The Country-specific Organizational and Information Architecture of ERP Systems at Globalised Enterprises

Bálint Molnár
Eötvös University of Budapest,
Faculty of Informatics, Information Systems Department,
1117 Budapest, Pázmány Péter sétány 1/C,
molnarba@inf.elte.hu

Abstract
The competition on the market forces companies to adapt to the changing environment. Most recently, the economic and financial crisis has been accelerating the alteration of both business and IT models of enterprises. The forces of globalization and internationalization motivate the restructuring of business processes and consequently IT processes. To depict the changes in a unified framework, we need the concept of Enterprise Architecture as a theoretical approach that deals with various tiers, aspects and views of business processes and different layers of application, software and hardware systems. The paper outlines a wide-range theoretical background for analyzing the re-engineering and re-organization of ERP systems at international or transnational companies in the middle-sized EU member states. The research carried out up to now has unravelled the typical structural changes, the models for internal business networks and their modification that reflect the centralization, decentralization and hybrid approaches. Based on the results obtained recently, a future research program has been drawn up to deepen our understanding of the trends within the world of ERP systems.

Keywords: Information System, ERP, Enterprise Resource Planning, Enterprise Architecture, Globalization, Centralization, Decentralization, Hybrid

Received 5 September 2011
Revised 30 October 2011
Accepted 5 November 2011
JEL Classification: M, M1, M15

1. Introduction

The Enterprise Resources Planning systems are widely applied both at large corporations and medium and small companies. Although commercially available ERP systems have a default architecture that could be tailored and re-configured to the existing requirements, the volatility within the business environment drives and triggers continual changes at various levels and tiers of both business and information architecture.

Exploiting the Enterprise Architecture theory, the paper tries to put the empirical data into the theoretical framework to discover some typical patterns within the trends. Sixteen companies have been investigated with international background and the data gathered have been used for a qualitative analysis.

2. Theoretical framework

2.1. Competing ERP definitions

(1) Latest phase in the development of computerized systems for managing organizational resources. ERP is intended to integrate enterprise-wide information systems. ERP connects all organizational operations (personnel, the financial accounting system, production, marketing, distribution, etc.) and also connects the organization with its suppliers and customers (Siegel, J.I G., Shim, J, K., 2005).
(2) A collection of applications that can be used to manage the whole business. ERP Systems integrate sales, manufacturing, human resources, logistics, accounting, and other enterprise functions. ERP allows all functions to share a common database and business analysis tools (Yen D. C., Chang C. J., 2002).
(3) Enterprise resource planning (ERP) is an integrated computer-based system used to manage internal and external resources including tangible assets, financial resources, materials, and human resources. It is a software architecture whose purpose is to facilitate the flow of information between all business functions inside the boundaries of the organization and manage the connections to outside stakeholders. Built on a centralized database and normally utilizing a common computing platform, ERP systems consolidate all business operations into a uniform and enterprise wide system environment (Bidgoli, Hossein, 2004).

2.2. Distinguishing between the concept of ERP and ERP as a system

There exists a concept-based definition of **ERP** that involves the “seamless integration of processes across functional areas with improved workflow, standardization of various business practices, improved order management, accurate accounting of inventory and better supply chain management” (V.A. Mabert, Soni, A. and Venkataraman, M.A. , 2000.). Meanwhile, an **ERP system** can be considered as merely the media through which this is accomplished.

The concept of ERP is profoundly linked to the integration, standardization, extension and assurance of future flexibility and resilience for corporate processes, whereas the ERP system represents the technical manifestation of these objectives and the alteration and modification within the organization required to achieve and maintain them (Ng, J.K.C., IP, W.H., Lee, T.C., 1999).

2.3. Paper's working definition

In this paper, an ERP system is understood as an enterprise-wide, comprehensive information system involving all information processing activities that covers the human resource, production, commercial, planning, inventory, material planning, management control and monitoring business processes by placing them into a unified framework.

The ERP systems are composed of several functional services that are implemented as modules. Considering ERP systems, the concept of modules and their mapping to business services and processes are diverse, however their fundamental property is incorporated in the fact that they are grounded in one, unified database, moreover they provide the opportunity for step-by step introduction, implementation and roll-out.

The fundamental benefits of ERP systems do not in fact come from their inherent "planning" capabilities but rather from their abilities to process transactions efficiently and to provide organized record keeping structures for such transactions. Planning and decision support applications represent optional additions to the basic transaction processing, query and report capabilities included with a typical system. ERP systems represent corporate infrastructures, much in the same way that physical highway systems or telecommunication infrastructure of a country do.

3. Research hypotheses

As research hypotheses, we formulate the following tendencies as to be investigated issues. The companies typically react to the changing environment in the various cases of market situation as follows:

(1) Standardization of ERP and generally information system (IS).
(2) Standardization of business processes, business services.
(3) The information systems existing at various countries at subsidiaries of international companies are centralized.
(4) The trends for standardization can be discerned mostly at business functions where strong coupling to the market can be seen.

The internationalization, globalization, market turbulences, changing regulatory rules raises issues that lead to changes and adaptation processes on several aspects of ERP systems: The companies typically react to the changing environment in cases as follows:

Integration of markets: The ever changing landscape of economics and their forces leads to higher level integration of markets. The major causes are EU integration, globalization in the world, regional integration etc. All of the forces directly or indirectly influence the financial and economic operation of companies and thereby the business processes. Through the business process, the IT processes and architecture of enterprise resources systems have been changing.

Integration between several development and manufacturing sites: The stream lining and downsizing are buzzwords that characterize the re-organizations of companies including the re-allocation of operational tasks to geographically different places, sites, moreover the strengthening the level of integration, the smoothness of interactions and increasing the effectiveness of the information interchange among the sites of companies are typical motivation for change. The consequences of decisions related to the before-mentioned approaches are to re-think of architecture and IT processes of ERP systems.

Integration between suppliers, service providers and manufacturers: Basically the development of supply chain management and the integration forces pushing both manufacturers and commercial companies effective and efficient close cooperation leads to strong coupling and high cohesion of their ERP systems.

Integration of multi-vendor hardware and software components: The outcomes of acquisitions, buyout or takeover results in heterogeneous hardware and software architecture that in long-term ensues unification and simplification towards a rather homogeneous and consistent IT architecture in tandem with the re-engineering of business processes.

Elements of an enterprise that initiates changes or should be changed:

Orders: Activities of an enterprise is triggered by customer orders from outside of the company, and then the customer orders are split up various internal orders (procurement orders, manufacturing/production orders, design orders, etc.). The business activities, processes have been transforming into ERP processes that are setting off information systems tasks.

Products: Within an enterprise, products can be viewed as a twofold architecture component of an enterprise: one side is the concrete technical data, description of related technology for creation of single product; the other side is the design process as a set of business processes of the company that depicts how the given product has been being devised.

Business processes: Business processes can be perceived as workflows that consist of processes that have some input and output that are transformed some way during the performance of processes. Processes within a business process uses, transforms, produces

Table 1. Major Functionality of an EPR system

Financial	**Human resources**	**Product Data management**
Financial Accounting	Personnel Management	Sales and distribution
Controlling	Organizational Management	Production planning and control
Joint Venture Accounting	Personnel Administration	Project system
Investment Management	Recruitment	Materials management
Corporate Real Estate Management	Personnel Development	Quality management
Enterprise Controlling	Training and Event Management	Plant maintenance
Treasury	Compensation Management	Service management
	Benefits Administration	
	Personnel Cost Planning	
	Time Management	
	Payroll Accounting	
	Travel Management	

materials, data, information, and knowledge. A process within a business process makes up tasks, procedures, etc. The processes of a business process and the business process itself can be mapped entirely or partly to processes of ERP systems. Majority these parallel business processes or workflows are required to be combined and made consistent so that they can be performed as collaborating and cooperating processes.

Technical resources: An enterprise as a system or an organization consists of several physical machines and devices as well as actors or roles such as physical architecture component (e.g. computers, database servers, application servers etc.) and application systems (i.e. software packages, database management systems, information systems etc.).

Information resources: Data, information, information systems, data or information flows.

Organizational resources and decision: Organizations are made of business units. Decisions can and should be made at various layer of the organization. The decisions must be harmonized and sent to the involved business units of the enterprise in time.

Human (resources): The role of employees in enterprise-wide, integrated systems is critical. The proper task for organizing of processes is to find a resolution in which people and machines can operate in synergy. The human resources should be used for intellectual tasks (such as to design, decide, plan, control, manage, communicate, learn, etc.) while machines should be used for repetitive, boring, tiring, or hazardous tasks (such as to process, manufacture, transport, store, etc.).

Cost and time properties: Both of them are important for the enterprise as they relates to constraints and restrictions on processes. The given environment, the external event, the requirement for compliance to outside world as e.g. regulatory authorities, provides the limit within the enterprise should operate.

3.1. A theoretical framework for analyzing information systems

To describe the nature of changes happening to ERP systems some adequate theoretical approaches are required. One of the methods is a socio-technical approach (Heeks, R., 2006) to characterize the information system within an organizational environment and make use of this description to depict the reason for actual changes and the driving forces behind the alteration.

The two central concepts of analyzing information systems – originally e-government information systems – are the ITPOSMO and CIPSODA as set of viewpoints. These viewpoints are customized for ERP as a comprehensive information system including the socio-technological aspects.

3.2. Benefits and Problems related to ERP System

The globalization, the increasing competition, the economic and financial crises enforces the streamlining not only the companies itself but the ERP systems

Table 2. ITPOSMO viewpoint to Information Sytems

Information	All the formal information that are relevant to the enterprise to carry out its business contained by the information processing system and the not formalized information – from data through information to knowledge – that applied by the people interacting with the *ERP system*.
Technology	It concentrates on the technological aspect of the comprehensive architecture. From the hardware to software and taking into considerations the various level of architecture form the basic networking services to the different service centers as application / information services, logical and physical application system component, logical and physical technological component.
Processes	The activities carried out by the important actors for whom the *ERP system* works both information-related processes and comprehensive business processes. The activities and / or business processes are generally arranged into separate workflows, each single workflow consist of several nodes incorporating self-contained information processing tasks that are complex and reflects the business logic or "intelligence".
Objectives and values	The **objectives** encompass the aspects of enterprise and information system strategy including corporate policies, the political and business interest of company. The **values** reflect company culture specific to the given organization and the environment that influences the decisions and activities of stakeholders.
Staffing and skills	Describes the personnel both acting within *ERP* as part of the organization and interacting with the *ERP system*. The skills, competencies and knowledge owned by persons are important characteristics for depicting the capabilities of users and employees
Management systems and structures	The governance or comprehensive management environment for directing and organizing the operation related to *ERP system*, the whole enterprise and the external relationships, e.g. supply chain, regulatory agencies etc.
Other resources	Principally, the time and money required to implement and operate the *ERP system*.
Outside world	The political, economic, socio-cultural, technological and legal environment that affect the significant roles and actors of *ERP system*.

of transnational enterprises. The application of ERP systems have become quite general and common for companies operating in several countries or all over the world on various continents. The table below (Table 4) summarizes the characteristics of ERP system both advantages and drawbacks.

Table 3. CIPSODA viewpoint to Information Sytems

Capture	Collecting the raw data required for the ERP system.
Input	Recording the data into the ERP system, e.g. Invoice, Account Payable or Receivable, Purchase order etc.
Process	Modifying the inputted data through calculation, classification, selection, and so on.
Store	Retaining raw and processed data in the ERP system.
Output	Generating and distributing the processed data.
Decision	If the processed data could be considered as valuable enough to be seen as information, it could have been made use for decision taking.
Action	During the business process or workflow from the raw data through information some knowledge has been created that can be transformed to action to execute the decision.

3.3. Enterprise Architecture and Information System Architecture

The **Information System Architecture** represents the structure of certain components of information processing systems, their relationships among components, those technological principles and directives of organization of which the main purpose is to support business. We can understand under **Architecture** a pragmatic, coherent and consistent structuring of a set of components that through these elements supports the vision of the "user" in an elegant, comprehensive and easily interpretable way.

In the 80s, *Software Architecture and Information Systems Architecture* were considered as synonyms. But in the 90s, the requirement come into sight to understand and deal with comprehensive and concise concepts that reflect the relevant and significant aspects of the overall information structure of organizations without enforcing extra burdens on the responsible persons handling a particular viewpoint. The description of how a system was internally built depicted primarily the technological components, especially the software building blocks. The **Zachman Framework** (Zachman, J.A, 1987) can be considered as the first important phenomenon that pinpointed to the fact that software architectures were not enough. While software architectures represent internal system details (using, for example, E-R and DFD diagrams) *Information System Architecture* focus on the high-level business and information system processes.

We perceive **Enterprise IT Architecture** as the suite of strategic and architectural disciplines that includes the *Business Systems*, *Information Systems*, and *Technical* Architectures.

We can exploit "the urban planner" metaphor for the architecture design of information systems populating an organization's information landscape (Maier, M., W. , Rechtin, E., 2000) 10in order to grasp the subtlety of the architecture design.

Using the "city" as a metaphor for the "community or municipality of information systems", we can use the concept of "information system urbanization" to emphasize the need for models to guide the evolution of information system independently of current technological trends. The urban planner's client (local governments, the leaders or agencies of communities or municipalities) usually lacks the resources to build the plan, but can certainly stop something from being built if it is not in the plan. To be successful, the urban planner and client have to look outward and sell their vision. They cannot bring it about without others' aid, and they normally lack the resources and authority to do it themselves. Urban planning also resembles architecting in a spiral or evolutionary development process more than in the waterfall life cycle model. An urban plan must be continuously adapted as actual conditions change.

An **Enterprise Architecture** can be divided into several levels:

- **Business** (systems) **architecture** - Defines the structure and content (information and function) of all business systems in the organization (the *ERP* of

Table 4. Benefits and problems of globalized and internationalized ERP Systems

Benefits and Advantages of ERP Systems	**Problems and Difficulties Arising during Operation and Implementation of ERP System**
– *Opportunity to acquire consolidated financial and other results, from all divisions of the enterprise, in all sites of the world, in an accurate and on-line way;* – *Chance of better coordination of the business processes of the enterprise's value chain carried out in different countries;* – *Prospect of presenting a standardized global service to global clients;* – *Likelihood for lowering of global IT costs;* – *Standardizing of the business practices at world level;* – *Accessibility in various countries with the possible application of various languages and currencies;* – *Allows standardization of Enterprise Architecture including IT platforms around the world ;* – *Shorter implementation and lead time than that of a transnational system developed in-house;*	– *Difficulty to create a standard model of the system for the different countries in which it operates* – *Complexity of the implementation project, in view of its extent and number of teams working in parallel* – *Various differences (characteristics of the different legacy systems, number of plants, geographical extension, number of divisions) may force the usage of different implementation strategies in each country* – *Difficulty to accommodate differences in business concepts and practices in the same system* – *Difficulties in language, calendar and time zones* – *Differences in the quality and cost of telecommunications between the various countries* – *Difficulties to adjust the "best-practices" models developed in Europe and North-America*

an organization);
- **Information Systems Architecture** (the *ERP system* of an organization);
- **Information** (or Data) **Architecture** – represents main data types that support business; furthermore the structure (including interdependencies and relationships) of information required and in use by the organization;
- **Application Architecture** – defines applications needed for data management and business support; the collection of relevant decisions about the organization (structure) of a software system, and the architectural style that guides this organization.
- **Technical Architecture** – represents the main technologies used in application implementation and the infrastructures that provide an environment for information system deployment. Technical architecture describes and maintains the integrity of the hardware, software, and infrastructure environment required to support the *Business Systems Architecture* and *Information Systems Architecture.*

Information Systems Architecture

The major purpose of the Information Systems Architecture is to identify and define the main data types that support business development. For example, data can be categorized according to different dimensions, including: primitive vs. derived, private vs. public, and historical vs. operational vs. provisional. The data can be grouped into entities representing significant business concepts. The data can be classified by security aspects as confidentiality, accessibility and the value for business in case of damage or loss.

Application Architecture

The second architecture level defines the main applications needed for data management and business support. This architecture defines the major functional components of the architecture to guarantee access to the data in acceptable time, format and cost. However, it should not be a definition of the software used to implement the information system. Spewak also proposes a methodology – Enterprise Architecture Planning (EAP) – to define an application architecture from informational and business requirements (Spewak, St., and Hill, St., 1992). Several authors have adapted Zachman's framework and Spewak's EAP to better address their own requirements, including several ad hoc standards known as the American Federal Government Architecture (Federal Enterprise Architecture Framework, version 1.1., September 1999), Joint Technical Architecture (Department of Defense, Joint Technical Architecture, July 2002), and the Treasury Enterprise Architecture Framework (US Department of the Treasury Chief Information Officer Council 2000).

Technical Architecture

This architecture defines the technologies that provide an environment for application building and deployment. At this level, the major technological concepts are identified, such as technologies to implement applications, inter-process communication, data storage, and so on. Boar proposed a set of blueprints for defining IT architectures in a systematic, coherent and rigorous way 2at *Technical Architecture* level, in the form of "Enterprise IT Architecture Blueprints" (Boar, B., 1999). However, all these proposals introduce new notions and icons, not supported by any rules or standards. As a result, potential users are reluctant to adopt these proposals because they are forced to acquire a high-level knowledge and experience before actually defining any IT architecture. The TOGAF wide-spread acceptance may mean a de facto industry standard at *Technical Architecture* level. However, TOGAF has a more comprehensive approach to the concept of architecture. For this reason TOGAF achieves popularity from business process management through information systems strategic planning to detailed logical and physical technology design.

Industry Standard Approaches for Architectures

In the 90's, the IEEE formed a taskforce that defined a standard called "Recommended Practice for Architectural Description of Software- Intensive Systems" to provide a conceptual framework for software architecture IEEE 1471 (IEEE 1471 2000). Based on this IEEE standard, the Open Group proposed the TOGAF (The Open Group Architectural Framework) framework for Information System Architecture design, description and evaluation (TOGAF Version 9, 2009). This framework provides not only a methodology for *Information System Architecture* development but also provides a taxonomy, architectural principles and standards for Information System Architecture, overarching from business process architecture through the application, software system services to at technical level. Thereby, the TOGAF's Architecture Development Method is not only an Information Systems Architecture but an overarching Enterprise Architecture development and modeling tool that could describe the architecture at the required granularity level. In addition, TOGAF proposes a technical reference model and moreover a Standard Information Base that defines a taxonomy for coherent, consistent and hierarchical description of services provided by the application platform. The services of application platform could be e.g. data management, network, operating system, transaction processing, and system administration. Finally, TOGAF also presents several architecture qualities that are inherent to the architecture definition, such as performance, availability, usability, adaptability, and portability that are generally considered as non-functional requirements at information systems.

3.4. Framework for analysis of effect of globalization and internationalization

The difficulties of introducing, implementing, adapting and changing of ERP systems are multiplied by the particular characteristics of organizations procuring ERP systems thereby these peculiarities of organizations necessitate unique business and information system solutions both on *ERP* and on *ERP system*. However, ERP vendors are interested in having a generic solution that could be sold to a broad market.

Thus, a decisive factor in the improvement of the success rate for ERP implementation is the mutual adaptation between the information system and business processes and their organization environment. Such an adaptation process must align the organization's existing operating processes and the packaged software's embedded functionality through a combination of configuration and organizational change, i.e. modification at various architecture levels, views and viewpoints.

Such information system centered approaches require change of the organization's socio-technological system, which intermingles technology, task, people, structure, and culture. Gronau (Gronau, N., 2008), raised an issue observing the German trans-national companies, their *ERP and ERP systems.* The trends of globalization lead to setting up manufacturing sites in foreign countries that lack the necessary motivation, competencies and capabilities of workforce, or there is an extremely high fluctuation of employees (e.g. China).

Gronau proposes for analysis a twofold model. One is a simple socio-technological architecture for *ERP system* as follows:

(1) **Centralized** *ERP system* can be considered as a system with functions that can be accessed from any places of the world. The disadvantage of such a system is its high complexity as the particular country specific features should be handled centrally or some external solution should have been found.
(2) The **decentralized symmetric** model contains a centrally used *ERP system* and another, different *application system* that offer services for Production and Logistics locally for "all over the world", i.e. for subsidiaries of the enterprise. The complexity of the decentralized system is less than the centralized one and the regional specialty could be incorporated easily into the system.
(3) The **decentralized organic** model makes use of the local selection of IT and application systems allowing the alignment to the local requirements more easily. The data interchange is implemented through a unified and standardized interface.

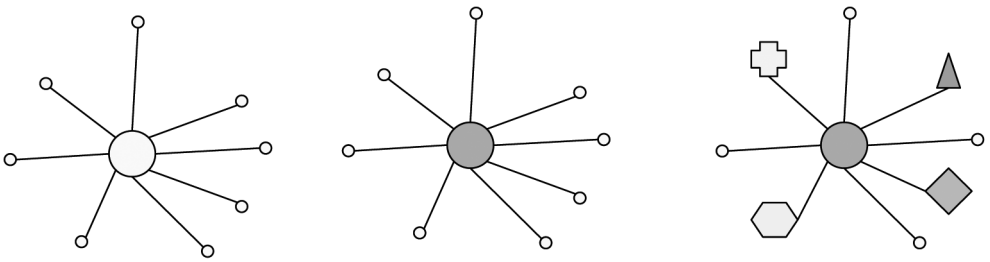
For evaluating the alternative models, some criteria are created for assessment as the **resilience** and **stability for future**, the **costs** and **satisfying the requirements** coming out from the allocation and distribution of business processes and activities.

(1) **Resilience** and **stability for future** means the adaptability and flexibility of *ERP system* for the future changes.
(2) Higher **costs** is acceptable only in case the resilience and stability for future can be ensured.
(3) **Satisfying the requirements** means the analysis of compliance to the demand of business, i.e. the business tasks and activities.

3.5. Problem conceptualization

In a smaller country (Hungary) than the investigated one by Gronau's research (Gronau, N., 2008), the effect of globalization for ERP systems is worth analyzing. The profound difference appears in the form of the ownership and the structure of subsidiaries of international enterprises. The typical trans-national or

Figure 1. Gronau's basic models of communication for enterprise architecture of ERP systems



Centralised ERP system used jointly by subsidiaries

Centralised ERP system communicating with standardized local application system

Centralised ERP system communicating with locally different applications systems

multi-national company in the country is a subsidiary of large international enterprises, the headquarters or centers are usually outside of the country, in some cases regional centers are operated within the country. As a first rough but comprehensive approach Gronau's evaluation schemes and taxonomy of enterprise and ERP system architectures are used.

To tackle the following issues we have made use of the above outlined analysis frameworks to find answers for questions as follows:

(1) What is the standardization level of *ERP systems* required by international enterprises?
(2) Which architecture models fits best to ERP systems reflecting the effect of globalization taking into account the continuum of enterprise and IT architecture?
(3) What are the business processes, functions or activities where the effect of globalization for *ERP systems* can be perceived in the form of changing of basic enterprise and IT architecture?

As a first cut, sixteen local companies of trans-national and multi-national enterprises have been investigated. The companies analyzed are involved in several sectors of industry as energy, software development, electronic equipment manufacturing and retail chains.

3.6. Research method

The basic approach and methods for the research were as follows:

- Trough exploiting the personal connections and relationships of members of research group, meetings for interviews were organized.
- In-depth interviews with CEOs of local subsidiaries of international companies (twenty subjects).
- In-depth interviews with CIOs of local subsidiaries of international companies (five subjects).
- During interviews, standardized questionnaire based on methodology were made use. The questionnaire was based on Gronau's research, Zachman's framework and ITPOSMO and CIPSODA viewpoints (Table 2, Table 3) (Gronau, N., 2008).
- After assessing the interviews, some clarifications of details and information were requested.
- Researcher from academia elaborated the case studies on standardized principles and guidelines.
- A comparative study and summary was created by qualitative and quantitative analysis (ELTE-GDF 2010).
- The research method was based on the case-study paradigm and aimed at qualitative and not quantitative research.

For each company, a comprehensive table was created that contained the ITPOSMO, CIPSODA and Zachman/ TOGAF architecture element. Using the transcript of interviews, the researchers tried to fit and place the answers of CEOs and CIOs into the template. The tables resulted after the analysis are used for discover some patterns of trends.

4. Research results

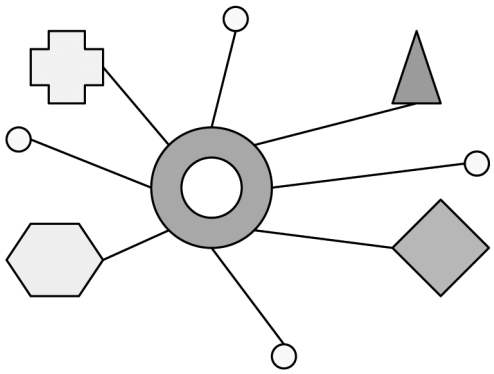
Several tendencies of ERP Systems' development were discerned at international companies; however the basic trends out of qualitative analysis can be summarized as it follows:

A. The country specific features or the separate ERP systems are unified and standardized into the integrated central information processing system.
B. Within a region, some business processes, business services and information processing are standardized.
C. The separate, in each country differing data or information processing units or systems are centralized (creating server farms at locations designated as central).

There is an example for an enterprise architecture where each single subsidiary in each country uses a country-specific *ERP system* supporting the data processing and management tasks. Naturally, there is counter example, where the headquarter of a multi-national company has already taken a decision to eliminate the heterogeneity of systems and create a homogenized architecture, i.e. standardize both the application systems, services and application platforms.

In another case study, a company for machine manufacturing that uses as marketing channel its subsidiaries established an architecture in which the financial and production modules are placed at the manufacturing sites and countries, the CRM module is deployed to the companies for sale in Asia, the financial controlling, accounting and management information

Figure 2. Model-4: Various application system communicating through Intranet towards a standardized central system



modules were rolled-out in the headquarter of the company.

There are examples for ERP architecture containing several layers. The typical cases are when the information processing organized into systems at regional level. The regional headquarter for Eastern Europe of software distributor company is situated in one of the capital of region. The sales data of region is collected by the regional headquarter using a most recently introduced CRM module playing central role within information processing then processed information is transmitted to the European headquarter for further processing.

The conclusion could be made that Gronau's basic models depict the essential attributes of architecture for ERP systems at international companies, i.e. the results of country level information processing is sent to some centralized systems ensuring to meet the demand for information at management level. The research concluded that the enrichment of Gronau's basic communication structure among the services of ERP and application systems is necessary. Two extra models were created for describing cases discovered during the research that more accurately reflect recent situation. During the research it was realized that there exists such an enterprise architecture (Figure 2, Model-4) that has been emerged after several acquisitions of local companies and when the centre has made a decision to keep the existing, country-specific systems in place and their development will have been carried out by decentralized way in the future.

Among the case studies there was an enterprise out of the insurance industry. The legal environment and jurisdiction differs overwhelmingly among countries, even between EU member states. For this reason, business services and their insurance policies (e.g. life, asset etc. insurance) could be created only by taking into account the country specific regulations then the business services are mapped into services of local application systems. The feature of this model is that *ERPs* of local companies use some specific modules as common components of *ERP system.* The common components can be accessed by each single subsidiary within the Intranet of the multinational enterprise (Figure 2). However, the long-term plan is to implement a standardized system out of which the data can be sent to the central information processing system to support the management decision.

Model-5 (Figure 3) mirrors an enterprise architecture that corresponds to one of the vision about the future of *ERP systems*. The significant characteristic of such an approach is to implement one standard *ERP system* (e.g. a product of one of the market leader) and then to make it compulsory and to enforce the change-over at all member companies of the enterprise. There is a multinational company in the energy sector that will centralize all country-specific information processing of subsidiaries operating in member states of European Union. A standard, central module (SEM = Strategic Enterprise Management) will have implemented through which the centralized management function will have realized. Use of this module, the application systems of subsidiaries can be accessed and consolidated data can be generated for the modules of Management Information Systems.

Figure 3. Centrally operated, standardized ERP system

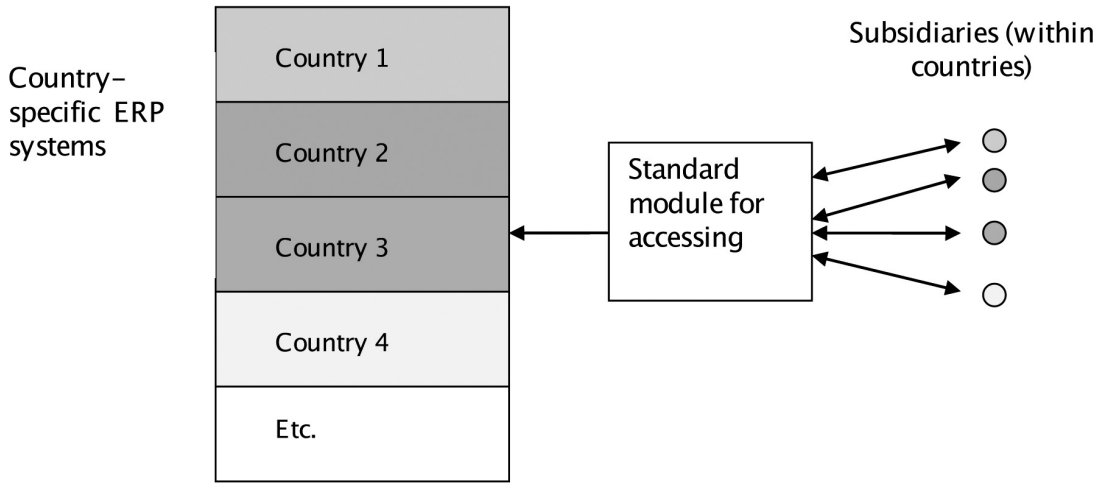


Table 5. Characterizing the tendencies at different architecture level

Perspectives of Zachman's Framework	Centralized	Decentralized	Hybrid
Business Strategy, Process, Business Scope	5	4	7
Enterprise Model	5	4	7
System Model	3	6	7
Technical Model	2	7	7
Components	2	7	7
Functioning Enterprise	3	3	10

5. Conclusions, discussion and summary of results

During the research several tendencies are spotted that reflect the multitude of development directions considering the ERP Systems and Enterprise Architectures. The main trends can be described as follows:

(1) The existing, separate, country-specific application systems are standardized and integrated to the centralized standard information processing system.
(2) Certain business processes, business services and – as a consequence – the services of application systems are standardized within a region.
(3) The legacy information processing units and systems existing at separate countries are centralized.
(4) The trends for standardization and centralization unambiguously can be highlighted at business functions and services where there is a strong coupling to the market and its volatility and these tendencies show accelerating features.

In this research, we have tried to focus on the *ERP* and *ERP system* as the changes and modifications is driven by the volatility of market and business. The feedback loop is shorter in time and the results and effects of business decision could be discerned more rapidly. For the CEOs of companies, the concept of *ERP* and *ERP system* is well known and the decisions related to *ERP system* are the everyday business of CEOs.

However, the major players and vendors of *ERP systems* attempts to incorporate more and more information services, there exists several information system services that are still not part of *ERP systems.* We have not investigated the tendencies of changes in the architecture of general information systems, but the cloud, virtualization and even the SOA architecture points towards general centralization tendencies at other information processing fields of enterprises.

Using the Zachman's framework, we have tried to characterize the centralization, decentralization and hybrid tendencies within the *Enterprise Architecture*.
The Table 5. contains the number of companies that can be classified by each single perspective and the centralization-decentralization continuum. The table stresses and underpins the conclusions, i.e. the strong trends towards centralization, mainly at the architecture level that are significant for business.

6. Future Research

However, the paper is outlined and presented a wide ranging toolset of analysis methods the collected information were not detailed enough to apply the whole spectrum of available investigation means.
The next step is to continue the in-depth interviews method and structured questionnaires created on the theoretical framework provided above to widen the fact gathering activities on empirical data.

Exploiting the rich theoretical background there is a potential to examine from various aspects the ever changing landscape of *ERP* and *ERP systems*. The re-engineering of ERP systems within different level of Enterprise Architecture as e.g. organization, business and application services, application systems and technology highlights the trends, the recent approaches that are followed by companies out of several reasons to accommodate to the volatile market and external forces. The trends that are fashionable are SOA and cloud computing and they have an impact on *ERP systems*. To analyze the most recent trends we need to align the general Enterprise Architecture and SOA approach to push further the qualitative studies in this research approach (Molnár, B. , Tarcsi, A., 2011).

As our research focuses on the collateral effects of globalization and internationalization on *ERP* and *ERP systems*, the system introduction and implementation issues are not investigated. In spite of this, the change

management as reaction to re-engineering the business operation leads to roll-out, re-organization of activities at sites and thereby similar issues and problems which emerge during introduction and implementation. Both at implementation and re-engineering the immanent phenomena of *ERP systems* appears in the form of inflexibility and the required efforts to keep-up the stability of systems. The concept of flexibility of *ERP systems* may be interpreted as the degree to which an ERP system may be dynamically amended, the whole enterprise architecture to be reconfigured in order to define new business models, functions and processes. One of the advantages of ERP systems is the standardized business processes based on best practices. The ERP-enabled standardization provides opportunities for enterprises to integrate disparate business information systems and give a chance for the seamless accessibility of organizations' data asset.

The standardization in the context of ERP is not without shortcomings. It is widely known fact that standardization might be achieved at the cost of flexibility and stability which is another important business requirement for organizations to incorporate emerging changes in business environments (laws, regulation by authorities etc.), internal changes of business processes and information technology. Nevertheless, the consideration on flexibility and stability should be given at the phase of ERP package selection that a balance between standardization and flexibility should have been achieved.

In the case of analyzing the effects on enterprises coming out of globalization, the systems are after the implementation and introduction phase and so the features of the selected *ERP system* are already given. The degree of flexibility is the attribute of existing *ERP systems* that influences how effective and efficient the re-organization or re-engineering the enterprise architecture and ERP systems could be. For such reasons the future research should cover the related questions. Among these questions is the resistance to change, when, for example, some employees become reluctant to learn new techniques or accept new responsibilities. Another problem is related to unplanned cost associated with new requirements emerging because of re-organization, centralization or decentralization of certain business processes.

Future research in this area may concentrate on carrying out a series of case studies, in-depth interviews, questionnaires and empirical studies on amendment and re-engineering *ERP systems* to fit to requirements ensuing from changing environment caused by globalization.. Other side of study can be the investigation of consequences caused by re-engineering enterprise architecture and ERP systems. It will be worth analyzing the influence of changes that affects on generally IT, IT and human resources infrastructure, strategic alignment, knowledge management and organizational learning, outsourcing and application service provider and competitive advantage.

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Dr. Bálint Molnár is former Member of Academic Relations Committee of ISACA, he is Senior Researcher at Eotvos University of Budapest, he teaches: Methodologies of Information System Development, ERP and Integrated Systems, Web technologies for Enterprise Information Systems. He is Associate Professor at Corvinus University of Economic Sciences and Public Administration, he teaches: Development of Information Systems, Project management, Knowledge-based systems development. His research area: Information System Modeling, ERP systems, Business Process Modeling, Semantic Web, Enterprise Architectures, SOA.

He has published several scientific and professional papers and been engaged as a consultant and project manager in the Hungarian Public Administration. He is a member of the editorial board of Journal of Information Technology & Politics, The Electronic Journal of Knowledge Management (EJKM).