

Process Oriented Information Systems Architectures in Healthcare

Benkt Wangler, Rose-Mharie Åhlfeldt
University of Skövde, Sweden

Erik Perjons
Stockholm University/KTH, Sweden

Abstract

An important insight in business management during recent years is the awareness that organisations need to focus on the processes that create value for their customers. This is in order to see to that value is created as efficiently as possible and that unnecessary or redundant activity is avoided. As a consequence, the organisations' IT support need to interact with business processes in a better way than is currently the case. Healthcare is by no means an exception, but also here there is a great need to concentrate on the processes for transparent communication between various actors and organisations, and between IT systems. Therefore, a new type of process oriented integration architectures has been developed by means of what may be referred to as process managers, which closely reflect the business processes. These are software devices that visualise the integration by means of graphical and easy to understand process models that also facilitate management and monitoring of the processes and their integration requirements. This paper discusses benefits and difficulties for healthcare of introducing an IS architecture based on process manager technology. The discussion is based on experiences from a project, in which a process manager is introduced to integrate IT systems over the patient process and involving several healthcare organisations. Results indicate that healthcare processes are indeed quite complex and involve much communication with various individuals and organisation. Particular problems are caused by communication across organisational borders due to e.g. security issues. However, process manager technology offers help in that it is able both to manage and monitor processes and to make communication with and between IT systems simpler and safer.

1. Introduction

One of the most important insights in business management during recent years is the awareness that organisations need to focus on the processes that create value for their customers. This is in order to see to that value is created as efficiently as possible and that unnecessary or redundant activity is avoided (Scheer, 1998; Johannesson et al, 2000). This in turn means that the organisations' IT support need to interact with business processes in a better way than is currently the case. Healthcare is by no means an exception, but also here there is a great need for process orientation and for transparent communication between various actors and between IT systems (Bij et al, 1999). The most important of the healthcare processes may be referred to as the patient process, i.e. the process where various healthcare providers interact with and for the patient in order to increase his or her quality of life (Vissers, 1998). Like most businesses of today, healthcare is functionally organised in e.g. primary care units, hospitals, home healthcare units, each with their own more or less isolated information systems. More precisely, these systems are characterised by the fact that they:

- support single organisational functions very well, but with little adaptation to a process oriented way of viewing things, i.e. where the intra- and inter-organisational processes can be efficiently coordinated,

- have been created at widely differing points in time and hence by using different development paradigms, and by using different software and hardware platforms. As a consequence, they are difficult to integrate and to make collaborate over the patient process.

In spite of these difficulties, it is not practically possible or even desirable to “throw out” existing IT systems and replace them with new ones that are developed anew and from scratch. Instead one needs to develop and introduce methods and tools that can transparently integrate existing IT support, and in such a way that new IT systems can be easily accommodated (Larsson, 2001).

Various approaches to managing the integration of IT systems have been developed such as distributed objects (CORBA), message brokers and Internet portals (Linthicum, 2001). Recently web services have appeared as a new approach to integrate IT systems, through valid XML documents over Internet protocols (Oellermann, 2001). However, with the exception of some recent developments of web services, e.g. Business Process Execution Language for Web Services, BPEL4WS (MSDN, 2003), these technologies mostly function as interfaces to existing databases and do not lend adequate support to the business processes. Therefore, a new type of process oriented integration architectures have been developed by means of what may be referred to as process managers (sometimes process brokers or process automation systems), which closely reflect the business processes. These are software devices that visualise the integration by means of graphical and easy to understand process models that also facilitate management and monitoring of the processes and their integration requirements (Dayal et al, 2001; Linthicum, 2000; Johannesson et al, 2000).

In order to investigate the potential of an IS architecture based on process manager technology, a project has been started at the University of Skövde and Stockholm University/KTH. The project is named VITA Nova (acronym for Swedish “Vårdens IT-Arkitektur i Ny belysning”), in which a process manager is introduced to integrate various healthcare providing organisations (VITA Nova, 2002).

The aim of this paper is to discuss benefits and difficulties for healthcare of introducing an IS architecture based on process manager technology. The discussion is based on experiences from the VITA Nova project.

The remainder of the paper is organised as follows. The next section describes the process manager technology. Section 3 provides a brief presentation of the VITA Nova project. In sections 4 and 5, the VITA Nova case study and its results are presented. Finally, Section 6, concludes the paper and suggests directions for further research.

2. The process manager

Integration of IT systems can be supported by different technologies and architectures. One possible architecture for integrating IT systems is the point-to-point solution where every IT system is directly connected to every other IT system, as shown in Fig. 1 (left). This solution could work for a small number of IT systems, but as the number of systems increases, the number of connections quickly becomes overwhelming.

The message broker architecture reduces this complexity, as shown in Fig. 1 (right). The main idea is to reduce the number of interfaces by introducing a central message broker and thereby making it easier to support the interfaces. If one of the IT systems changes format, only one connection has to be changed: the one to the message broker, which has tools to facilitate the format conversions of the messages that are sent between the IT systems (Linthicum 2000).

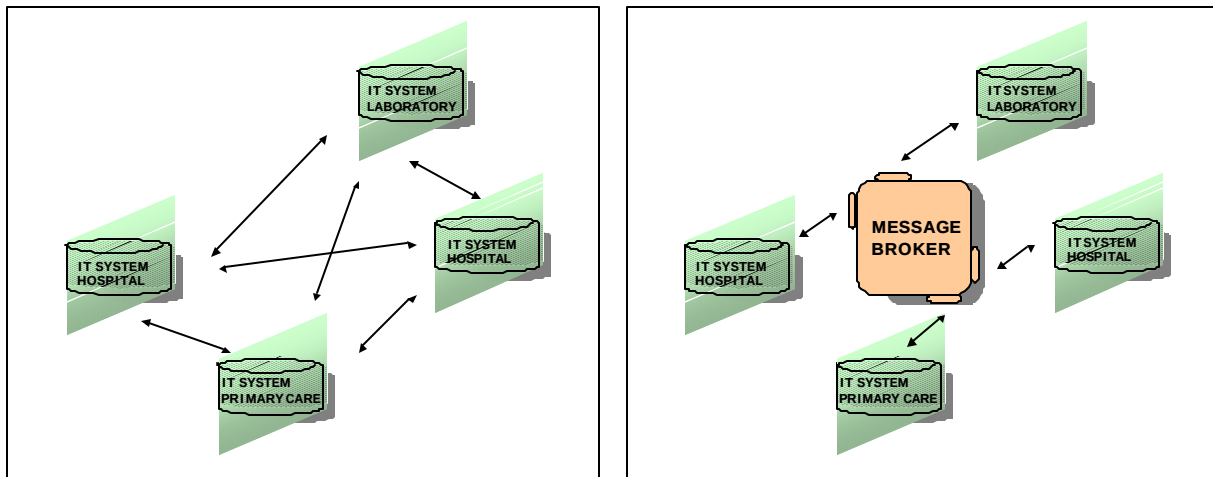


Fig. 1 The point-to-point strategy to integrate applications, to the left. To the right, the Message Broker architecture, which reduces the number of interfaces.

The process manager is an extension of the message broker, as indicated in Fig. 2. In addition to handling format conversions, the process manager encapsulates all logic for communication between IT systems. In that way it is possible to study, model, simulate and change the communication by using a graphical interface against process models (Dayal, 1999; Linthicum 2000). This visualisation reduces complexity and makes it possible to make quick and flexible changes to the business process IT support. Furthermore, the process manager takes care of the execution of the communication between IT systems. The graphical process models that were created are, hence, used in operation. This makes it possible to monitor, measure and optimise the process during operation (Johannesson et al, 2000).

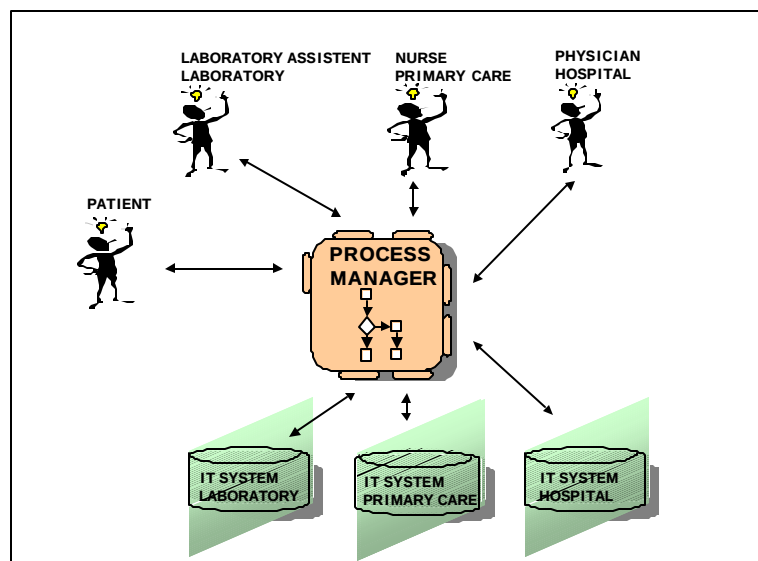


Fig. 2 A process manager visualises and facilitates communication between applications and human beings.

Much effort is today spent in developing process manager technology – some products utilising this technology are Vitria Technology's BusinessWare (Vitria, 2003), IBM's MQSeries (IBM, 2003), Microsoft's Biztalk Server (Microsoft, 2003), and Visuera Integration AB's Visuera Process Manager (PM) (Visuera, 2003).

Visuera Process Manager (PM), which is used in the VITA Nova project, consists of three types of tools, see Fig. 3. The *Visuera PM Modeler* is a tool in which the business designer specifies the communication between the IT systems and the users, by using graphical process models, graphical message descriptions, and programming code. The second tool is the *Visuera PM Operator*, in which the system operator can

control and supervise the execution of the process instances, using the same graphical models as designed in the Visuera PM Modeler. For instance, it is possible to inspect a specific patient process for a specific patient and the content of the messages sent to and received from the IT systems and users, e.g. patient, and the nurses and physicians in different healthcare organisations. Furthermore, during the supervision of the patient process some part of the process may be discovered to be not efficient enough. It is then easy to redesign the process by using the Visuera PM Modeler. The third tool is the *Visuera PM Web client*, by means of which the users can communicate with the process. The messages sent from the process and received by the user are stored in an input mailbox, in the Web client, and users can select messages to read from that mailbox. When the user is required to send a message to the process he/she can do this via the Web client by filling in predefined forms. These forms are automatically generated from the specifications in the *Visuera PM Modeler*. Finally, the execution and storage of process instances, and the communication between users and IT systems are managed by different server components, in Fig. 4 summarised as *Visuera PM Services* (Visuera, 2003).

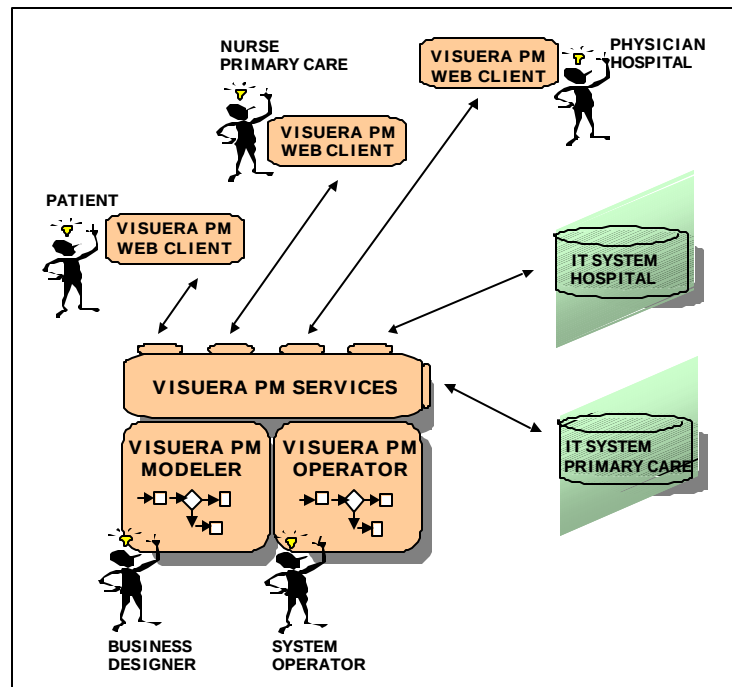


Fig. 3 Visuera Process Manager consists of Visuera PM Modeller, Visuera PM Operator, Visuera PM Web Client, and Visuera PM Services.

The graphical process modelling language used in the Visuera Process Manager is named BML (Business Model Language), and developed by Wåhlander et al. (2001). The language has similarities with SDL (Specification and Description Language) (Belina et al, 1991), but is more adapted to IT systems integration. BML is a communication oriented process language, which means that it focuses on describing interactions between systems through the sending and receiving of messages. This makes the language suitable for IT system integration and for process managers. An important advantage of BML is the fact that the language can be used for business specification, design, and simulation, as well as in the execution of systems. In other words, the same language can be used in different phases of a system's life cycle: in feasibility analysis, in requirements specification, in the design, simulation and implementation phases, and in the actual running of the process. This enables different categories of stakeholders to use the same language for different though related purposes (Johannesson and Perjons, 2001).

In Visuera Process Manager, BML is used directly as an implementation language and replaces, to some extent, ordinary programming languages, which also means that it is the BML models that are executed during operation (Wåhlander et al, 2001).

BML describes the structure as well as the behaviour of a system by using two kinds of graphical diagrams. The structure of the system is visualised by a static diagram, referred to as a Business Process Integration (BPI), which describes the processes in a static mode, see Fig. 4. The static diagram describes the messages transferred between the processes and between the processes and the environment, i.e. the external IT systems and the users. The dynamic behaviour of a system is described by using process diagrams, referred to as Business Integration Application (BIA) diagrams, and which visualise the control flow of the processes, i.e. in which order the messages shall be sent and received, see Fig. 5. An important component of BML is the data model, visualised in a hierarchical tree structure. The data model describes the structure, type and meaning of the data in the messages.

3. The VITA Nova project

The VITA Nova project aims to contribute to a change-over to a process oriented way of viewing IT systems integration and of working in healthcare in order, in the long run, to increase quality, efficiency, and security for everyone involved: patients, relatives, healthcare personnel and other healthcare stakeholders. VITA Nova is a collaboration between the University of Skövde, and Stockholm University/KTH; the healthcare providers Skaraborg Hospital, Hentorp Primary Care, the cities of Skövde and Falköping, Capio Diagnostik AB; and the technology providers Visuera Integration AB, and Unicom Care AB (VITA Nova, 2002).

The project will focus on the patient and the patient's family, and the individual healthcare provider. By studying the processes of healthcare from these perspectives it will be possible to identify the problems that the patient, patient family and professional roles experience with existing ways of working and with existing IT support. Patient and professional role are also comparatively stable over time, while the organisation, which otherwise is often taken as the basis for business studies, may be more frequently changed. More precisely, the mentioned perspectives involve:

- The patient and family oriented perspective stresses that processes are studied with a focus on which information that needs to accompany the patient throughout the healthcare process to get optimal treatment.
- The healthcare provider perspective entails that processes are analysed to identify which information healthcare personnel needs as well as how information will be made available.

The project contains the following two broad activities:

- Business and systems analysis. The main part of the activity is devoted to surveying and detailed modelling of a number of healthcare scenarios and processes within a particular medical field among the involved organisations. Existing IT systems will be studied. Emphasis will be put on security issues particularly regarding the privacy requirements posed by authorities, healthcare providing organisations and patients. The important thing is that information concerning patients is given to precisely those that need it and nobody else. The models of existing business processes and systems will constitute the basis for the development of a prototype.
- Development and evaluation of the prototype. A prototype will be developed that integrates the most important processes and systems within the field selected. Experimenting and simulating with the prototype will form the basis for process improvement as well as the design of the real system. The prototype is developed by means of process manager technology.

4. The VITA Nova case study

In order to investigate advantages and difficulties when introducing process manager technology in healthcare, a prototype in the form of a patient process for leg ulcer has been developed by means of the Visuera PM. The reason for choosing this particular illness is that the regional hospital has leg ulcer as one of its specialities and that it hence has set up a regional Leg Ulcer Centre to deal with this.

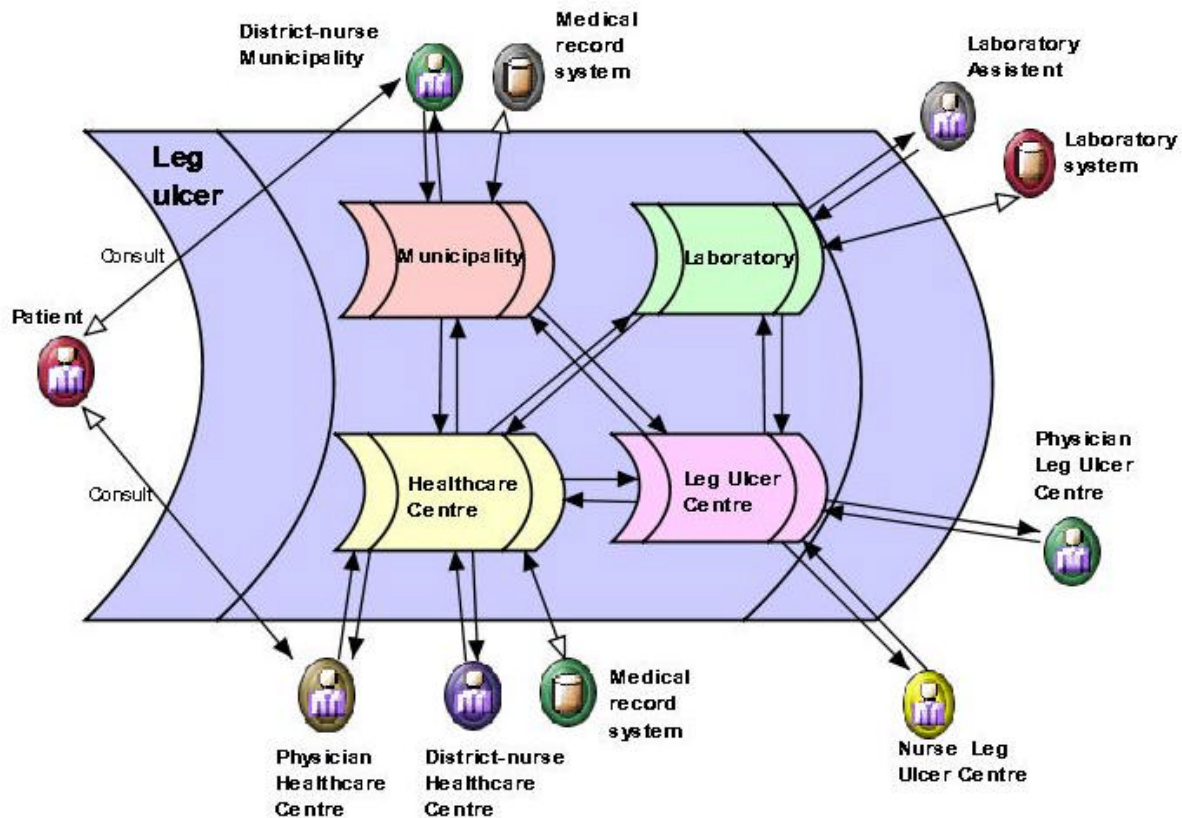


Fig. 4 The BPI diagram visualises the interacting roles, the messages, and the processes involved in the Case Study.

Fig. 4 shows the structure of the system by means of a BML static diagram, referred to as a Business Process Integration (BPI). The BPI visualises the interacting roles, which are the patient, the nurses and physicians, and the IT systems; the messages sent between the interacting roles, represented by arrows; and the processes in which the interaction is specified, i.e. municipality, healthcare centre, the laboratory and the Leg Ulcer Centre. To visualise the dynamic behaviour of these processes, i.e. the control flow, BML uses diagrams referred to as Business Integration Applications (BIA). Fig. 5 shows part of the municipality process in a BIA diagram.

The process depicted in Fig. 5 is enacted when the district nurse at the municipal home healthcare unit sends a message “patient registry” to the process manager (PM) including name, address, and phone number of a person with a suspected leg ulcer who has contacted the home healthcare. The nurse sends the message to PM via the PM Web Client. The nurse might alternatively have sent the message via an existing (medical record) system, which in turn communicates with the PM.

According to the BIA diagram in Fig. 5, the PM then automatically sends a message “need of patient visit planning” to the nurse (or to a group of nurses), which informs the nurse that she or he must plan for a visit at the patient’s home. The message is inserted into the input mailbox of the PM Web client. After the PM has sent the message to the Web client, a timer is started with a predefined expiration time. This is to remind the nurse, should she fail to take appropriate action. The nurse reads the message by fetching it from the inbox and sends a reply message, “patient visit planning” to PM (see lower route of diagram in Fig. 5) in which he/she suggests a point in time to visit the patient and which nurse is making the visit. Should the reply message not be sent before the set time, the timer expires (see upper route of diagram in Fig. 5) and the nurse is reminded, either with a new message in the inbox or in some other way, that the message “patient visit planning” has not been sent to PM.

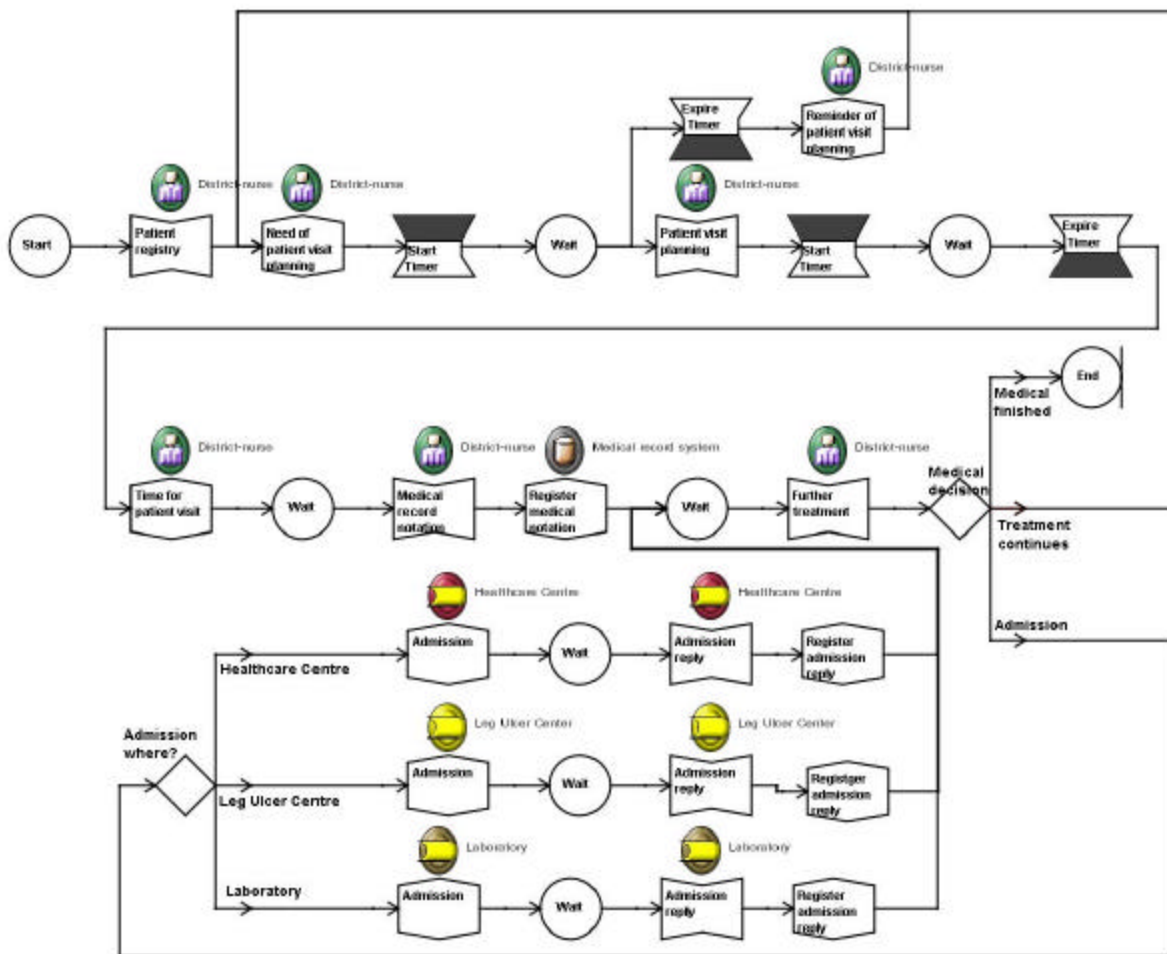


Fig. 5 The Municipality BIA Diagram.

When the nurse has sent the message “patient visit planning”, a new timer starts that expires on a set time before the visit. The PM will then notify the nurse by sending a message, “time for patient visit”, to his/her mailbox. After the nurse has finished the visit, the diagnosis, the treatment given, as well as any ordinations and instructions concerning bandaging are documented. This information is sent to the PM via the message “medical record notation”, and is also registered in the patient’s medical record by the PM (“register medical notation” in Fig. 5). The nurse also sends a message “further treatment, which contains information about a medical decision made by the nurse concerning the patient’s further treatment, i.e. should the treatment of the patient be finished or continued, or should the patient be transferred to a healthcare centre, the Leg Ulcer Centre, or is there a need to take a specimen at the laboratory. If the nurse decides that the treatment is finished, the process instance stops. If he/she decides that the treatment will continue a new “need of patient visit planning” is sent to a nurse (or group of nurses). If the patient needs to be transferred to a healthcare centre or the Leg Ulcer Centre, or if there is a need to take a specimen, a message “admission” is transferred electronically to the organisation in question. The municipal home healthcare then waits for the “admission reply”. When the “admission reply” is received electronically, it is automatically sent to the medical record system (“register admission reply” in Fig. 5).

The message “admission” can consist of the patient’s medical record, i.e. all information that has been documented in the PM about the patient. Similarly, relevant information about the treatment given at the healthcare centre, the Leg Ulcer Centre, or the results from the specimen, is sent back in the message “admission reply”. After that the nurse makes a new medical decision about the patient.

Fig. 4 shows that many roles and organisations may be involved in the patient process for leg ulcer, i.e. at the municipal home healthcare it is the district nurse, at the primary care centre it is a physician or a nurse, at the Leg Ulcer Centre a physician or a nurse, and at Capio Diagnostik a physician, a nurse or a

biomedical assistant. Capio deals with various types of tests and samples. Capio staff receives information concerning the tests electronically and may enter the results into the PM in order to have it sent back to the organisation that requested the test. Each process indicated in Fig. 4, municipal, primary care centre, Capio and the Leg Ulcer Centre, has a corresponding BIA diagram (or more precisely one or more BIA diagrams).

5. Results from the VITA Nova case study

The preliminary results from the VITA Nova case study show that the leg ulcer process instance for a particular patient may be quite complex, involving several roles and autonomous organisations, and where the communication today is done manually by regular mail, fax or phone calls.

The case study shows that each organisation has its routines, IT systems and even terminology, which makes integration of the complete process considerably more difficult. When the patient is transferred from one organisation to another, information about the patient is sent via regular mail or fax, or questions are answered by phone. Often the communication is triggered by some person at one of the organisations contacting a person at one of the other organisations by phone and asking for medical record information about the patient. This information is often filled in manually in particular forms that are sent by mail or fax. After that the information is entered manually into the receiving organisation's information system.

The communication often has the character of a point-to-point solution. This means that if a patient has first been taken care of by the nurse at the municipal home healthcare unit and later at the primary healthcare centre and then at the Leg Ulcer Centre, the latter organisation first has to contact the home healthcare unit and then the primary healthcare centre in order to acquire the complete information about the patient's medical history. The municipality and primary healthcare centre may use a different terminology than the Leg Ulcer Centre, which complicates the communication further.

By introducing the process manager to deal with the communication between organisations and professional roles, the communication may be automated. As soon as a patient is transferred between organisations, the relevant information may be transferred electronically, and hence informing about earlier treatments at other organisational units.

Furthermore, by introducing the process manager, also the processes at the various organisations will be visualised. Thereby, means for analysing the processes are created, i.e. the process manager will contribute to the development of value-creating processes by identifying potential for improvement. Terminology used when exchanging patients need to be standardised or at least differences have to be clearly identified, in order to increase comprehensibility and minimize the risk for misunderstandings.

Another important advantage with the process manager is that involved personnel may be notified about visiting patients or other routine matters. This is important in connection with the communication between organisations: the risk for misunderstanding or forgetting planned treatments is minimized due to improved communication between healthcare providers.

Using a process manager to integrate existing and often dissimilar systems also enables long term process monitoring and quality assessment. This is made possible by logging, in time stamped form, the information produced during the process, and such that it can be used for e.g. measuring the productivity, cost etc. of the process.

However, there are several problems with introducing a process manager. First of all, patients are often dealt with in an ad hoc manner and not according to some standardised process. This entails that there may be hostility to structuring the process among individual healthcare providers. Secondly, personnel who have been working for a long time in the same organisation and who are safe in their professional role, do usually not want to be forced to work according to routines set up by someone else. Therefore, processes must be designed such that they are flexible enough to allow as much individual adaptation as

possible. However, support for the integration of applications within and between healthcare providing organisations will change the way of working for healthcare staff and provide support for new forms of healthcare, new ways of working and collaborating over organisational borders.

In order to protect people's privacy, Sweden has several laws that limit the availability and the transfer of patient information between different actors and care providers. The Secrecy Act (SFS, 1992) is an example of such a law according to which the primary purpose of secrecy is to protect people's privacy. In healthcare, secrecy applies for information about the state of health and other private circumstances of the individuals if it is not clear that the information can be revealed without any disadvantages for the private person or someone close to him. Earlier work has shown that there are clear shortcomings in how municipalities manage patient information in home healthcare concerning privacy and secrecy (Åhlfeldt, 2002). Above all, it is the users' insufficient knowledge about information security and the absence of security strategies and policies from the organisation that is the main cause to these shortcomings.

The results of VITA Nova also indicate, that deficiencies in how care performers manage patient information do indeed exist. Some healthcare providers do have a security policy, well-established security measures etc., and some do not. An interesting finding is that one of the healthcare providing organisations does have strict security policies and security measures due to the fact that it is accredited by SWEDAC (The board of accrediting and technical control). Hence, it meets certain security standards as far as exchange of patient information with other care providers is concerned. Since security issues are important when it comes to how patient information may be exchanged between various actors, these issues have to be taken into account when employing the process manager technology. This is even more important when there are limitations due to laws and when there are inadequate security strategies from the organisation.

However, the analysis of processes in healthcare is done with a focus on the patient and patient relative and on the individual healthcare provider. In that way, knowledge is acquired concerning how solutions concerning security, ethics and legality may be designed in a way that is satisfactory from the perspective of the patient and his relatives and functional for the healthcare providers.

6. Concluding remarks

Although not yet finished, the VITA Nova project already offers important insights concerning healthcare processes and the potential benefits of using process manager technology for systems integration, for facilitating data transfer between healthcare providing organisations, and for streamlining the patient process in general.

Employing process manager technology in healthcare will, in the long run, provide the following advantages:

- Since transfer of information between different healthcare providing organisations is done in a more efficient way, the process manager will contribute to improving IT based home healthcare by e.g. solving current problems with information transfer as is the case in e.g. transferring patients between hospitals and the municipal home healthcare.
- The process manager will contribute to the development of value-creating processes by identifying potential for improvement, and also since new information channels are created by means of which new knowledge can be created and utilised. Using a process manager to integrate existing and often disparate systems enables long term process monitoring and quality assessment. This is made possible by logging the information produced during the process time stamped and such that it can be used for e.g. measuring the productivity, cost etc. of the process
- Support for the integration of applications within and between healthcare providing organisations will change the way of working for healthcare staff and provide support for new forms of healthcare and new ways of working through the development of information systems.

Furthermore, expected results of the project include:

- A methodology for the introduction of a process oriented architecture in healthcare.
- A methodology for dealing with security issues in regard to the transfer of information.
- Documented experience from a case study of process oriented integration within healthcare.
- Documented knowledge of processes within healthcare and of how IT may support these processes as well as insight into how information transfer between healthcare providing organisations is realised in a safe manner.
- Further development of integration technology in accordance with experience gained from healthcare as the project proceeds.

Process oriented IT support makes possible a number of improvements:

- Documented changes to a patient's health status are available resulting in increased security for the patient.
- The risk for misunderstanding or forgetting planned treatments is minimized due to improvement in communication between healthcare providers.
- The patient will be met by personnel who have been able to prepare their work.
- Current information is always easily available and can be received manipulated and read in place right by the patient.
- Important and correct information can be viewed by authorized personnel.
- Individual healthcare providers are in charge of their own work at the same time as they are helped with carrying them through.
- Responsible personnel can quickly find out what, when, how and by whom a treatment has been given.

Further research should include a deeper study of security issues, a study of potential process improvements caused by the introduction of process manager technology and how that affects various healthcare actors, and an implementation study in a limited context.

Acknowledgements

The authors would like to thank all the VITA Nova project members and in particular Jan Bengtsson and Ann-Sofie Kvist from the Department of Healthcare, Anneli Gustavsson and Anne Persson from the Department of Computer Science at the University of Skövde, Paul Johannesson from Stockholm University/KTH, Mikael Nilsson from Visuera Integration AB, Siv Leijon and Olle Nelzén from Skaraborg Hospital, Markku Nikula from city of Skövde, Thomas Karlsson from city of Falköping, Eje Johnsen from Hentorp Healthcare, Jörgen Johansson from Capio Diagnostik AB, and David Bezjak from UniCom Care AB.

The project is sponsored by the ITHS2 programme jointly financed by the Knowledge Foundation and the Vårdal Foundation.

References

- Belina F., Hogrefe D., Sarma A., 1991. *SDL with Applications from Protocol Specification*. Carl Hanser Verlag and Prentice Hall International, UK.
- Bij J.D. v. d., Dijkstra L., Vries G. d., Walburg J., 1999. Improvement and renewal of healthcare processes: results of an empirical research project. *Health Policy*, 48, pp. 135-152.
- Dayal U., Hsu M., Ladin R., 2001. Business Process Coordination: State of the Art, Trends, and Open Issues. In *Proceedings of the 27th International Conference on Very Large Data Bases, september 11-14, 2001, Roma, Italy*, pp. 3-13.
- IBM. *WebSphere MQ* [online]. Available from: <http://www-3.ibm.com/software/integration/wmq/> [Accessed April 2003].
- Johannesson P., Wangler B., Jayaweera P., 2000. Application and Process Integration – Concepts, Issues, and Research Directions. In: Brinkkemper S., Lindencrona E., Sølvberg A, editors. *Information Systems Engineering, State of the Art and Research Themes*. Springer.
- Johannesson P., Perjons E., 2001. Design principles for process modelling languages in enterprise application integration, *Information System* 26, pp. 165-184.
- Carelink, 2001. *Strategier för effektiva och samverkande IT-stöd i sjukvården*. Rapport nr 1. (in Swedish).
- Linthicum S. D., 2000. *Enterprise Application Integration*. Addison-Wesley.
- Linthicum S. D., 2001. *B2B Application Integration – e-Business-Enable Your Enterprise*; Addison-Wesley.
- Microsoft. *BizTalk Server* [online]. Available from: <http://www.microsoft.com/biztalk/default.asp> [Accessed April 2003].
- MSDN, *Business Process Execution Language for Web Services* [online]. Available from: <http://msdn.microsoft.com/library/default.asp?url=/library/en-us/dnbiz2k2/html/bpel1-1.asp> [Accessed April 2003].
- Oellermann W. L., 2001. *Architecting Web Services*, Apress.
- Scheer A.-W., 1998. *Aris – Business Process Frameworks*. Springer.
- SFS 1980:100, 1980. *Sekretesslagen*, Justitiedepartementet L6 1980. Reprinted in SFS 1992:1474 (in Swedish).
- Vissers, J. M. H., 1998. Health care management modelling: a process perspective, *Health Care Management Science*, 1, pp. 77-85.
- Visuera. *Visuera Process Manager* [online]. Available from: <http://www.visuera.com> [Accessed April 2003].
- VITA Nova consortium, 2002. *Projektplan VITA Nova I* [online]. Available from <http://www.ida.his.se/ida/research> [Accessed April 2003].
- Vitria. *Business ware 4: The leading platform for agile business process integration* [online]. Available from: www.vitria.com/library/brochures/vitria_businessware_brochure.pdf [Accessed April 2003].
- Wählander, C., Nilsson, M., Törnebohm, J., 2001. *Visuera Process Manager*.Visuera Integration AB.
- Åhlfeldt, R., 2002. Information Security in Home Healthcare: A Case Study, In *Proceedings of the Third*

International Conference of the Australian Institute of Computer Ethics (AiCE), september 30th, Sydney, Australia,
pp. 1-10.