Grzegorz JURKOWSKI[*], Bronisław SŁOWIŃSKI[**]

IT APPLICATIONS AND SPECIFIC GOAL OF EAI TECHNOLOGIES IN SME

Abstract

Collaborating partners and market interconnections of SME sector change frequently. This is their special characteristic in comparison to big companies. SME use a variety of business applications, using different operating systems (sometimes even DOS). This causes the necessity of transferring information by human operator along with all inconveniences of this solution. It is also a reason why SME sector pay huge attention to EAI solutions, but only those, which reduce costs and time of IT, implementations. This paper presents the condition and expectations of the SME sector.

1. INTRODUCTION

At present computer aiding plays a critical role in connecting strongly differentiated areas of business activities and IT resources. Nowadays, critical business processes increasingly require high performance IT applications. Still, more conventional back office activities cannot be cost effective without appropriate support of business software. It is recognised that the future of successful organisations depends highly on the effective deployment of IT applications. The gap between business processes and IT resources is dependant on adequate tailored supporting tools. (See Figure 1) IT applications deployed for, and used by business processes, are also known as business applications. Enterprise Application Integration (**EAI**) is the process of linking these applications and others in order to realize financial and operational competitive advantages [7]. When different systems can't share their data effectively, they create information bottlenecks that require human intervention in the form of decision-making or data entry. With a properly deployed EAI architecture, organizations are able to focus most of their efforts on their value-creating core competencies instead of focusing on workflow management. There are three principal areas that are prime candidates for automation and support by such business applications:

1. Internal operation,
2. Inward logistics,
3. Outward logistics.

[*] dr inż. Grzegorz Jurkowski, Technical University of Koszalin, Faculty of Logistics and Exploitation, e-mail: jurkowsk@tu.koszalin.pl

[**] dr hab. inż. Bronisław Słowiński, , Technical University of Koszalin, Faculty of Logistics and Exploitation, e-mail: broneks@poczta.fm

Internal operations of enterprises are traditionally among the firsts to be supported. Applications in this area manage and optimise the enterprise resources of all kind, e.g. material, time, equipment, facilities, humans, finance etc. These are known as Enterprise Resource Planning/Management (ERP or ERM) applications. Outsourced to third parties. As a side effect, management and coordination of supplier's activities is rapidly becoming a core competence. In industries where complex products have been produced for a long time, e.g. automotive or aeronautics industry, it is a well-known situation; other industries have started to experience it just recently. Applications supporting management of inward logistics of goods and services from supply chain are known as Supplier Chain/Supplier Relationship Management (SCM or SRM) applications.

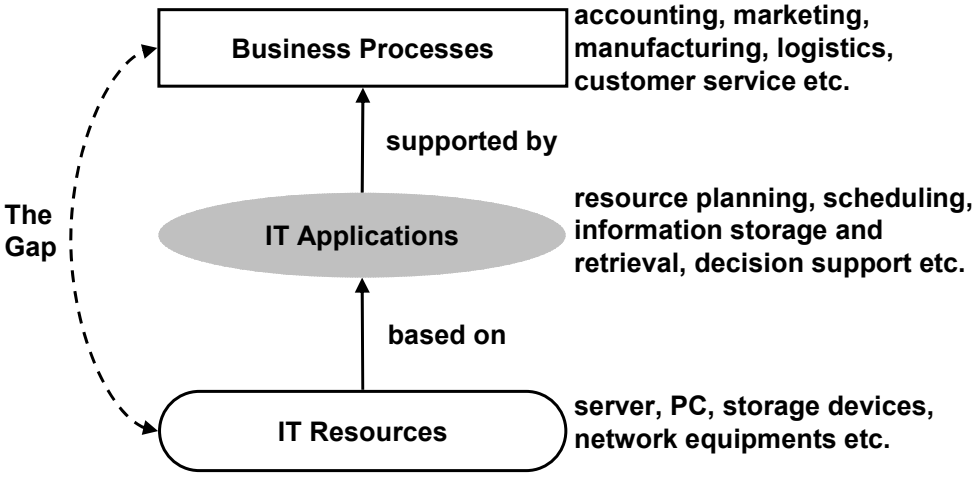

Fig. 1. Applications connect Business to IT

Customer-orientation is priority for any business wishing to generate profit. However, the customer-oriented business processes have not been supported efficiently by IT applications in recent years. IT support in this area can range from simple contact management through customer service and marketing management to complex management of all customer related information, including analytical information.

As enterprises try to focus on their core (profit generating) activities, they use an increasing number of suppliers. Beyond their traditional partners, more and more activities are processing. Applications that support outward logistics of goods and services for the customers are known as Customer Relationship Management (CRM) applications. However, the key application areas are not isolated from each other, on the contrary, they contain processes that are tightly interconnected to each other. So should the support of business applications be set up? In addition, evolution and development of Internet and web-based services and technologies necessitated, that these interconnections extend beyond autonomous organisations. Currently the issue is to integrate cooperating partners' (suppliers' and customers') IT applications. Electronic business denotes a situation when organisations' ERP/SCM/CRM applications are integrated into a cross-enterprise interoperable system [9].

2. APPROACHES TO IMPLEMENTING BUSINESS APPLICATIONS

Traditionally, there are two basic contradictory approaches to implementation of business applications: ***build vs. buy,*** which are in the forefront of IT decision making.

Build is an attractive approach for companies with process focus and unique business models that require use of strategic, custom-tailored applications. Efficient and complex IT department with application development skills is necessary in this case, otherwise additional costs are generated, Other companies that do not need such custom applications to achieve competitiveness and satisfactory business results will find ***buy*** as the most cost effective choice. At least it is a typical, exemplary solution in SME sector. Expected that, in near future, a growing number of enterprises will be ***building*** their own solutions with support of vendors' standard application components (***buy***). Such a situation would lead to improvement of standard business applications in the upcoming years.

Currently, the market situation enforces tight cooperation in the SME sector, as single SME rarely issue final products. More often semi-finished products are forwarded to partner SME for further processing. Along with the product itself, product description and information needs to be forwarded as well. This requires ***increased flexibility***, and more complex approach to business applications and their implementation in the area of SME.

The most straightforward solution is the fusion of cooperating organisations (***merge & acquisition***) and implementation of one homogeneous system. This way, resources of participating organisations are combined and then rationalised. One of the main advantages of ***merge & acquisition*** is significant market position improvement.

However, the choice between ***build*** or ***buy*** is not entirely the same as the choice between custom application development and package implementation. ***Application integration*** is a combination of both, especially when bought parts of an application are standard components (e.g. web services). It is main advantages of ***merge & acquisition*** is significant market position improvement. However, it usually requires substantial effort and expenses to consolidate technically and culturally different resources. This is a way to create so called Virtual Enterprises out of a loosely coupled chain of dispersed (diffused) enterprises.

Another approach for information flow integration is ***outsourcing. The key driving force behind such a solution*** is the economy of scale. A critical review of internal operations in an organisation issued by an outsourcing company may easily define areas of inefficiency, waste of resources, cost overruns and insufficient added value. Activities of these areas are prime candidates for outsourcing, e.g. replacing internal activities with external services. Nowadays, an increasing number of companies regards part of the IT activities (especially, the commodity type IT activities) that need to be outsourced since they cannot easily maintain the required competence and IT systems are just getting more and more complex. However, there is no way for organisations to get rid of IT entirely. IT is becoming so highly interwoven with business processes that at least strategic planning and alignment activity needs to remain within the border of an organisation. 'Over outsourcing' is one of the typical causes of failures in IT outsourcing these days, partially because it may weaken integration capabilities of the outsourcing organisation. Outsourced applications are typically more difficult to integrate with other applications, since there is an additional layer of responsibility of the outsourced organisation.

Insourcing is then the result of recognising that too much (and, perhaps, not in an appropriate way) has been outsourced.

There are also more 'conservative' or incremental (and, therefore, less destructive) ways of changing the internal operations in an organisation. ***Continuous process improvement*** is one

the best-known examples, especially, when it is supported by strategic management of the organisation's businesses.

However, it is not only the organisation itself, which needs to be changed, but also the ***cooperation*** among the different but related organisations. In fact, a variety of cooperation frameworks has been developed, proposed and experimented in the last couple of years. Value chains, ecosystems and virtual organisations are just the most frequently cited examples of such frameworks. In a ***value chain***, activities of companies are sequenced and optimised to achieve increased overall business results, frequently by a dominant organisation, e.g. supply chain in automotive industry. When there is no need for subordination of activities of different organisations in the chain, it is better to speak about an ***ecosystem***, a network of peer organisations. Each organisation in an ecosystem has its own specialised role with which it contributes to the overall goals. For example, a car manufacturing company together with smaller engine and car body design shops plus a world wide network of car distributors and a system integrator (IT) company can be rightfully regarded as an ecosystem, e.g. a loosely coupled group of organisations with shared business goals. Organisations can participate in a number of different ecosystems; therefore, there is a highly increased need for interoperability of the business applications at each organisations participating in an ecosystem. Otherwise, they cannot easily join to, or decouple from, other companies participating in an ecosystem. Flexibility in integration and interoperability is of primary importance here.

If the connections among the participating organisations got stronger and tighter, and the organisations themselves had less and less activities outside of the ecosystem, then the whole

Ecosystem would be better described as a ***virtual organisation***. The need for flexibility in integration is not so high here as was in the case of ecosystems because organisation-wide standardisation has much better opportunities. However, application integration as a whole has an increased role as compared to traditional, standalone companies and loosely coupled group of companies (ecosystems), since it is the integration of processes at the various parts of a virtual organisation, which actually holds together the entire organisation.

ERP/SCM/CRM applications are integrating into a cross-enterprise system of interoperable applications.

3. IT APPLICATIONS AND CORE FUNCTIONS AND PROCESSES IN ENTERPRISES

Business processes can usually be divided into two main categories:

1. Operational processes.
2. Decision making processes.

ERP/SCM/CRM applications support operational processes, e.g. support daily activities of enterprises, which are used by employees at lower levels of organisational hierarchy. On the other hand, the decision making processes used by middle and top managers, which have larger and longer impact in the enterprise, are usually supported by a fourth type of business applications, the so-called business intelligence (BI) applications (see Figure 2).

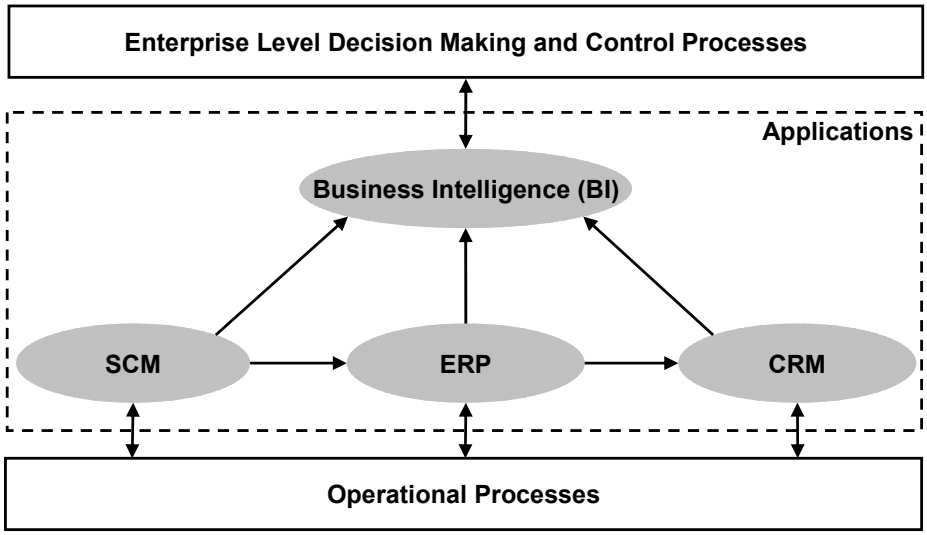

Fig. 2. Overview of Types of Processes and Applications

The above generally described functions appear in the various software packages available on the market, in a more concrete format such as:

1. ERP Functions
   - Production Planning
   - Financial Management (e.g. general ledger, asset management)
   - Material Planning
   - Product Life -cycle Management
   - Inventory Management
   - Maintenance
   - Human Resource Management
   - Human Capital Management
   - Strategic Enterprise Management
2. CRM Functions
   - Contact Management
   - Complaint Management
   - Sales Force Automation
   - Campaign Management
   - Retail Execution and Monitoring
3. SCM Functions
   - Procurement Management
   - Demand Planning
   - Contract Management
   - Inventory Management
4. BI Functions
   - Corporate Performance Management
   - Balanced Score Card Support
   - Business Activity Monitoring

- Analytical Customer Relationship Management
- Analytical Supply Chain Management

Functions provided by these applications vary according to type of application. Figure 3 illustrates both, BI and previously mentioned types of applications by putting them into the context of an entire information processing architecture, which can be found in most of large enterprises.

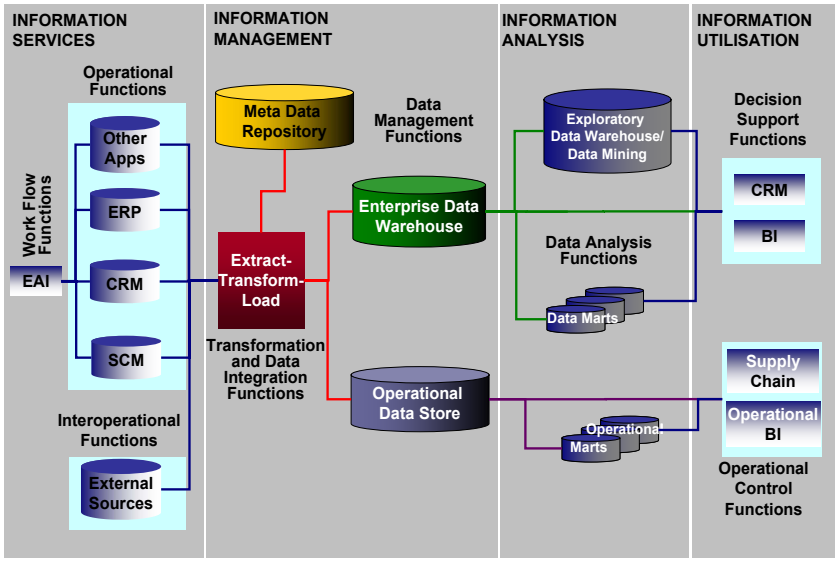

Fig. 3. Enterprise Information Processing Architecture [8]

It identifies 4 layers of information processing and summarises main functions and key components of these layers.

The ***Information Services layer*** contains operational and workflow type applications, which are the primary source of information within an enterprise. The ***Information Management layer*** comprises of applications responsible for integrating and consolidating information at enterprise level.

The ***Information Analysis layer*** includes various applications for simple and complex analysis of enterprise level information. Finally, ***Information Utilisation layer*** covers the decision support and operational control applications.

In addition to data entry and presentation functions, ***operational functions*** typically include transaction processing as well as resource and process optimisation functions, required by various front-end or back-end business processes. A similar set of functions (***interoperational functions***) provides interfaces and coordination towards external applications owned by other partner organisations. The ***workflow functions*** support directly the performance of business processes with sequencing, controlling and invocation of elementary and composite applications, in order to accomplish distinct business tasks. Workers, clerks or other non-managerial, administrative staffs uses functions in this group.

The ***data management functions*** are responsible for extracting, transforming and loading primary (operational) data into various enterprise level data stores and repositories (e.g. data warehouse, operational data store and meta data repository). It should be noted that a

substantial number of enterprises does not yet perform or support such functions effectively. Most of the big enterprises in the financial and manufacturing sector, however, have already a data warehouse in place, optimised for data analysis purposes. However neither data consistency across the whole enterprise is typically ensured through Meta data repositories, nor is the operational data available for further analysis. Smaller enterprises typically have not yet developed data warehouses, and only sporadically have functions to support data management. A subset of such functions deals directly with preparing data (***transforming and integrating functions***) for usage in various contexts and to allow reuse.

All of these functions are typically used by dedicated data administration staff and potentially controlled by a central group for enterprise information consolidation.

The ***data analysis functions*** include simple day-to-day analysis of operational and locally integrated data, but also more strategic level analysis of data using ad hoc and exploratory techniques of data mining. OLAP (On-Line Analytical Processing) falls into the former while analytical CRM functions into the latter category, for example. These functions are used by dedicated experts responsible for certain business areas or processes, and frequently core ERP/SCM/CRM applications support operational processes, e.g. support daily activities of enterprises which are used by employees at lower levels.

The ***decision support and operational control functions*** provide the final means of utilisation of produced information. Enterprise- and customer-oriented decisions are typically supported by such functions, while support for monitoring and control of the suppliers as well as business activity monitoring are not yet used by most of the enterprises. These functions are for the top and senior management positions in an enterprise.

4. CHALLENGES OF IMPLEMENTING BUSINESS APPLICATIONS

When organisations are changing their internal operations and external co-operations in one way or another, they usually face a lot of challenges. Interestingly, IT is always associated with these challenges either as a source of problems, or as a potential solution for problems.

When organisations ***merge or acquire***, the IT infrastructure and applications might be different, and therefore, have to be consolidated. Legacy applications might be put off from implementation of new business direction or the cooperation with other companies.

When organisations ***improve*** themselves, new business strategies often involve custom requirements for supporting business applications; however, they might not be well and easily aligned with standard, best practice and “state of the art” solutions embedded in application packages. On the other hand, in order to make implementation cost effective, organisations have to change their own processes and get them aligned with the package application they acquire.

When organisations ***outsource***, critical business applications may also be the subject of outsourcing. If this is the case, then the organisation may easily end up in a situation where it is quite difficult and expensive to make any change in such an application. The outsource company is motivated to lower its costs and treat each application as a commodity, not requiring enhancement.

When organisations create ***value chains*** ecosystems or virtual organisations, than the applications and the parts of the IT architecture need to be standardised across the group of companies involved. This may also necessitate a full-scale e-business solution to be implemented. However, participating companies are hardly prepared for such a standardisation.

All in all, changes within business environment of organisations and related follow-on changes required within the organisations themselves cannot be coped, if changes in business

applications and application architectures are difficult and expensive. Therefore, the strategies for implementing business applications are of primary importance. There are three main, relatively distinct strategies currently used for implementing business applications:

- Custom application development.
- Package implementation.
- Enterprise application integration.

4.1 Custom Application Development

Direct relationship between IT and business allows innovative business solutions to be implemented ever more quickly, efficiently and effectively. This has been, and will be, the driving force behind business specific applications of IT. Commodity-like applications can be implemented by ready made, off-the-shelf software products but the more strategic needs of a business requires special focus and solutions to achieve real benefits Traditionally, custom application development creates required functionality for strategic business needs, and serves to integrate or link internal or external business processes. Although nowadays there are other technologies for this purpose (e.g. application integration), a modest trend toward custom application development in which organizations mix standard enterprise application modules with custom components, is also present.

Many application development activities can be standardized and are a target for moving off-site or offshore, whereas the up-front stages require more face-to-face time with clients. As a result, application development and deployment services markets have been and will be most vulnerable to price competition.

Most businesses retain an in-house contingent of project managers, systems analysts, architects and designers, business process experts, database administrators, system administrators, and a few technology or application specialists. Much of the custom development, integration and testing work is done by an external service provider (ESP), often via staff augmentation and increasingly delivered from offshore. Typically, enterprises approach custom application development as a discrete (or standalone) project that begins with the specification of new business application functionality and ends with going live. This discrete project usually has a limited scope defined during the requirement analysis. As a consequence, development covers only the functionality that should be provided to support enterprise's actual business needs. Development projects have typically a large percentage of potentially off-site activities (see Figure 4).

This is why these activities are prime candidates for offshore sourcing. Decision on whether to send development projects off-shore or keep them home or close to home (near-shore sourcing) is one of the most difficult that IT managers face nowadays. Because developers' wages account for the highest percentage of application development costs, ability to capitalize on lower wages is one of primary factors driving off-shore/near-shore sourcing of development.

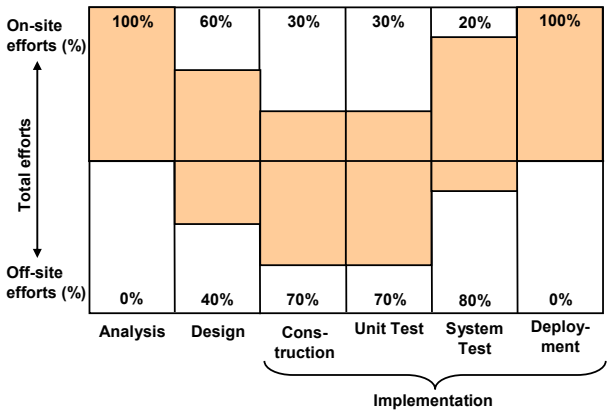

Fig. 4. On-site and off-site efforts in a typical development project [6]

To keep up with the ever-changing business needs, re-evaluation of required functionality should be regularly performed during post-implementation period, and decision on upgrade or withdrawal of custom applications should make.

5. ENTERPRISE APPLICATION INTEGRATION

Although individual – either packaged or custom developed – business applications may be appropriate for certain business processes, the complete set of such monolithic, isolated applications on the enterprise level, is not acceptable in the long run and, therefore, gradually abandoned. Application integration means making independently designed applications work together. One of the key driving forces behind Enterprise Application Integration (EAI) is the protection of investment, and most demand will be for software that can help deliver more value out of established applications. This strong business case behind EAI ensures that application integration remains one of the core drivers of innovation in the software industry.

However, an over-simplistic approach to EAI often leads to'spaghetti' architecture of applications where complexity prevents enterprises from easily extending and changing applications on enterprise level. Reducing this complexity is imperative to software industry to avoid massive setbacks and user dissatisfaction.

Therefore, next round of enterprise application integration arrives with new architectures (see Figure 5) for reducing complexity of software engineering, deployment and maintenance. Existing applications are being partitioned, distributed, integrated, and new applications will be designed to integrate, in such architecture.

Typically, enterprises approach application integration as a discrete project that begins with specification of a composite application and ends with going live. This discrete project usually has a limited scope defined during requirement analysis. As a consequence, integration covers only applications whose interoperability should be established to support enterprise's actual business needs.

Integration projects do not typically extend to the full scale of applications. Even if they do, a new application might then be easily implemented without integration with the rest of application portfolio. To maintain the level of integration within the enterprise, potential

extension of the composite application should be regularly considered during post-implementation period.

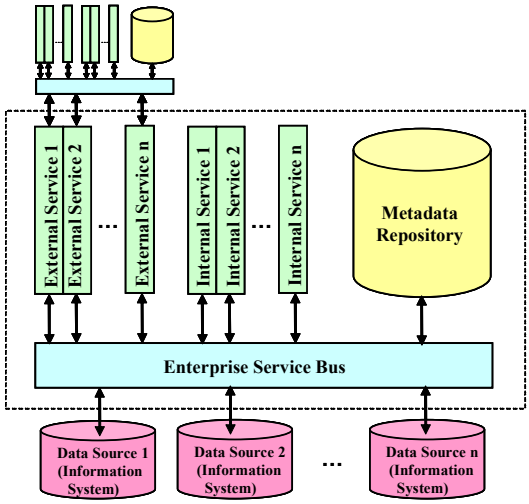

Fig. 5. Service-Oriented Architecture [10]

5.1 The most important technologies of EAI

The core technologies of EAI are presented as follows:

Message-Oriented Middleware (MOM)

Modern business applications are, increasingly, assemblies of encapsulated software modules (services) in need of consistent, efficient and standard methods of inter-system communication. The messaging middleware model has been proven to be more suitable for application integration than the synchronous RPC (remote procedure call) model. New applications assembled with heterogeneous components will benefit from this industry experience. The next generation of inter-system communication middleware is emerging as an evolution from a tightly coupled session-bound RPC model (Java Remote Method Invocation [RMI], .NET Remoting) to a loosely coupled Web services model (HTTP/SOAP) and a decoupled event-messaging model (Java Message Service, Microsoft Message Queuing). Future messaging-based middleware products will gradually replace the RPC transports now underlying Java RMI and .NET Remoting.

Composite Applications (CA)

A composite application is a software assembly that implements one business function and whose component parts are heterogeneous in terms of their information architecture. The conceptual relationship between client and server in a composite application is always request/reply. For example, a composite application may service a request from a human client, a user of a new Web-based application that, unseen to that user, invokes one or more back-end services in legacy or packaged applications. Alternatively, it may be responding to automated input from another system. A composite application is an application system where every path of execution is either homogeneous (if it runs entirely within the consistent code base of one of its constituting software modules) or composite (if it runs across several of its software

modules). Composite applications are the most complex but also most fragile form of application integration because the software modules are highly interdependent.

Service-Oriented Architecture (SOA)

Essentially, SOA is a software architecture that starts with an interface definition and builds the entire application topology as a topology of interfaces, interface implementations and interface calls. SOA could be also named as interface-oriented architecture.

SOA is a relationship of services and service consumers, both software modules large enough to represent a complete business function. Services are software modules that are accessed by name via an interface, typically in a request-reply mode. Service consumers are software that embeds a service interface proxy (the client representation of the interface).

SOA is gradually replacing monolithic architecture as the premier design principle for new business applications. This process is driven in part by inherent benefits of SOA for new application projects.

Business Process Management (BPM)

It is becoming more and more apparent that a Service-Oriented Architecture (SOA) cannot be successful without a clear focus on business processes - which means having business process management infrastructure in place. Since a true SOA requires that its business supporting services are created and used independently of each other, it is imperative that there is a mechanism in use enabling these components to be linked quite flexibly.

In this way, business process management enables business analysts and managers to be able to visually design the flow between business process components, but there needs to be a two-way connection between visual design and programmatic interfaces: the process should be audited and monitored on a continuous basis.

On the other hand, business process management must be flexible according to changes based on roles, responsibilities and business context, and able to work with whatever infrastructure and applications are supported within enterprise environment.

Business process management systems are preferably implemented from a life cycle perspective.

Business process management systems are preferably implemented from a life cycle perspective, rather than based on a single implementation or aspect of an implementation.

Enterprise Service Bus (ESB)

An ESB is a Web-services-capable middleware infrastructure that supports communication and mediates application interactions. To be an ESB core, a middleware subsystem must: a) Implement program-to-program communication; b) support Web services standards; c) have an extensible, intermediary-based architecture; d) be capable of address indirection and intelligent routing; and e) use metadata to manage the descriptions of the messages.

ESBs facilitate modular, standards-based applications that are dynamic (that is, undergoing frequent additions or modifications) or require high scalability, high availability, tight security, and platform heterogeneity. Business process management systems are preferably implemented from a life cycle perspective, rather than based on a single implementation or aspect of an implementation or monitoring. However, ESBs are "overkill" for most small applications; plain SOAP stacks, message-oriented middleware and remote procedure call capabilities that are built into application servers, Web servers and portals, have sufficient communication and management capabilities for simple, stable, point-to-point SOA interactions.

Meta Data Management (MDM)

Excellence in metadata management will differentiate leaders in application integration [11]. There are two broad categories of metadata: business and technology. Integration and consistency of metadata across businesses and technologies does not happen

automatically, it requires hard work. Because metadata normally resides in multiple locations and technologies, it requires a repository integration strategy for proper metadata management.

However, attempts to physically synchronize or consolidate metadata are usually constrained by semantic problems that can limit what can be shared. Depending on the degree to which the IT organization wants to resolve inconsistencies among the metadata, political and cultural issues can severely and adversely affect the resolution of semantic differences. These factors include metadata ownership, ongoing costs and potential bottlenecks, such as analysis and administration of changes.

Growing importance of business process management, including modelling of human process flows, system process flows and combinations of both, increasingly requires modelling and simulation tools, also heavily dependent on the creative use of complex, partly standard and partly proprietary metadata. Traditionally, typical integration suites contain a number of incompatible and partly redundant metadata formats. Best of integration products are now only beginning to offer a central integrated metadata repository for consistent management of all of the integration-related metadata.

Companies should develop an ***enterprise information integration*** framework that is independent of any one application, and they should use it as a central point for all future application and integration programs. This holistic semantic "blanket" will enable faster integration and real interoperability between applications and services, thus making it possible for IT to support more dynamic business requirements. Without such a framework in place, costs for integration will remain excessively high (one application at a time), and competitive advantage and agility will remain low and continue to erode. This holistic approach will lead an IT organization to create an ***information layer across the business***, which is independent of applications (see Figure 6). In other words, integration of the next application will be a lot easier and faster, given that the semantics are clean and consistent.

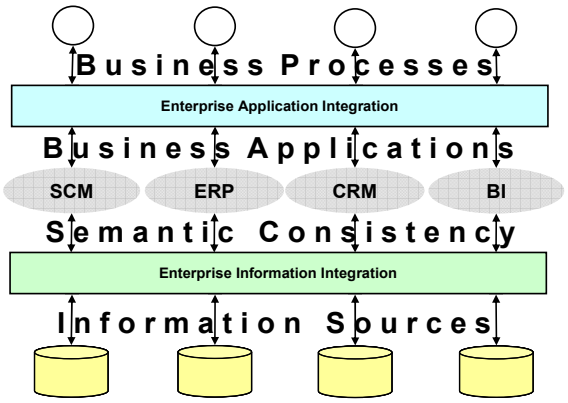

Fig. 6. Evolution of Application Platforms

All IT applications can be broken into three layers: a) ***Presentation Layer*** (What the user sees), b) ***Business Logic Layer*** (The underlying processing engines and their rules), and c) ***Data Layer*** (The physical data storage layer).

The necessity for this layered approach is adaptability of systems. In the IT world things change extremely quickly and often dramatically. As a result, developers must often modify applications to meet new requirements in short order. How flexible an application will be, will depend on how well the three layers have been separated.

6. POSITIONING OF EAI IN SME

Business process management must be flexible to change based on roles, responsibilities and business context, and able to work with whatever infrastructure and applications are supported within the enterprise environment EAI must be an enterprise application integration strategy and implementation plan for connecting critical system elements. EAI Technologies should enable back-end systems for end-to-end web processing and work flow automation. According to Gartners report recommendations, [1] application integration should effect with a significant increase of enterprise's economical effectiveness due to smoothened information flows in an integrated structure and real time operating (zero latency time).

Particularly we understand this goal as an integrative role in the system conversion (Figure 7). It should enable:

- End-to-end web processing,
- Automating previously manual work-flows,
- Providing integrated data flow solutions across disparate IT systems in an enterprise.

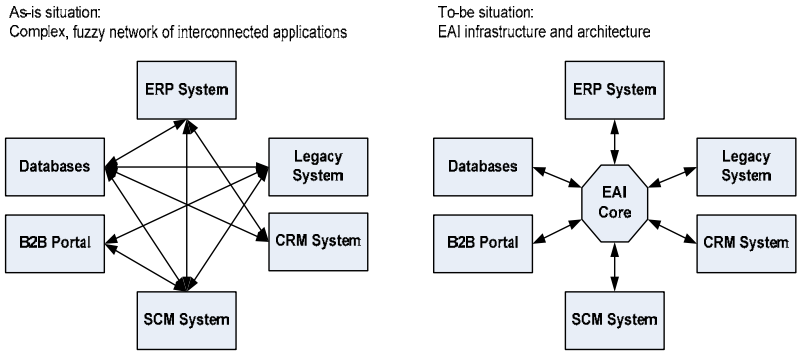

Fig. 7. The Enterprise system environment with and without an EAI system [10]

A good way to show the difficulty of this process is examining the variety of business applications in use by the SME. In conditions of Poland (which is currently the most dynamically developing business application market in Europe) ERP systems from over 80 vendors are available [2], which makes Enterprise Application Integration much more difficult.

7. CIRCUMSTANCES OF EAI IN SME

SME operate mainly in the area of varied services.

A widespread spectrum of services is created for individual demand. Services are delivered usually by small dispersed enterprises Services such as free time planning, job-seeking, scheduling, trip-planning and similar, are based on information exchange over the Internet, and need automation of processes in a wide range. Each one of these enterprises can be (and

usually is) participating in several supply chains the situation in manufacturing is more complicated. As mentioned before, enterprises from the SME sector rarely offer final products; more often they participate as subcontractors of supply chains, even though they usually are medium sized. Each of these enterprises can be (and usually is) participating in several supply chains and business processes created by other partners and they need to be communicated with suppliers of complementary services (see Figure 8).

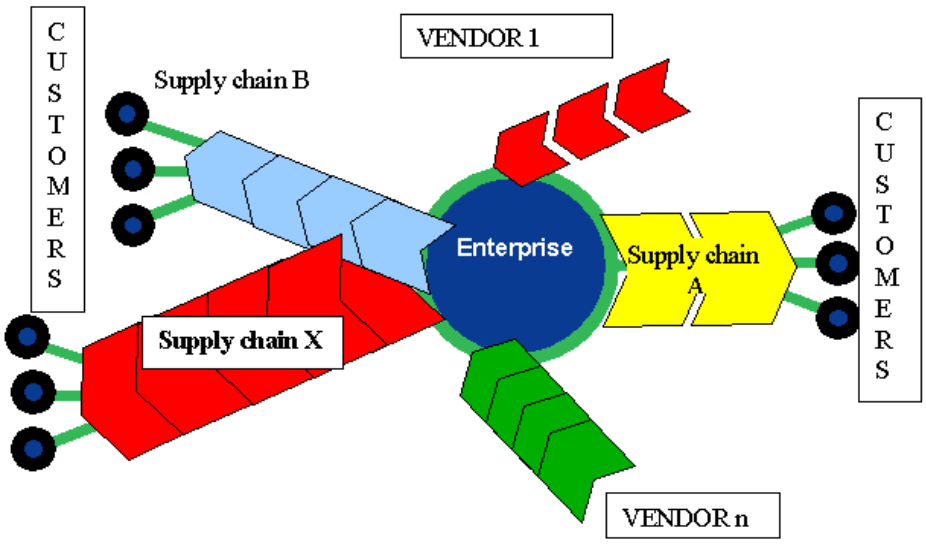

Fig. 8. Multiple chains supply in SME

This is a typical feature for Virtual Enterprises. A supply chain within the manufacturing industry is often organized in N - tiers structure as showed on case from automotive industry (see Figure 9) [3]. At each layer, product is manufactured of some pieces. For example, product P is manufactured of 7 pieces (A-G). Each of subcontractors has subcontractors on tier 2. In this case, part, B consists of 4 pieces (B1-B4). Part B2 consist of two pieces and a company in tier 3 manufactures the first of them (B21-B22). Part B21 consist three pieces manufactured by a company in tier 4. A Company provides their articles to many other contractors and thus has a need for integrating with many (different) systems. For instance, part 212 might be part of many product trees thus having a need for being placed in several and in different context. Often companies do not interpret the same concept in the same way. In each of the supply chains, a different standard of IT applications can be used. Therefore, information exchange meets great difficulties and usually a human operator is solving them. This on the other hand may be a reason of many inconsistencies including generating many errors, which lower the productivity of the company. Most of projects analyzed in [4] use-case scenarios to apply Semantic Web technologies application based on Ontologies and semantic Web technologies might be a useful solution. For example, peer-to-peer business collaboration (very popular) needs specific clients for each net. Solution for nearly automatic translation is use of

web services or Service Oriented Architecture. SME expect help to apply semantic solutions from vendors of ERP/CRM systems.

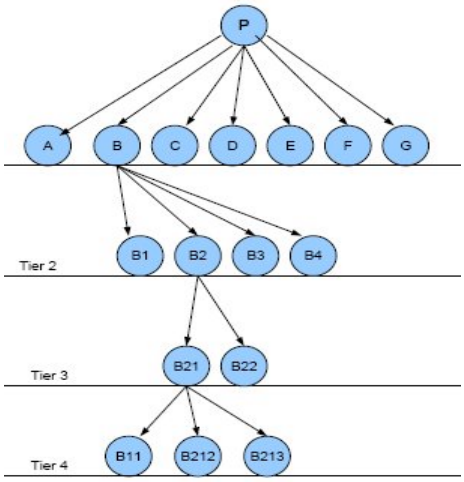

Fig. 9. N - tiers structure of supply chain in manufacturing company [9]

7.1. Inner perspective of EAI in SME

The challenge for EAI in the field of SME is an application "spaghetti" resulting from paying low attention to the need of thorough and complementary business application selection, and also misunderstood thriftiness that orders splitting purchases in time. The simplest resolution of course would be changing applications and data migration, which in SME is usually entrusted to outer specialist (expensive and time-consuming). This resolution is excluded due to high expenses and time required for such an operation. Another solution, which is more widely accepted, is using middle-ware applications mediating in data translation and conversion between different applications and systems. Such problems concern mainly applications operating in back office processes from inner perspective and connections with outer partners.

7. 2. Outer perspective of EAI in SME

A commonly used EDI (Electronic Data Interchange) and communication via Internet has become the reason for aspiring to automation or data exchange processes between business partners. Similarly to huge companies, nowadays SME also think about EAI. In a study of 1000 organizations using EAI techniques [5], nearly 50 percent were integrating the back-office with electronic trading partners, and about 45% were extending front-office applications out over the Web. Well over half were engaged in tying together front- and back-office applications within their enterprise. Today's high-end EAI products were born as result of this market demand. These EAI vendors came into the market with "adapters", based on technical and business relationships established with the enterprise package vendors. Traditional models

for electronic business are based on long term point to point and tightly coupled relationships. Electronic Data Interchange (EDI) has been used since 1980s to automate routine transactions between established trading partners especially for direct goods, supply chains. However, EDI syntax is not programmer or Web friendly. Not well suited for small business or more spontaneous, open market transactions like indirect procurement. Nowadays even small manufacturing companies are implementing some form of ERP solutions. Web presence has become de-facto need of every entity. Everyone wants to take advantage of growing e-Business platform to reduce cost of operations. With all these changes in small and mid-sized setup, comes the need for integrating existing applications among themselves or with their future applications.

8. SUMMARY

The goals and requirements of SME sector enterprises are specific. It is the result of the fact that the majority of SME sector enterprises decide not to produce the final product on their own but to participate in production process as a contractor. SME are interested particularly in efficient exchange of information with external partners. High-level IT solutions increase costs and require long time of solutions implementing, SME are interested in effective EAI solutions which use already possessed supplies. The big hope of today is that matching these all, contradictory requirements, gives more advanced technologies of integration based on the idea of semantic Web.

References

[1] S. HAYWARD: *Business Process Fusion: Enabling the Real-Time Enterprise,* Gartner Research ID Number: AV-20-9895, 16 October 2003

[2] G. JURKOWSKI: *Llogistical aspects of transfer information in transactional and integrated business application,* International Conference ". New Technologies in distance learning, Koszalin /Osieki 2005 (summary in English)

[3] P. FLENSBURG, G. MOSNIK: *Ontologies in practice,* Vaxjo University Sweden www.wxu.se

[4] L. NIXON, M. MOHOL (FU Berlin) D 1.1.2 *Prototypical Business Use Cases,* KWEB EU-IST-204-507482 http:/knowledgeweb.semanticweb.org

[5] P. RAVISHANKAR: *EAI – Viability for an SME,* A White Paper of Business Functions LL; www.business-functions.com

[6] S. BORGO, A. GANGEMI, N. GUARINO, C. MASOLO, A. OLTRAMARI: *Wonder Web Deliverable D15 Ontology Roadmap,* 31December 2002

[7] http://en.wikipedia.org/wiki/Enterprise_application_integration

[8] W. H. INMON, R.H. TERDEMAN: *The Corporate Information Factory and Enterprise Infrastructure,* 2000

[9] D. NEWMAN, T. FRIEDMAN: *Data Integration Is Key to Successful Service- Oriented Architecture Implementations,* Gartner Research 2005

[10] WP 1Deliverable: D1.1 State of the art Work package – *1 FUSION Approach and Methodology,* 2006

[11] M. J. BLECHAR: *Metadata Management Semantic Issues,* Gartner Research 2005