THESIS SUMMARY

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The metamorphosis of ERP Systems
Ph.D. thesis

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# Table of Contents

I. Research Motivations and Goals ................................................................. 2  
   I.1.1. Hypotheses ............................................................................................. 5  

II. The realization of the research ................................................................. 6  
   II.1. Research Methodology ............................................................................ 6  
   II.2. The Applied System of Paradigms and Tools ............................................. 7  
   II.3. The Verification of Thesis ......................................................................... 9  

III. The Results of the Research ................................................................. 11  

IV. References .................................................................................................... 13  

V. Relevant Publications of the Author ........................................................... 19
I. Research Motivations and Goals

In our days organisations face many challenges. Besides price and cost pressures, businesses are becoming global and new markets are developing rapidly. The success of a company in micro and macro level is increasingly determined by how quickly it can react to changing market conditions with adequate products and services. Furthermore, there is rapid technological development and product lifecycles are shortening. It is no longer enough to define customers by market segment. There is increasing expectation that products will be configured for individual customer needs. On top of all these trends there are country-specific or industry-specific regulations and compliance issues to which companies must respond.

Companies look for techniques and methods, which can help them to improve their capabilities in effective organisational management. It is almost impossible to run a competitive business without computerized information systems. Providing a computerized solution to a business problem may require integrating a lot of information systems. The rapidly increasing use of the web has changed the manner in which business is done in almost all organizations.

ERP (Enterprise Resources Planning) systems have been the most popular enterprise applications, and have presented new model of enterprise-wide computing since 1990. They allow enterprises to replace their legacy systems with a single, integrated system, in which it is possible to plan and manage the use of the resources of an entire enterprise.

IT infrastructure that has grown organically and chaotically over the years to handle focused issues as they arose, with no recognizable roadmap or process in place. Connections between pieces of this infrastructure tend to be inflexible and very difficult, expensive, and time-consuming to change.
Custom Point-to-Point Integration is expensive to maintain and very expensive for new business requirements. Any change to either endpoint is likely to break it. Changes to internal components will break it also. EAI is less brittle, changes to endpoints may require some changes but they don’t ripple through the entire infrastructure like Point-to-Point Integration. Changes to internal components may force changes to other components since internal broker components are typically tightly coupled. Initial costs are higher than Point-to-Point Integration, but maintenance is much lower.

As the business transforms, the IT systems implementing transformations have to be agile enough to change quickly and cost effectively while still performing current business function. Business agility is the fundamental business requirement – The ability to respond to changing requirements is the new meta-requirement for business. The entire enterprise architecture must support the business agility requirement.

The desire to make IT more flexible is not new. It is as old as the IT industry itself. Early initiatives involved making monolithic architectures more flexible by breaking them into callable subroutines and procedure calls. The idea was then built upon by the concept of business objects – discrete pieces of code which included data and its behavior which could change depending on context. Object technologies were mostly tightly coupled and so messaging technologies were developed to loosely couple applications from one another. Various EAI techniques were then developed to make applications even more modular and loosely coupled. Enterprise Application Integration is defined as the use of software and computer systems architectural principles to integrate a set of enterprise computer applications.
EAI encompasses methodologies such as object-oriented programming, distributed, cross-platform program communication using message brokers with Common Object Request Broker Architecture and COM+, the modification of ERP to fit new objectives, enterprise-wide content and data distribution using common databases and data standards implemented with the Extensible Markup Language (XML), middleware, message queuing, and other approaches.

Information sources change every day and consumption of sources change every day. Therefore, to make business flexible, and not based on a specific integration project but a flexible information architecture. Today, Service Oriented Architecture is the culmination of all of these architectures. SOA builds upon previous integration techniques but does not replace them. SOA blends the best of all these concepts into one new architecture that promises to make the notion of applications even more flexible. SOA is not the end of the road, it's the next step in the evolution of flexible enterprise infrastructures. I think this evolution will continue into the future.

Hypotheses and Relating Research Questions

Main research questions of my thesis were the next: what kinds of methodologies exist for integration application development in the literature and how these paradigms can be extended, modified, integrated and customized for a new domain in ERP-centric enterprises. Nowadays companies are to survive in a dynamic environment. New business models will be an even greater source of competitive advantage than new products and services. Organizations are trying hard to continuously align their actual business processes, as executed by the multiplicity of systems, with the should-be processes as derived from managerial needs. My research topics have been dealing with the role of BPM and the possibilities in application integration problems in ERP-centric enterprises. The importance of business driven approach especially in
integrated business architectures is obvious. Process models are the core elements of the integrated enterprise architecture.

Common and unified interpretation is fundamental in data and information processing. Managing the organizational resources and integrated systems development are strategic issues in many companies. They require a common platform to integrate business and IT architecture. Business driven SOA environment could offer an alternative solution to satisfy these needs, as I have discussed in my thesis.

The following research questions were discussed in my thesis:

- how can we use ERP systems in agile dynamic business environment
- what are the decisive methodologies for integrated systems development in the literature;
- what are the most frequently cited business modelling methods;
- what kind of business modelling methods and tools are in use;
- how can these business models be extended, modified and transformed support integrated systems development?

I.1.1. Hypotheses

The Main Research Statement:

_The key of the solution of integration problems in the conglomerated environment of the organisations that implement ERP system also in middle-distance to make capital out of the synergy of the collaborative use of the modern application development paradigms and methods - like BPMS, SOA and MDA._
The First Research Statement:

*With the use of ARIS method and tools realizable the model of business integration of the organisation that implement ERP system.*

The Second Research Statement:

*With the collaborative use of the principles of BPM, SOA and MDA the integration problems of an organisation can be solved in business driven way.*

The Third Research Statement:

*An ERP – centric organisation that develops and optimises its BPMS process models quickly and cost effectively can follow the changes of its environment with its integrated information systems and applications.*

II. The realization of the research

II.1. Research Methodology

My research area is on the borderline of information technology and social sciences. This interdisciplinarity influences the methodology of my research.

Regarding the approach this research is a deductive one, since it focuses on the verification of already existing theories by the application of business modeling and software engineering methodologies, modeling languages and relating model transformation methods on a new field. In the initial phases of the research questionnaires cannot be applied for proving the statements of
hypothesizes, neither statistical samples are available. The most adequate solution for the verification or disproval of the applicability of this approach is the use and thorough analyzes of case studies.

II.2. The Applied System of Paradigms and Tools

Many techniques are used for modelling enterprise architectures. I have summarized the most promising modelling approach and toolset. ARIS has become market leader; therefore I applied the widely accepted ARIS methodology and framework in my research. I have also summarized the business integration framework.

I proposed the ARIS method to provide the model of business integration of an organisation that implement ERP system because:

1. The ARIS - Architecture of Integrated Information Systems - provides a structured approach to modelling, and also an Architectural Framework that provides a specification of how to organise and present all of the information that comprises an enterprise’s architecture.

2. ARIS is market leader also in Hungary.

3. ARIS models are in use at organisations for BPR purpose.

4. The ARIS reference models of remarkable ERP systems (eg. SAP) are available.

5. The principles of ARIS concept (views and layers) make available to provide the integration between the vertical and horizontal layers of the model of business integration.

6. ARIS method uses top-down approach for the development of the process structure of an enterprise.

To make business able for change dynamic and based on flexible information architecture, I offered to develop using SOA foundations.
I followed business process management methodology for business driven development of my SOA application because business process management is a discipline combining software capabilities and business expertise to accelerate process improvement and facilitate business innovation.

The first step in the business driven development of a SOA application - applying the BPM principles - is to create the model of the business process. Models can be used for documentation and compliance purposes - providing a visual and textual representation of the processes, organization, resources, collaborations and business measurements. The next step is to turn business processes into models that can be analyzed, simulated, refactored, and ultimately turned into software applications.

I applied the IBM WebSphere tools during the development. WebSphere Integration Developer's tools are based on a service-oriented architecture. The tools allow both a top-down design approach to building an integrated application, where the implementation for one or more components does not exist and is added later; or a bottom-up approach, where the components are already implemented and the developer assembles them by dragging and dropping them in a visual editor and then creates a logical flow amongst them by joining them with lines. A debugging and test environment means full testing before the applications are deployed to a production server. Setting monitoring points lets see how an application is used in real time in order to fine tune it for optimal performance.

I refined the high-level business process model - the EPC process model from the ARIS repository - in the ARIS SOA Architect. Business processes are transformed into technical processes using the ‘10-step’ methodology.
II.3. The Verification of Thesis

First Research Statement’s Verification

I proposed the ARIS method and toolset to provide the model of business integration of an organisation that implement ERP system. I demonstrated the ARIS support in the implementation of the business integration model by assigning the model types from ARIS views and layers to the elements of the business integration model.

Second Research Statement’s Verification

The first step in the business driven development of a SOA application - applying the BPM principles - is to create the model of the business process. To turn business processes into models that can be analyzed, simulated, refactored, and ultimately turned into software applications i used IBM WebSphere Business Modeler. Modeler can be used for documentation and compliance purposes - providing a visual and textual representation of the processes, organization, resources, collaborations and business measurements. Modeler includes a simulation tool that allows to analyze and optimize the process. Modeler is built on the Eclipse tool framework making it easy to share information about the business design with other parts of the organization and tools. I exported the design into WebSphere Integration Developer so that – this means a model transformation from BPMN to BPEL - I can use that as a blueprint for designing process flows for automating the business design.

I demonstrated how to develop service oriented architecture by implementation of a complex business process using model driven methods for the transformations from high abstraction level business processes to executable business processes.
Third Research Statement’s Verification

I assumed that the observed enterprise had applied the ARIS method during the implementation of its ERP system and development of its business architecture; also maintains process models in a common repository. In this mental experiment I had a lot of organisations because of the market position of the ARIS.

I assumed that the enterprise makes its applications work on the Websphere platform. With this assumption I narrowed the experimental set but because of the market position of the IBM I had considerable amount of organisations.

I looked at a change that needed quick reaction in strategic standpoint. This should be a frequent case in the enterprise’s life not to be empty the experimental set.

The main enterprise’s business objectives:

- Use automation to enhance the performance of the “Purchase order“ process
- Document the process
- Make the process easy to integrate
- Make the process easy to update and modify

Business processes were transformed into technical processes using ARIS SOA Architect and the ‘10-step’ methodology.

I have proved by the described deduction that in a SOA environment - that implements the proposed process management method and toolset; the ERP system developed by the proposed method and toolset; and some other applications - a quick and cost effective solution can be provided for a new
business challenge with the use of model transformations, that suits both the strategic and high abstraction level business models and on the implementation level suits the business integration architecture of the organization.

III. The Results of the Research

On the field of methodologies for integrated application development and business modelling the most influential approaches applied in my thesis were building business driven SOA environment, BPM and MDA methodology. Business driven SOA development has a new approach for integrated application building based on partly BPM methods. There are not so many implementation descriptions available in the literature for the verification of their method. They published mainly research experiences. I modified and customized these methodologies in order to satisfy the requirements of my research tasks. Therefore my approach concerning the methodology for integrated application building and implementation is new.

Most important results of my work are the following: modification of integrated application methodology for building business driven SOA environment using the results of the assessed methodologies and the application of the modified methodology for a new domain to produce a prototype.

Research is timely and up to date because of the constantly increasing use of e-business, emphasizing enterprise agility and business flexibility issues. One of the practical importances, applications of my research is that the results can be used in teaching and in further researches of my department. It seems that the outcome can be used at the graduate level in business informatic courses, in diploma consultation, and at postgraduate level. Achievements could be useful for organizations also, because there are not so many research projects with the same subject in Hungary. It can serve as a base, as a prototype of projects for integrated system development and analysis.
I continue the research in a common researching project with IBM, SAP and IDS in the topic of business driven SOA development.
IV. References


Howard Smith & Peter Fingar Workflow is just a Pi process, V2.1, November 2003.


V. Relevant Publications of the Author


Ternai, Katalin (2005): 'Integrált gazdálkodás - nem középiskolás fokon.' Vezetéstudomány (Management Science) - february, pp. 31-37.

