A Process Broker Architecture for Systems Integration

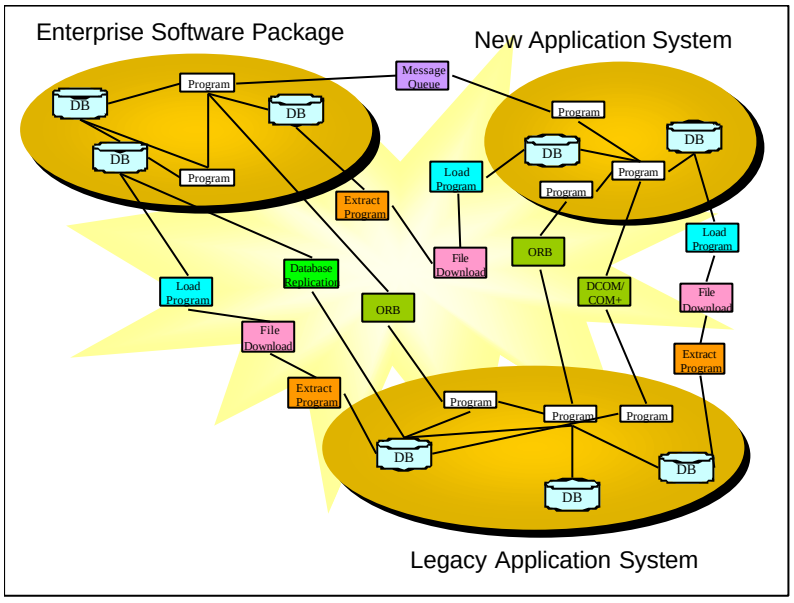

Fig.1 The IT systems of an organization are often complex, consisting of many interfaces and platforms.

Introduction

The IT systems of many organizations consist of a complex mix of legacy application systems, enterprise software packages, and new applications, see Fig.1. The problem is that few of this systems are integrated such as to fully support the business processes. [Makey 1996]

A solution to this problem is the Process Management Systems, which aims at aligning the IT systems of an organization to the business processes. The Process Management Systems also reduce the complexity for the users in that the integration and the business processes can be studied, analyzed, and changed using a graphical interface.

This paper describes the research project "A Process Broker Architecture for System Integration" going on between Kungliga Tekniska Högskolan (KTH) and Viewlocity (former Frontec AMT), supported by NUTEK, aiming at investigating Process Management Systems. The issues are analyzing and evaluating description techniques of process modeling, methods of application and process integration, and implementation

architectures for process oriented system. The paper also describes the background of the Process Management Systems.

Background

Traditionally, organizations have been functionally divided. For example, companies have been separated into departments such as market, production, and service, see Fig. 2. However, the functional organization has been shown to have a number of weaknesses. In particular, it requires a huge administration to handle issues crossing functional borders. Considerable resources are allocated to tasks that do not create value or are wasted, like supervision and time-consuming routines, such as attestation of invoices. At the same time, customers require instant service and constantly shorter times for delivery. [Davenport 1993]

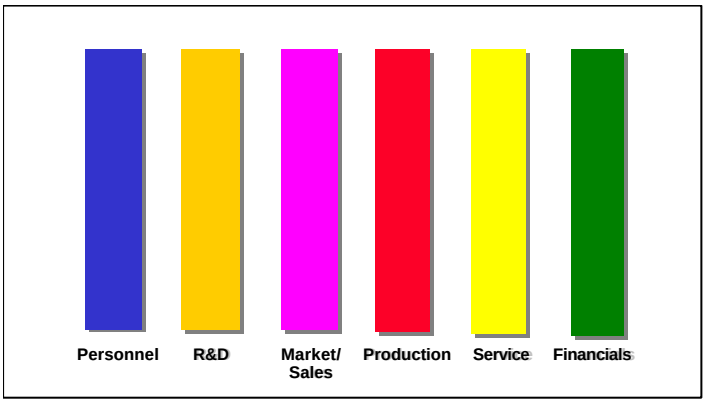

Fig.2 Examples of functions in a traditional organization

In order to overcome the problems of a functional organization, companies have been concentrating on business processes, that is the connected activities that create value for the customer. These processes cross the internal borders of an organization and involve different functions and regions of responsibility. Examples of processes are to develop new products, to handle relationships to customers or to manage the complete chain from receiving an order to the delivery of a product or a service, see Fig.3. [Davenport 1993]

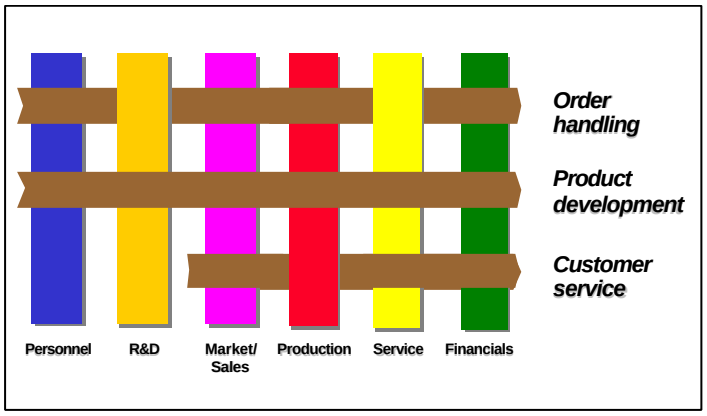

Fig.3 Examples of business processes that cross the functions in an organization.

Presently, there is also a trend towards increased inter-organizational cooperation, exemplified by virtual enterprises and extended supply chains, see Fig. 4. For example, many companies today are involved in various areas of electronic commerce. In order to make this cooperation effective it is essential to connect the activities and processes of the different companies. [Riempp 1998]

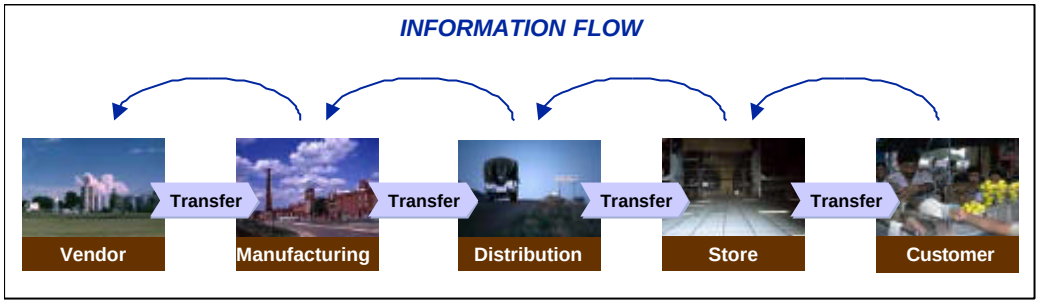

Fig.4 A supply chain that integrates the vendors and customers of a company.

Supporting cross-functional and inter-organizational processes put new requirements on the IT-systems. Traditionally, the IT-systems have been built up around departments or functions in the companies. The result has been a "stovepipe like" relation between the functions and the IT-systems, see Fig. 5. Every function in the company is supported by its own system or application. When an increasing number of companies have begun to transform their organizations towards a horizontal and process-orientated way of working, an integration of the IT-systems becomes necessary, see Fig. 6. [Makey 1996]

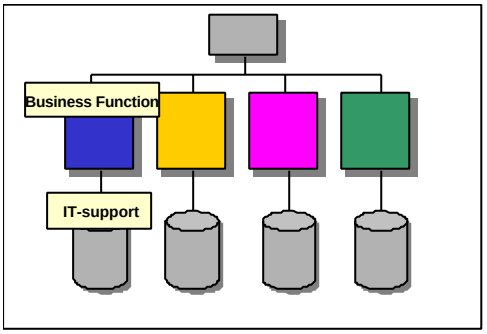

Fig.5 The traditional function oriented structure with the" stovepipe like" relation between the business functions and the IT-systems.

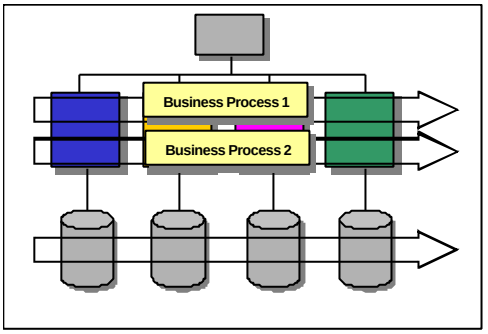

Fig.6 The process oriented organization also requires integration of the IT-systems.

Companies that can react swiftly according to the constantly changing demands of the customers will have an advantage in the stiffening competition of today. It is essential that the IT-systems support such changes. This means that the IT-systems not only have to be integrated, they also have to be flexible. When for example a new service is introduced, the IT-systems quickly must support this change to avoid expensive manual routines.

The integration of distinct IT-systems gives rise to more complex systems. If the systems also have to be flexible, the complexity increases even more. Thus, there is a need for

methods, technologies, and tools that can handle the complexity. A main problem here is to make today's complex IT-systems understandable for different categories of stakeholders, such as business managers, technical designers, business operators, and other users.

Managing complexity

An established way of managing the complexity of large IT-systems is to move parts of the functionality of applications into different types of generic software, so called middleware. Using this approach, more and more of an application's complexity can be moved into the middleware, retaining only the unique process logic in each application.

Today, there is a growing interest in middleware for distributed applications, exemplified by technologies such as CORBA, DCOM, and Enterprise Javabeans. This middleware hides the complexity of communication that is due to differences in platforms, operating systems, and network protocols. Another type of middleware is the Message Broker, described below.

However, in order to visualize sequencing and timing of application interaction, several layers of abstraction are needed. This is accomplished by the Business Process Broker, also described below.

From application integration…

An integration of applications can be handled in many different ways. Fig. 7 shows a situation where every application is connected directly to every other application. This point-to-point solution has many weaknesses, which becomes evident when more and more applications are to be integrated. Soon a situation will arise generally described as "application spaghetti".

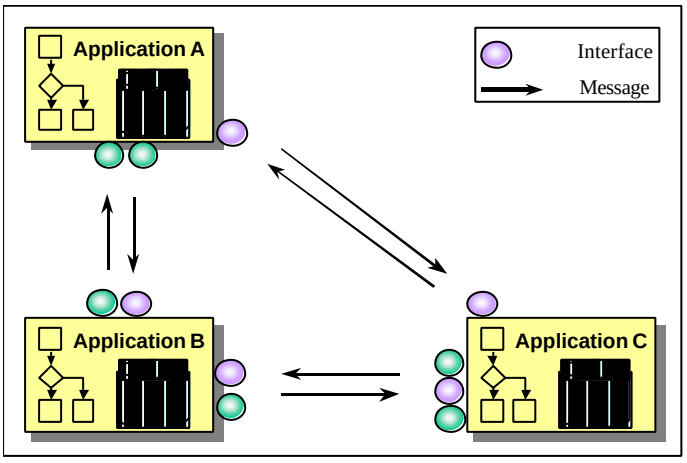

Fig.7 The point-to-point strategy to integrate applications.

If the applications, for example, differ in data formats and communication protocols, the translation and transformation of the messages between the applications will be very complex. The maintenance problem becomes pressing if any of the applications changes

its format. In that case all the connections have to be changed, that is the conversion programs between that particular application and all the others. The point-to-point interfaces soon make the replacement of any application difficult to manage.

The Message Broker technology reduces this complexity, see Fig. 8. The main idea is to reduce the number of interfaces and thereby make it easier to support them. If one of the applications changes format, only one connection has to be changed: the one to the Message Broker.

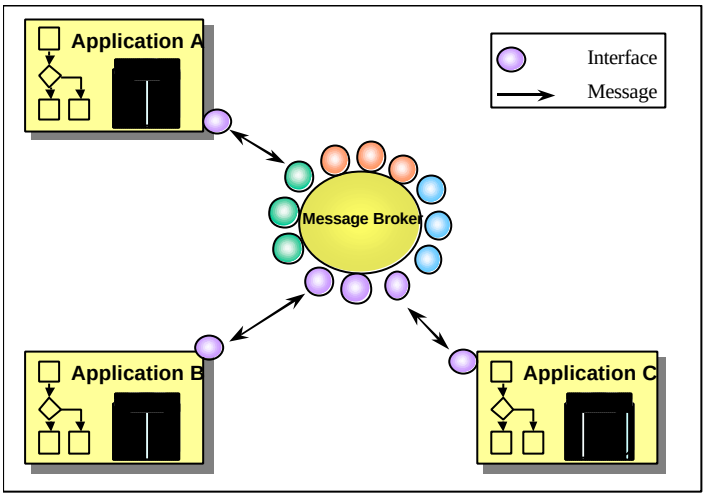

Fig. 8 The Message Broker reduces the number of interfaces and thus the conversion programs

The Message Broker also makes coordination between different applications easier, that is to forward a message from one application to another. Furthermore, the Message Broker can decide to what application a message should be sent depending on the content of the message. For example, if an order exceeds a certain sum it can be sent to one application, otherwise it will be forwarded to another. This means that a certain part of the process and business logic can be coded in a Message Broker. [Yeamans 1999]

However, the Message Broker lacks a central mechanism handling and visualizing the whole flow of processes. There is no tool to give the business analyst an overview of the critical flow of works, for example where the bottlenecks in the processes are to be found or how far in the processes a certain order has reached. For that reason, it is also difficult to automate the processes and change them swiftly, problems which a Business Process Broker (see below) can handle.

… to process integration

The Business Process Broker, also called Process Management System, can be seen as an extension of the Message Broker. This technology controls the whole order in which the applications are to be connected, see Fig.9.

Traditionally process logic is spread and embedded in different applications, but by separating process and application logic and collecting all process logic in a Business Process Broker, all process logic can reside in one single place. This separation of concerns will provide for easier maintenance and greater flexibility. [Butterworth 1997]

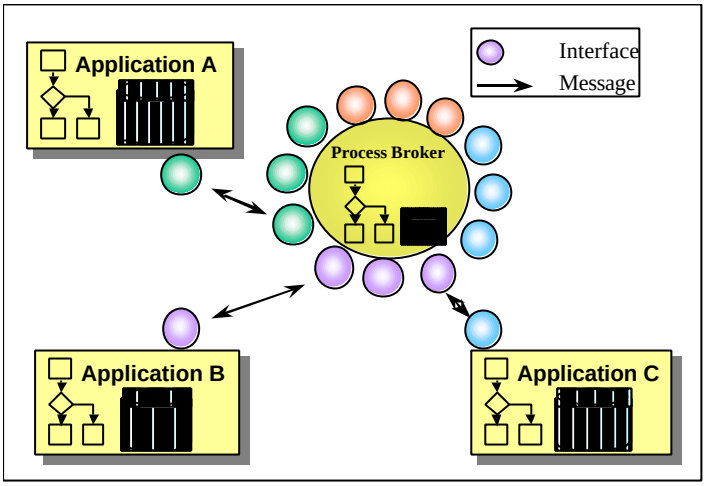

Fig.9 The Process Broker integration solution collecting all process logic in the Process Broker.

It will be possible to modify the processes in an easy and dynamic way, that is to change the order of contact between the different applications or to add new applications to the processes. The possibility to automate will also be easier, and the customers can be offered a faster delivery of products and services. [HP Changengine 1998]

When all process logic resides in one single place, it is also possible to study, analyze, and change the processes using a graphical interface. The user, for example the business manager, the analyst or the operator, can analyze the process, find out possible bottlenecks and determine where a specific process instance can be located. Many Business Process Brokers also offer the possibility to simulate, that is different scenarios can be tested in advance of execution.

To sum up, the main advantages of a Business Process Broker are as follows:

- The business processes are at the center of the analysis
- A change of the process logic will be possible without a costly recoding of the applications
- The monitoring and analysis of the business process will be easier
- It will be possible to simulate different scenarios.
- Automation of the processes will be facilitated
- It will be possible to trace the status of a certain process instance, for example the history of an order

Workflow and Process Management

A technology related to the Business Process Broker is the Workflow Management System. The first generation of Workflow systems, during the 80's and the early 90's, was supporting communication between people, concentrating on document routing. Many systems involved repetitive processes with simple task coordination, such as routing a travel request or an insurance claim. The next generation of Workflow technologies put the business processes in focus. By also involving automatic actors, the automation of the processes could be facilitated further. [Makey 1996] The next step for

the Workflow systems should be to implement enterprise wide workflow solutions and provide tools for managing the processes themselves. This process management includes, [Georgakopoulos 1995]:

- Process modeling: requires models and methodologies to capture processes
- Process reengineering: requires methodologies for evaluating and optimizing processes
- Process implementation and automation: requires methodologies and technology for using IT systems and human performers to implement, execute, monitor, and control tasks and processes

The Business Process Broker can be seen as this next step to process management, by providing modeling and simulating opportunities, but the Business Process Broker also enabling quick changes of the business processes because of the flexible way of handling application integration.

The Business Process Broker technology gives rise to new challenges for industry as well as research. The technology requires some kind of graphical model language to describe the business processes, a subject of ongoing research [Schäl 1996]. It is also necessary to work out methods to describe the business processes with these languages. Furthermore, the process orientation enables new implementation architectures.

The project

The purpose of the Process Broker 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. The project is a cooperation between KTH and Viewlocity (former Frontec AMT), supported by NUTEK. The project is planned for 1999-01-01 -- 2001-12-31, see [Johannesson 1998].

The approach of the project will be a combination of theoretical investigations and empirical case studies. The issues of 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 visualize application and process integration. Furthermore, if the description techniques can be used and understood by several groups of users, for example business managers, technical designers or operators, the communication within the organization will be easier.

Some research question are: How should a graphical language be designed so that it becomes easily understandible? How expressive should such a language be? What are the relationships between such a language and more technical modeling languages, e.g. UML?

A present study at KTH compares and analyses different description techniques, like SDL, IDEF, and Petri nets, see Fig 10, which can be used in a graphic interface tool. As a base for the comparison, a number of criteria for evaluation have been researched.

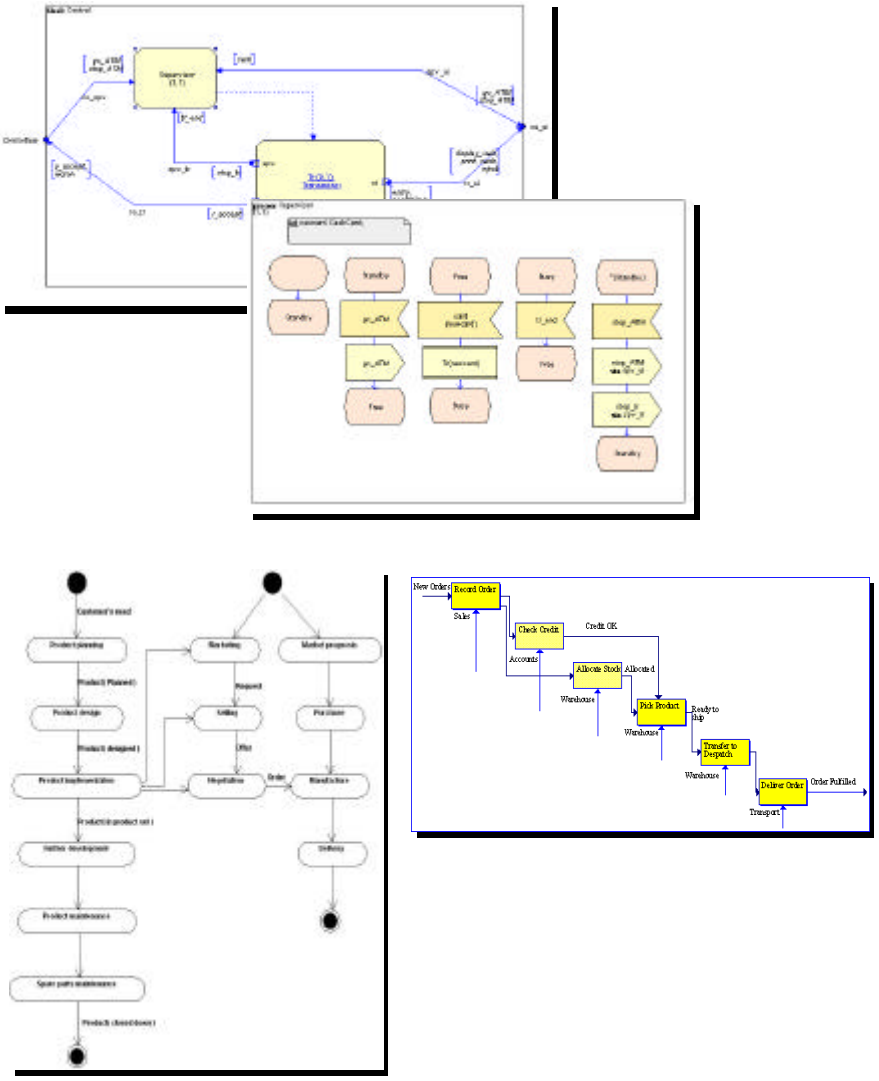

Fig. 10 Different discription techniques: Above SDL, down to the left the UML activity diagram and down to the right IDEF0.

Methodology

A difficult problem in process engineering is that of identifying and describing processes. It is not always obvious which processes exist or should be introduced into an organization; 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 research questions are: How should the responsibilities be divided between the Process Broker and the existing application systems? To what extent is the traditional transaction concept useful in process integration? How should the communication with non-automated actors be managed? A

main goal in the project is to design support that allows different categories of users to take part in all systems phases, including modeling, design, and operations, see Fig 11.

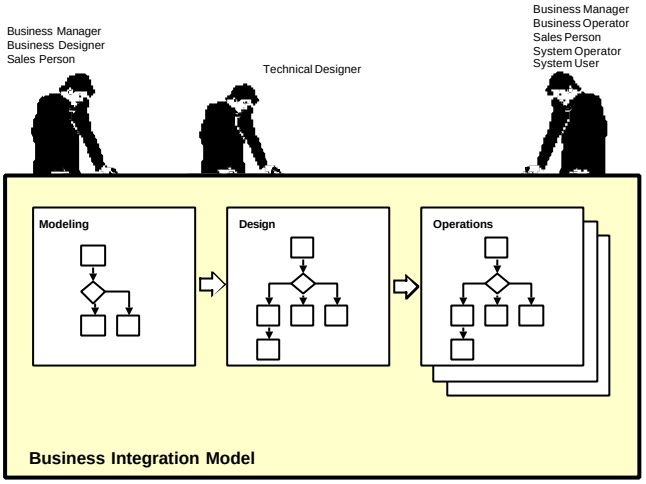

Fig.11 Different categories of users should be able to take part in the modeling, design and operation phases.

Implementation architecture

A focus on business processes and their integration will enable new architectures for implementation. It will become possible to handle data related to a process as it is created and refined. Process related data would then be viewed and handled both from the business perspective and the technical implementation perspective as one single data instance supporting the whole flow, as compared to traditional solutions where data are broken down into type oriented and normalized relational database tables.

Case studies

The case studies will help to evaluate and improve methods and tools. Presently there are two case studies in the project: The IFIP case and the Telecom case.

The IFIP case

To make the comparison between different possible model languages, a standard case has been chosen at KTH, the so-called IFIP-case. The aim is to investigate evaluation criteria (for example visualization, abstraction, view integration), modeling strategies, methods and methodological guidelines.

The Telecom case

The Telecom case is a real-world case where a European Telecom company will introduce a new service. The case is a clear example that an IT-organization can be forced to integrate many disparate systems and application to meet the demands of the market, systems that belong to different business units. The new service requires a complex interaction between administrative systems as well as technical systems. The Telecom company will also improve several present processes, which make this case extensive.

Participants in the Telecom case study are KTH, Viewlocity and business managers from the Telecom company. The case study is based on Viewlocity´s Business Integration Method (BIM) approach. The result and process of the case study is documented and evaluated according to a constructed evaluation model.

There are several interesting approaches in the Telecom case study. For example, it has been the business managers of the Telecom company that mainly has been using BIM to model the business and process logic.

Expected 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 Viewlocity´s BIM together with methodological guidelines for its use in modelling processes, as well as its realization 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 architecture, 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 KTH.

Participants

KTH

The research group SYSLAB within DSV at KTH, Kungliga Tekniska Högskolan (The Royal Institute of Technology), and Stockholm University is since long well established in research in enterprise modelling and database technology as well as in software engineering. SYSLAB has shown this by participating in numerous national as well as international research projects, and through publication of articles in recognized scientific conferences and journals.

The Process Broker project members from KTH are Benkt Wangler (project leader), Paul Johannesson, Birger Andersson, Prasad Jayaweera, Erik Perjons, S.J. Paheerathan and Nasrin Shakeri.

Viewlocity

Viewlocity, former 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. Viewlocity´s flagship product, AMTrix, has been installed in more than 2,500 locations around the world.

The Process Broker project members from Viewlocity are Christer Wåhlander (project leader at Viewlocity), Mikael Nilsson and Jan Törnebohm,

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