A PROCESS BROKER ARCHITECTURE FOR SYSTEMS INTEGRATION

BACKGROUND

Organisations and their IT-support have traditionally been structured around business functions as is depicted in Fig. 1, which shows each function being supported by its own systems and applications. This leads to problems when it comes to integrating systems and business processes across functional areas.

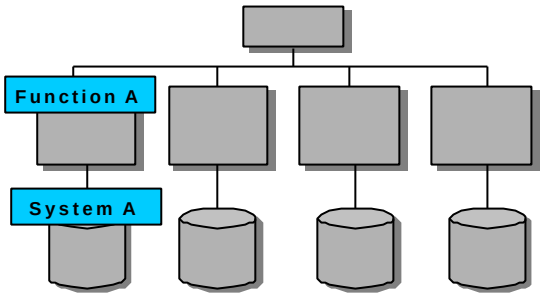

Fig.1 The Traditional Function-Oriented Structure

In consequence, this structure is not adequate for today's process oriented organisations with business processes spanning several functions, see Fig. 2. Furthermore, there is presently a trend towards increased inter-organisational co-operation, exemplified by virtual enterprises and supply chains. This type of co-operation gives rise to new requirements on software applications and their integration; in particular there is a need to support business processes across functions and existing applications as well as supporting processes between organisations. In addition, systems on different levels within an organisation need to interoperate. For instance, process control systems need to be fed with control information and to forward data to higher level systems such as enterprise resource planning. There are presently two major technologies for accomplishing the integration between applications and processes: Message Brokers and Business Process Brokers.

A Message Broker implements a loose coupling between applications. This coupling is used to interface applications designed in different technologies or residing in different functional areas. Typical Message Broker functions are: communication connectors for transporting messages; format connectors for describing different message types, such as EDI X12, SAP IDOC, and XML; technology connectors for connecting different technologies, such as different database management systems and programming languages; message routing for redirecting message flows; message format conversions for transforming messages between different formats.

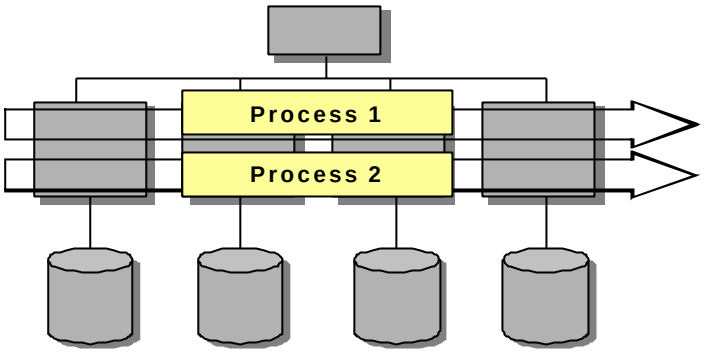

Fig. 2 The Process Orientation

A business process integration interface is a mechanism for transferring content between two business processes that act as sender and receiver. The content can be of any type and may consist of several different combined contents, e.g. a physical product and paper or electronic information. Process integration interfaces are managed by a Business Process Broker. A Business Process Broker provides a higher level of abstraction than a Message Broker does by giving users the ability to define integration requirements through workflow and business process models. A Business Process Broker will provide functions for synchronising events into one business transaction, handling parallel business transactions, mixing email (person to person) and application (machine to machine) messages in one business transaction. By means of a Business Process Broker it will be possible to build Process Management Systems that align the IT-support to the business processes, see Fig. 3. Advantages of this alignment is that people and systems can be linked together in the processes, that decisions based on business rules can be automated, and that the impact of process design can be increased.

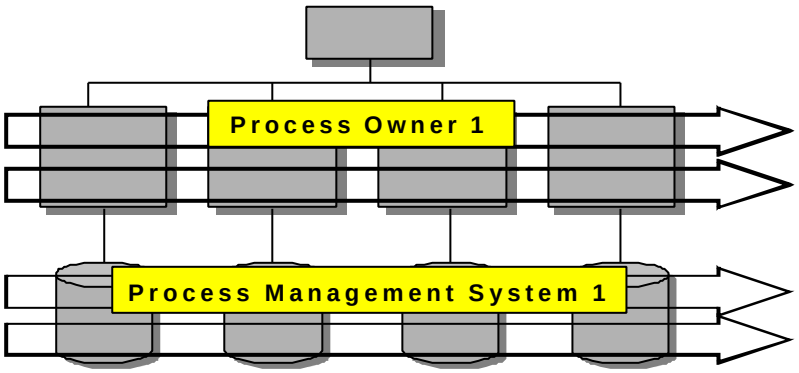

Fig. 3 Process Management Systems

PURPOSE

The purpose of the project is to investigate Process Management Systems, in particular description techniques and methods for application and process integration as well as implementation architectures for process oriented systems.

ISSUES

The issues addressed by the project can be divided into three groups:

DESCRIPTION TECHNIQUES

Process integration solutions are aimed at business users. They should enable those who understand a business process to define the process through a graphical interface and easily change processes when necessary. It is therefore essential to provide a graphical description technique that makes it possible to visualise application and process integration. It is envisaged that the interface applications between business processes can be seen as a series of activities, where the most important activities are: receive a message, send a message, wait for a specific message a predefined time period, analyse a message content, make a decision on a message content. Some questions that need to be addressed are the following: How should a graphical description language be designed so that it becomes easily understandable for business users? How expressive should such a language be? What are the relationships between such a language and more technical modelling languages, e.g. UML? How should the relationships between activities and messages be described?

METHOD

A difficult problem in process engineering is that of identifying and describing processes. It is not always obvious what processes exist or should be introduced into an organisation; instead this may require explicit decisions and reengineering efforts. Analogous problems will surface also in application and process integration, and methodological support is therefore needed. Some questions that arise in this context are: How should the responsibilities be divided among interface applications and other application systems? In what circumstances, e.g. long vs. short processes, are interface applications appropriate? To what extent is the traditional transaction concept useful in interface applications? How should the communication with non-automated actors be managed? How should the transition from a business focus to a technical focus be handled?

IMPLEMENTATION ARCHITECTURE

A focus on business processes and their integration through interface applications will enable new architectures for implementation. It will be possible to store data related to a process as it is created and refined as the process develops in time. Process related data would then be stored in one single place instead of being distributed over several locations as in a relational database solution. Some questions that need to be investigated here are: Will an implementation architecture based on storing process related data together be more efficient than current normalised database solutions? If a database solution is not chosen, how should data be stored efficiently, securely and in a scalable way?

Another, more long-term, line of research is to investigate whether models for process interface applications can be utilised also for general systems development and maintenance and how they compare to current state of the art models, such as object oriented approaches.

APPROACH AND WORK PLAN

The approach of the project will be a combination of theoretical investigations and empirical case studies. The case studies will be based on Frontec Business Integration Method (BIM), which is a model for constructing process interface applications.

All project partners will participate in all activities. The role of participants from Frontec will be to transfer knowledge on architectural issues and about BIM to the rest of the consortium as well as to feed results of the work back to the Frontec development team. The role of IMI participants will be to assist in selecting suitable case studies and to take part in these as technical experts, as well as to help in the study of the applicability of of the process broker architecture and methodology. A steering committee will be formed that through quarterly meetings will monitor the progress of the project.

The suggested three year work plan takes the following form:

YEAR 1

During the first year we will carry out a large case study. Parallel with this, we will also carry out two theoretical studies that are intended to provide a foundation for further work.

1. Design of case study (months 1 – 3)

We will identify an end-user application at IMI, where there is a need for application and process integration. An evaluation model for the integration will be constructed, which will later be used for the evaluation of the case study. This model will focus on issues concerning description techniques and methodology, in particular how to facilitate for non-technical people to become involved in the integration process.

2. Execution of case study (months 4 – 11)

The case study will be carried out at IMI based on Frontec Business Integration Method approach. The case study will result in a completed integration, including a prototype implementation.

3. Documentation and evaluation of case study (months 10 – 12)

The results and process of the case study will be documented and evaluated according to the evaluation model constructed in 1. The results from this evaluation will be an important input to the further work during year 2.

4. Study of frameworks, languages, and methods for process modelling (months 1 – 12)

Frameworks, languages, and methods for process modelling will be studied and their applicability to process integration will be assessed. We will investigate current research on topics such as transactional properties of processes, process visualisation, and co-ordination of human and computer activities. Research frameworks (e.g. language/action approach) as well as industry standards (e.g. UML and IDEF) will be included in the study.

5. Survey of commercial products for application and process integration (months 1 – 9)

A framework for classifying products for application and process integration will be constructed. A number of state of the art products will be classified and compared according to this framework.

YEAR 2

During the second year, we will improve BIM and apply this new version to another case study.

6. Improvement of BIM (months 13 – 18)

Based on the evaluation of the case study and the theoretical work of year 1, we will add a number of improvements to BIM. We will also develop and document methodological guidelines for applying BIM based on the experiences of the case study.

7. Design and execution of second case study (months 19 – 24)

We will design and carry out a second case study together with an end user. The evaluation model of step 1 will be refined.

8. Design of process oriented implementation architecture (months 19 – 24)

We will design an implementation architecture that is based on the approach to store process related data together and carry out a prototype implementation for this.

YEAR 3

During the third year, we will evaluate the second case study and experiment with alternative implementation architectures.

9. Execution and evaluation of case study (months 25 – 30)

Continuation of the case study from the second year and evaluation according to the evaluation model of step 7.

10. Experimentation with implementation architectures (months 28 – 36)

Based on the second case study, we will carry out and compare two implementations: the first based on a traditional database architecture and the second on the architecture from step 8.

11. Dissemination

The results of the project will be disseminated through a seminar series and publications in the form of handbooks. Furthermore, papers for conferences and journals will be written during the entire period of the project.

RESULTS

The result of the project comprises improved methodology and architectures for business process integration together with clear evidence of their feasibility for real-life applications. More precisely, the project will result in an improved version of BIM together with methodological guidelines for its use in modelling workflows, as well as its realisation in a business process broker architecture. The methodology will be documented in the form of a handbook.

The case studies will result in several prototypes, based on BIM and the process broker architechture, thus demonstrating the feasibility of the architecture and methodology.

The results will be documented in the form of reports published in scientific journals and conference proceedings and addressing the issues introduced above. Results will also be incorporated into suitable courses at the involved university departments.

RELATED WORK

Process and workflow management is a subject of growing interest in the research community with specialised conferences and special journal issues. Some of the most pertinent topics are process specification languages (SDL, Petri nets, IDEF); process-based information systems models; transactional properties of workflows, such as concurrency; process visualisation technologies; co-ordination of human activities and computerised applications; analysis, simulation, integration, and testing of workflows. There are also multi-disciplinary approaches to process and workflow management, e.g. the language/action approach that applies linguistic instruments, in particular speech act theory and conversation analysis, to process modelling.

In the marketplace, a new breed of middleware technologies focused on enterprise application integration has emerged. As mentioned above, there are two major types of technologies: Message Brokers and Business Process Brokers. Message Broker vendors provide functionality that enable applications to interoperate with a minimum of custom coding. Some of the major products here are Frontec's AMTrix System, IBM's MQSeries Integrator, and ENTIRE BROKER from Software AG. Several of the Message Broker vendors are adding process modelling and simulation capabilities to their produces, thereby moving into the Business Process Broker market. Some of the major products in this market are: NEON's Enterprise ProcessExecutive, Vitria Technology's BusinessWare and CrossWorlds Software's CrossWorlds.

EXPLOITATION

FRONTEC

Frontec is a major vendor of software for application and process integration and its AMTrix product has a world-wide market penetration. The project will enable Frontec to investigate new directions of research and development, which would be difficult to pursue in a pure industrial setting. It is envisaged that the results of the projects regarding description techniques and implementation architecture will be incorporated into future products of Frontec. Furthermore, the results of the project concerning methodology will enable Frontec to better explain its approaches to customers. Finally, the co-operation with Swedish universities will facilitate for Frontec to recruit students with adequate education.

INDUSTRI-MATEMATIK

Industri-Matematik International Corp. (IMI) is a leading supplier of customer-driven supply chain management solutions. IMI will benefit from the project in the same ways as Frontec. However, while Frontec utilises the results of the project for its own integration product AMTrix, IMi will use the project results in order to be able to let its application software become more easily interoperable with other vendors' software. Thus, the industrial partners will utilise the results of the projects in complementary ways.

Frontec and IMI has a market and technology partner relationship. The relationship takes the form that IMI incorporates Frontec's integration software into their applications. This will help IMI to extend its interoperability with other vendors' applications.

KTH

The Department of Computer and Systems Sciences (DSV) at SU/KTH views this project as an important means for enhancing its research as well as educational efforts concerning the study of business process orientation in general and of business process integration in particular. The project results will directly influence other ongoing research and will also be incorporated in courses on all levels of education as the project proceeds.

CENTRE FOR DISTANCE-SPANNING TECHNOLOGY

CDT views the results of the project as highly relevant for bridging distances between geographically distributed enterprises. Improved process management and integration will enable enterprises to co-operate efficiently across organisational boundaries. This will be especially helpful for small to medium sized companies that participate in integrated supply chains.

THE PARTNERS

DEPARTMENT OF COMPUTER AND SYSTEMS SCIENCES

The research group SYSLAB within DSV is since long well established in research in enterprise modelling and database technology as well as in software engineering. It has shown this by participating in numerous national as well as international research projects, and through publication of articles in well-reputed scientific conferences and journals.

FRONTEC

Frontec AMT is a leading supplier of solutions for integrating and exchanging information, offering proven approaches to an increasingly heterogeneous IT environment. The company enables business process integration across the entire value chain, increasing the efficiency of inter-enterprise and intra-enterprise communication. Frontec's competence in application integration and e-commerce initiatives has led the company to have a greater global coverage than any other company of its type.

Frontec AMT is the worldwide software sales, marketing and support arm of the Frontec Group, a $100 Million publicly traded (Stockholm Exchange) firm that has grown to more than 900 employees since its inception in 1981. From major international offices located in the United States, the United Kingdom, Singapore, Sweden, the People's Republic of China and Australia - as well as a growing chain of distributors, value-added resellers and partners - Frontec's flagship product, AMTrix™, has been installed in more than 2,500 locations around the world.

INDUSTRI-MATEMATIK INTERNATIONAL CORP.

Industri-Matematik International Corp. (IMI), with worldwide revenues for the fiscal year ended April 1998 of $95 million, is a leading supplier of customer-driven supply chain management solutions for manufacturers, distributors and third-party logistics providers of fast-moving, high-volume products. The company has strong technical expertise in global logistics management from its 30 years in the industry. IMI, headquartered in Stockholm, Sweden, also has offices in Australia, Canada, France, Germany, The Netherlands, United Kingdom and United States. IMI has more than 200 logistics management systems implemented worldwide at organizations such as Ahlsell, Black & Decker, British Airways, Campbell Soup, Canon, Carlton and United Breweries, Hartz Mountain, Kellogg's, Pioneer/Standard Electronics, Skyway Freight Systems, Spicers, and Starbucks.

CENTRE FOR DISTANCE-SPANNING TECHNOLOGY

The mission of CDT, Centre for Distance-spanning Technology, is to develop competence, products, and business opportunities at the intersection of computer and communications technology. The goal is to strengthen the competitiveness of companies and business in the region of northern Scandinavia. CDT is a joint venture between Lulea University of Technology, Ericsson Erisoft, Frontec, and Telia Research, with financial support from government and local community. Organizationally, it is a unit within the university but with a separate board with decisive company representation.