user. The implementation of portal is used by CMS systems. A wide range of commercial CMS systems and open source CMS systems with a large number of modules enables maneuvering when making the right choice of required portal. It is always necessary to find a suitable environment for creating a data warehouse and publishing BI. The corporate managers have immediate access to certain information through the portal.

An example of the integration of user-level can be the project of integration of CRM system called Microsoft Dynamics CRM 2011 with CMS open source called DotNetNuke (10).
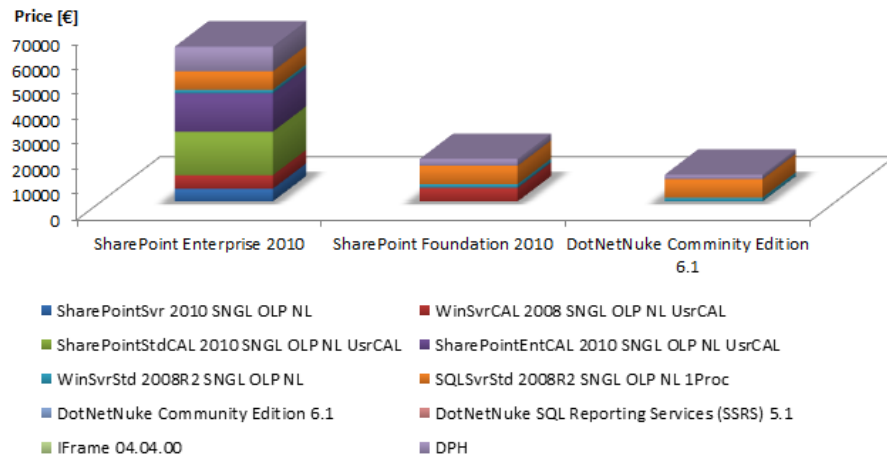
Fig. 2 *Example of price calculation in user-level integration* (10)

Appropriately selected vertical user integration reduced costs almost ten times compared to standard solution of CRM integration with SharePoint. In the final stage of project, we evaluated the considered technologies, prepared more price variations of architecture and compared advantages and disadvantages of these variations. You can see the prices of individual parts of all price calculations in Fig. 2 (10).

MAIN PROPERTIES OF LEVELS   Table 1

Integration/ Properties	Data integration	Application level	Process level	User level
When?	for consolidation data, elimination of duplicate data, basis for complex system integration	for company infrastructure	for processes	for uniform interface
Main solution	ETL	SOA	-	-
Tools	N	Y	Y	N
Standards	N	Y	Y	N
Shared services	N	Y	N	N
Shared data stores	Y	N	N	N
Shared UI	N	N	N	Y
Trends	ETL and its alternatives	SOA with EIA – company infrastructure	BPM	ERP integration with portal
Other	ETL- relatively easily implemented, can be problem with non-synchronous data.	Middleware, Standards (XML, SOAP, Web Services…).	The focus is on business processes and services.	The least expensive integration method.

Vertical integration between higher levels of controlling

Systems integration of control systems to information systems is a complex interconnection process of heterogeneous subsystems into a single logical unit which provides mutual support and integration of target functions and services.

Integration options:
• Direct integration of ERP systems to control systems
• Integration by using integration's intermediate layer (middleware)
• Integration by using information systems MES (11).

MES systems provide information to enable the optimization of production activities from the start order to finished products. A common used method of integration between MES systems and enterprise information systems and level of production is a direct integration.

MES is a key element in direct integration. It must be implemented in local computer centers because it communicates in real time. The fieldbus production networks will have to communicate with open IS through the open standards such as OPC or Ethernet. MES systems represent a specific gateway which performs all required functions on the part of automation systems without inevitability of direct connectivity nodes of information system. DDE, OPC and proprietary technology are commonly used as an interface to the industrial systems on the side of MES. In such case, information network nodes have access to the system at the manufacturing level only indirectly through the MES system (12).

There are many standards which solve the issue of integration of ERP and MES. The most famous is the ISA S95 defining the concepts and models that are used for the integration of ERP systems at the enterprise level with automated systems at the manufacturing level. The standard is divided into several parts. Majority of standards are based on ISA S 95 standard.

Conclusion

Companies use external firms for integration. Selecting a systems integrator can be a perplexing, emotional, and time-consuming process. Not only is the competition among integrators increasing, but the proliferation and rate of change of technology have created countless options and choices. There is very little agreement as to what actually constitutes a systems integration project and systems integration services. The organization can engage the appropriate integrator and find its money well spent; the organization that chooses the wrong integrator not only wastes its money but finds that its vision and project may never be implemented. Thus, there are risks and advantages to using a systems integrator (1).

What is more, systems integration is one of the hidden costs of the ERP deployment. The cost can eventually rise up to 40 percent of the total cost of the ERP deployment (13).

Direction of systems integration of control systems at a higher level enterprise will depend on evolution of ERP and MES systems.

We cannot find the unique method that can cover the needs of systems integration in all businesses and organizations. Several large companies such as IBM, SAP and Microsoft created the Best Practices ("right / best methodologies") for integration of their products, which can help in choosing appropriate integration.

Moreover, many studies focus on the future infrastructure of EIA. EIA will definitely be a future because it is based on an independent platform. On the other hand, there will be weaknesses such as lack of standards, lack of professionals, constant changes, as well as complicated interface and security (14).

Kevin Beasley, director of Vormittag Associates IT company, which is the world leader for enterprise management software and integration, assumes that manufacturers will rely primarily on mobile devices and on-demand software enabling seamless integration, monitoring and optimization of key roles in the production, storage, and management of the entire process to overfill capacity, material planning and control of product quality in the very near future (15).

Smart phones and tablets will become a critical technology for manufacturers and systems and, together with a suitable integration, they will secure that any person in the company or production immediately obtains the necessary information. For example, manager will execute orders in real time and then implement them immediately in production.

The systems integration will be directed to a single environment with a user perspective, where the users will be provided with various types of information from different systems in a uniform way.
Currently, studies predict for Cloud computing major expansion over the next few years. Thus, it necessary to assume that cloud computing and its services will have a major role in the systems integration at various levels in the years to come.

Acknowledgement

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