Potentials of Enterprise Resource Planning systems in Danish Hospital Service
Report produced for SundhedsITnet, SAP & IBM

Hrönn Kold Sigurðardóttir, Ph.D candidate, IT University of Copenhagen
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1 Introduction and Purpose of Study

In January 2007 a comprehensive structural reform was launched in Denmark. The goal was a merger of the existing 14 counties into 5 regions. Consequences of the merger revealed diverse incoherent IT-infrastructures in the Danish healthcare system and coexistence of various stand-alone IT-systems that support the same work processes in many of the hospitals. Each Region now runs and administers the local hospital services and has developed or is in the process of developing new healthcare IT-strategies. A prominent element in these strategies is the focus on consolidation and standardization of IT-solutions. The consolidation is about reducing the number of IT-systems that build on different technological platforms and support the same functional areas of the hospitals e.g. patient administration and medication ordering. Their strategy is; one function – one IT system (Region Hovedstaden, 2007; Region Syddanmark, 2007; Region Nordjylland, 2008). The major argument for implementing Enterprise Resource Planning systems (ERP’s) as put forward in the studied academic literature and in international hospital case stories is consolidation and need for standardized IT-solutions.

Therefore, the purpose of this study is in collaboration between researchers, vendors, and the hospital service to bring forward knowledge based on international experiences on Enterprise Resource Planning systems in hospital service that makes it possible to conclude whether implementation of such systems, as e.g. SAP, can support some work processes in the Danish Hospital Service.

The target audience for this report are decision makers in Danish health informatics organizations, such as the Chief Information Officers in the Regions IT-departments and hospital administrators that currently face the challenges of dispersed IT-infrastructures and political demands (SDSD, 2007) to optimize the digitalization of the healthcare system.
2 Project Initiation and Partners

This study was initiated as a SundhedsITnet pathfinder-project in October 2007. Acure, an IBM Division, and SAP Denmark had recently joined in a strategic partnership to explore the potentials of ERP in Danish Healthcare IT market and therefore they were highly motivated to take role as project partners and together finance 25% of the study. SundhedsITnet finances the remaining 75%. On February 1st 2008, junior researcher Hrönn Kold Sigurdardottir, PhD student at the IT University of Copenhagen was hired to conduct the study with guidance from Professor Finn Kensing, Copenhagen University. The project ends on September 10th, 2008. Readers interested in further details about the organizing of the project can contact SundhedsITnet (info@sundhedsIT.net). In the following text I will often refer to Acure, an IBM Division and SAP DK as “the vendors”.

SundhedsITnet
SundhedsITnet (network for IT based Health Services) is collaboration among universities, health services, business and patients. The aim of the network is to bring together actors in the field, for the exchange of knowledge about healthcare IT, in a holistic approach to healthcare IT. The Danish Ministry of Science, Technology and Innovation supports the network.
Source: www.sundhedsit.net
3 Study Questions and Hypothesis

In the initiation phase of the project, the following study questions were put forward in a collaborative effort between the project partners:

How can Danish Hospital Service utilize traditional Enterprise Resource Planning (ERP) solutions?

And the following sub-questions:

a. What are the characteristics of the industrial processes that ERP systems are developed to support?
   - What can SAP® for Healthcare support in relation to such industrial processes?

b. What characterizes work processes in Danish Hospital Service?
   - What characterizes clinical and administrative work processes respectively and how is the relationship between the two?

c. Which work processes in Danish Hospital Service might be supported by SAP® for Healthcare?
   - What are the potential benefits and challenges when implementing SAP® for Healthcare for support of various clinical and administrative work processes in Danish Hospital Service?

d. How is the relationship between SAP® for Healthcare and other information systems in the hospitals in relation to technology and work practice?

To support these questions we formulated following three hypotheses that were meant to function as point of departure for the study.

1. We expect that Danish Hospital Service can utilize SAP® for Healthcare in following functional areas:
   - Finance, Human Resource Management, Procurement, Logistics, Asset management, and maintenance as there are many international experiences and one in Denmark; The Central Denmark Region (Region

Source: www.SAP.com 2008
Midtjylland) has implemented Supplier Relationship Management (SRM) of the SAP ERP.

2. We expect that Danish Hospital Service might be able to utilize SAP® for Healthcare in following functional areas:
   - Patient administration as there are several international experiences
   - Booking\(^1\), order entry, and results review

3. We expect that Danish Hospital Service can not utilize SAP® for Healthcare in following functional areas:
   - Medical/Nursing record keeping, medication ordering, and medication administration and hereto related work processes.

Hypothesis nr. 1 is studied through literature review, hypothesis nr. 2 and 3 are studied in an empirical context and through documents analysis. The main focus has been on studying hypotheses nr. 2.

3.1 Delimitations of the study

As apparent in the study questions and in the hypothesis, this study does not compare ERP solutions provided by different vendors on the market although the descriptions of the concept of ERP apply to the phenomenon in general and not to the specific solutions provided by different vendors.

Very shortly after the beginning of the study I attended a SAP Ecosystem Summit conference in Germany and had my first acquaintance with SAP® for healthcare. One of the findings from the summit was that SAP themselves do not develop clinical IT-solutions. But to be able to offer healthcare clients a comprehensive IT-solution, which is the SAP® for Healthcare portfolio, they have partnered up with three other vendors, Siemens, T-Systems Austria, and Accenture that specialize in clinical IT-solutions. This study focuses on SAP’s own IT-solutions for the healthcare sector that are described in more detail in chapter 7, SAP® for Healthcare.

\(^1\) The concept “booking” denotes several different work processes in the hospital that all involve planning of some sort, e.g. planning of patient admissions, planning of surgeries and planning of medical image examinations.
4 Methods

This section provides an overview of the applied methodology and analytical framework of the study. The empirical data are gathered through following qualitative research methods: literature review, semi-structured interviews, in-situ interviews, and documents analysis. To supplement my knowledge on SAP ERP and SAP® for Healthcare, I had a 2-hour crash course on ERP via the Internet, provided by an SAP consultant from Sweden and I participated in a 2-day SAP Ecosystem Partner Summit in Mannheim, Germany. Furthermore, I visited SAP healthcare industry business unit (IBU) at SAP Headquarters in Walldorf, Germany, for 3-days and I made a 4-day fieldtrip to an Austrian hospital that has implemented SAP® for Healthcare. My Austrian informants have reviewed chapter 9 and a few minor changes were made accordingly.

4.1 Literature review

A review of the academic literature on ERP and on ERP in hospital service was conducted in order to put the concept in context and to get an impression of how comprehensive the discussion of ERP in Healthcare currently is. The search was conducted in three different Internet resources: Google Scholar, Science Direct, and MEDLINE/PubMed. Enterprise Resource Planning (ERP) system does not exist as a MESH term (Medical Subjects Heading) in MEDLINE/Pubmed which might point at little discussion of the subject in the medical informatics literature. Different but related concepts; Information Systems, Personnel Staffing and Scheduling Information System, Management Information System and Operating Room Information System are defined as MESH terms, and these were applied in the MEDLINE/Pubmed search strategy to identify relevant articles in medical informatics literature. ERP is a well-established concept in Information Systems (IS) literature even though there is an ongoing debate on the accuracy of the term and suggestions for substitutes that never have gained as much use as ERP. It is here, through Science Direct, that most of the articles are located. The literature review is focused on academic literature that explores the concept of ERP, provides an
overview of rationale for ERP implementation in Hospital Service and some of the challenges that arise. The results of the review are written in chapter 6.

4.2 Interviews
To support the interviews I followed a semi-structured interview guide. This method makes it possible to follow a sequence of themes to be covered, as well as suggested questions. Simultaneously the method is open to changes of sequence and form of questions in order to follow up on the answers given by the informants (Kvale, 1996). I conducted interviews with clinical and administrative personnel at Krankenhaus der Barmherzigen Schwestern in Linz, Austria and with persons working in SAP’s Healthcare Industry Business Unit, in Walldorf, Germany. Each interview lasted from 30 minutes to 1 hour. Due to the short timeframe of the fieldtrip I used in-situ interviews with several of the clinical personnel. In-situ interviews are an efficient way of getting an understanding of current work practices as they allow the user (in this case the nurses, the radiologist and the secretary) to verbalize their work practises simultaneously as they conduct the work. Each in-situ interview lasted approximately 2 hours.

4.3 Analytical framework
The analytical framework applied in the study is based on a sociotechnical perspective (Berg, 1999; Bødker, Kensing, & Simonsen, 2004) on technology in organisations. Any technology must in this perspective be studied in relation to the organisational context and the competencies of its users. The organisation shapes the technology and the technology shapes the organisation. How this interplay changes either the technology or the organisation, or both, is never given a priori. It is therefore only in studying the relations between the technology and the social context that makes it possible to discuss the usefulness of a technology. Studying the use of SAP in a concrete context and interviewing its users is therefore one of the most important elements of this study. The contents of the analysis are described in chapter 9. ERP in action – a case study from KBHS, in Linz Austria.
4.4 Changed prerequisites and plans

There are two prerequisites that changed during the course of the project and due to their effect on the overall focus of the study I will mention them here. Representatives from SAP in Denmark and Germany, and representatives from Acure, an IBM Division, had, prior to my involvement in the project, conducted collaborative workshops that mapped the processes supported by SAP’s patient administrative system (PAS) to the requirements to PAS that IBM has experienced and are put forward by Danish healthcare administrators. The vendors proposed that the study took outset in these mapping efforts but unfortunately due to misunderstandings between the vendors and me this was not possible. The second prerequisite that changed was that initially the vendors suggested that one of the cases I should study could be a specific hospital in one of the Danish regions. After several efforts to gain access to this hospital we had to abandon the idea as the hospital was not interested in participation. The reasons for their decision will not be disclosed here due to confidentiality issues but is known to the project partners. Finally, the original plan was to visit two different European hospitals but unfortunately and despite persistent efforts we only succeeded with one.

To sum up the empirical study in Austria, the literature review as well as the changed prerequisite and plans, all together provide basis for reframing the initial study questions. Therefore, rather than strictly confirming or denying the three hypotheses, this report will discuss: “what should be taken into consideration in relation to Enterprise Resource Planning Systems in general and in relation to SAP for Healthcare when discussing ERP’s potential role in Danish Hospital Service”?

5 What is ERP? – A Summation of the Literature Review

Similar as known in relation to the concept of Electronic Health Record (EHR) (Elektronisk patient journal (EPJ) in Danish) which meaning is heavily debated in the health informatics literature, and in practise, there is a profound
discussion in the Information systems (IS) literature on what ERP really stands
for and whether the acronym rightly denominates the phenomenon. In this
chapter I describe how the concept of Enterprise Resource Planning (ERP)
systems is understood in the literature.

5.1 ERP in a broader context
In the literature, ERP systems are related to a broader range of information
systems that are entitled as Enterprise Systems (ES). These information
systems not only model information processes in an enterprise but also
human interaction processes within and outside of the enterprise. ES build on
standard software modules and have inscribed knowledge on business practises that has been accumulated by vendors through implementation
projects at a broad range of clients. The integrated architecture of Enterprise
Systems allows the organisation to share data across the enterprise and to
integrate with information systems developed by other vendors. Yet another
characteristic of ES, is that as a commercial product it is generic and must be
configured and customized by the client organisation before it can be taken
into use (Shanks, Seddon, & Willocks, 2003). The total cost of ES
implementation projects is difficult to determine due to substantially different
preconditions of each customer. Still, the vendor use a rule of the thumb to
give a picture of the price for ERP implementation\(^2\), saying that \(\frac{2}{3}\) of the
total cost is dedicated to implementation activities such as configuration,
customization, integration with existing systems, process-documentation and
mapping against SAP process-model etc., whereas \(\frac{1}{3}\) of the cost is for the
licenses.

A concrete example of a commercial Enterprise System is the mySAP Business
Suite\(^3\) that is developed by SAP AG (Figure 1 on next page). The system
consists of several different modules that support specific functional areas of
a generic business organisation. The core of the business suite is mySAP ERP

\(^2\) The vendors define ERP implementation period as the time from initial project planning till
the date for go-life (Hjort, C., SAP; Westring, U., Acure and IBM division).

\(^3\) mySAP is the name of the newest versions of SAP solutions. This study takes primarily outset
in descriptions of mySAP solutions and not previous versions.
which also is made up by several different modules e.g. Sales and Distribution, Materials Management, Financials, Controlling and Human Resources.

The ERP modules support internal information processes of the organisation whereas the four modules surrounding the core, Supply Chain Management (mySAP SCM), Product Lifecycle Management (mySAP PLM), Customer Relationship Management (mySAP CRM) and Supplier Relationship Management (mySAP SRM) extend the functionalities of the ERP core to handle the suppliers and partners that are external to the organisation as well as its customers. All the modules exist both as general modules that are broad in their scope of functionality and as industry specific modules, that as implied are narrower in scope of functionality and specifically designed for a particular industry. For some of the 25 different industries supported by SAP solutions (SAP AG, 2008a) the ERP core can be general and some of the surrounding modules may be industry specific. Underneath all the modules, the SAP NetWeaver takes care of integration between SAP, non-SAP, and legacy systems as well as providing portal capabilities and components for electronic data transfer, master data management and business intelligence (SAP AG, 2008b).
In choosing one of the modules of the mySAP Business Suite, e.g. the mySAP SRM module, the customer automatically gets mySAP ERP and the NetWeaver in the package but is not required to utilize all the modules.

In this study I focus specifically on ERP - the core module because it is considered to be the central infrastructural element of Enterprise Systems.

Now, we have looked at how Enterprise Resource Planning systems are a part of a broader context of Enterprise Systems and in the next section I will explore ERP as a phenomenon, its characteristics and developmental roots.

5.2 Roots of ERP, characteristics and developmental trends

The roots of ERP software is of many scholars (Klaus, Rosemann, & Gable, 2000; Monk & Wagner, 2006) said to be traced back to the industry of manufacturing, where its predecessors MRP II and I where developed. MRP stands for Material Requirements Planning (MRP I) and Manufacturing Resource Planning (MRP II) respectively. MRP I was developed to calculate more efficiently the materials needed in a production process. It evolved into MRP II that encompassed new functionality like sales planning, capacity management, and scheduling. Computer integrated manufacturing (CIM) is regarded as the next step in the evolution. CIM embedded the technical functions of the product development and production process in a comprehensive integration framework, extending the functionality to also encompass finance, sales and distribution, and human resources. This is what we refer to as a “traditional ERP”. The concept of a totally integrated enterprise solution is now called ERP. It was not until in the 1990s that integrated ERP software became feasible due to enhancements in computer power. Current ERP systems evolved as a result of three things: advancement of hardware and software technology needed to support the system; the development of a vision of integrated information systems; and the reengineering of companies to shift from a functional focus to a business process focus. This last developmental trend is also visible in the healthcare sector, where there are a growing attempts to develop information systems that are “process-oriented” (Greiner et al., 2005; Kawamoto, Houlihan, Balas,
A simple definition of a process-oriented information system is one that offers the right tasks, at the right point in time, to the right person along with the right information needed to perform these tasks (Dumas, van der Aalst, & ter Hofstede, 2005). Despite these trends in information systems development the organising of hospitals in Denmark is based on the principle of functionally separate units. Re-engineering of clinical work processes is only visible in isolated projects that focus on optimizing selected work processes in separate departments. For example, there are ongoing projects in surgical departments of several different hospitals in the Capital Region of Denmark that use LEAN\(^4\) methodology to optimize the utilization of operating theatres. The focus of these projects is on optimization of local work processes but not on optimizing the overall work processes in all surgical departments of the regions 14 hospitals.

In the search for descriptions of ERP systems it became evident that the concept of ERP and ERP as a phenomenon are heavily debated in the Information Systems (IS) literature. There exist no standardized requirements for which functionalities and modules an ERP system must contain in order to be given the label “ERP”. As a result the term is observed applied to systems only consisting of a common database and a financial module. This is the issue of a study conducted by Klaus and colleagues (Klaus et al., 2000). They conclude that it is unlikely that a broadly agreed definition of ERP can be achieved and question the value of such ongoing efforts. Instead they suggest that we describe the characteristics of ERP systems as a contemporary commercial product that is offered by a range of vendors that specialize in this segment of the software market. So what characterizes ERP software is

\(^4\) LEAN methodology is about organizing and managing product development, operations, suppliers, and customer relations. Business and other organizations use lean principles, practices, and tools to create precise customer value—goods and services with higher quality and fewer defects—with less human effort, less space, less capital, and less time than the traditional system of mass production (source: http://www.lean.org/WhatsLean/Index.cfm)
that it exists on three different forms: a) generic, b) pre-configured and c) installed:

a) In its most comprehensive form, the software is generic, targets a range of industries, and must be configured before it can be used.

b) Packaged or standardized, pre-configured templates have been derived from the comprehensive software. These templates are tailored towards a specific industry, sectors (e.g. healthcare) or companies of a certain size.

c) For most users ERP-software presents itself as the operational installation after the generic or pre-configured package has been individualized according to the particular companies requirements on site.

Only in its generic condition (Figure 2) can ERP software be purposefully characterized since any configuration by either adding or reducing detail creates distinct instances of the product. (Klaus et al., 2000; Rikhardsson et al., 2004).

Figure 2. Generic ERP (Rikhardsson et al., 2004).

ERP software is based on an underlying database that stores master and transactional data in a consistent way and with controlled redundancy. ERP
purports to support all generic business functions of an enterprise, especially procurement, material management, production, logistics, maintenance, sales, distribution, financial account, asset management, cash management, controlling, strategic planning, and quality management. In addition ERP often supports industry specific functions like patient management in hospitals and student administration at universities (Klaus et al., 2000).

In the above figure, ERP software is presented in its generic form. Data is stored in a central database and entered in the different modules that support various business areas of the company together with shared management reporting tools. The central modules of many ERP’s are the financial management and accounting modules. These modules support e.g. management of debtors, creditors, assets, budgets, investments, and accounts. The modules that support procurement, sales, and distribution are also central for many companies in managing the production, and flow of materials and products in and outside of the company. The module for control of human resources contains e.g. wage administration, control of training and education of personnel. ERP systems link different parts of the organisation by coordinating all business processes (purchasing, logistics, financial and staff).

The circle around the modules on figure 2, designated “e-trade” symbolises the ERP systems capability to support communication with the world outside of the company.

There exist no standardized requirements for which functionalities and modules an ERP system must contain to entitle the denomination - ERP system. As a result the term is applied to various forms of implementations of partial ERP systems that for example only consist of a common database and a financial module.

Having provided these descriptions of ERP systems I will finish the section by mentioning the primary goals that enterprises aim for with implementation of ERP systems:

- Improving organisational performance
- Increasing responsiveness to customers
- Integration of data
- Providing data access across common data systems
  

### 5.3 Challenges with ERP systems in general and in hospital service

Implementation of ERP systems can entail profound organisational transformation such as introduction of new business processes, new appointments, change in organisational structure etc. and should be considered as projects of organisational development (Rikhardsson et al., 2004).

The problems of ERP systems are often divided into two classes: implementation problems and structural problems. Implementation problems concern the transition from the pre- and post-ERP implementation, but mistakes made during implementation can show up much later. From the literature (van Merode et al., 2004; Trimmer, Pumphrey, \& Wiggins, 2002; Botta-Genoulaz \& Millet, 2006) we learn that typical ERP implementation problems are the following:

- Resistance from the members of the organisation towards a new technology
- ERP systems are not flexible enough to adapt to the processes of the particular organisation. To implement ERP the organisations usually need to go through a major reengineering process
- ERP requires that processes be described very precisely. Often the formal description is not complete, and the implementers do not know where the different types of process knowledge reside in the organisation
- Organisational memory mismatches. This problem relates to the previous one. ERP systems require that not only organisational data but also knowledge is stored in a structural way. If this is not the case part of the organisational memory content is located in the ERP system and part of the content is
stored in other organisational media (e.g. in heads of individuals and process manuals). Such memory mismatches cause underperformance of the ERP system leading to need for coping, for example through further enhancing the ERP system. As a result, processes may also fail in unpredictable ways and may be difficult to trouble-shoot and correct.

The challenges related to implementation of ERP’s reveal several prerequisites that every organisation needs to consider before implementing ERP systems. It is essential for the success of ERP implementation that the organisation accepts to adapt its work processes to the ones that are dictated by the system. This is especially important when the organisation cannot provide detailed formal descriptions of these work processes.

The other class of problems with ERP systems are the structural ones that relate to the misalignment between the structure of the ERP system and the structure of the organisation. Misalignments occur when there are differences between the structures embedded in the organisation (as reflected by its rules, procedures and norms) and those embedded in the ERP package (Soh, Sia Siew, & Tay-Yap, 2000; Wang, Klein, & Jiang, 2006). Another study in hospital service by Soh et al (Soh & Sia, 2004) identified three different forms for misalignments between the structure of ERP systems and the structure of the organisation:

- **Country specific**
  - Unique regulatory or social practices
  - Patient care modules are specialized industry modules and they are not as well integrated with the mainstream modules such as finance and materials management

- **Company specific**
  - Organisational structure
  - Medical specialties offered
  - Management styles
  - Procedures
• Public sector specific
  o Reporting requirements to regulatory authorities
  o Standard formulas and processes for government reimbursement to hospitals for services to patients
  o Standard civil service human resource practices

Furthermore, they found that imposed organisational structures e.g. by external authoritative pressure were overwhelmingly resolved by the hospitals through ERP package customization, while most voluntarily acquired structures were resolved via organisational adaptation (Soh & Sia, 2004).

5.4 International experiences of ERP in Hospital Service

Enterprise resource planning software applications are designed to facilitate the system wide integration of complex processes and functions across a large enterprise consisting of many internal and external constituents. Although most currently available ERP applications generally are tailored to the needs of the manufacturing industry, many large healthcare systems are investigating these applications. Due to the significant differences between manufacturing and patient care, ERP-based systems do not easily translate to the healthcare setting. In particular, the lack of clinical standardization impedes the use of ERP systems for clinical integration. Nonetheless, Jenkins and Christenson argue that an ERP-based system can help a healthcare organization integrate many functions, including patient scheduling, human resources management, workload forecasting, and management of workflow, that are not directly dependent on clinical decision making (Jenkins & Christenson, 2001).

The rationale for implementation of ERP systems in hospitals is based on the aim to solve the following problems:

- Lack of integration between dispersed systems (Raths, 2006; Jenkins & Christenson, 2001; Donaldson & Mayes, 1999)
- Need for complete and consistent overview of the organisation and stability (García, 2007).

Several studies have identified the possible advantages of ERP’s in hospital service. One such study suggests that hospitals should be divided in a part that is concerned only with deterministic processes and a part that is concerned with non-deterministic processes, as ERP systems can be very useful for planning and controlling the deterministic processes (van Merode et al., 2004). The previously mentioned study (Jenkins & Christenson, 2001) supports the view by van Merode et al, and proposes that ERP applications can facilitate a hospital service provider’s adoption of work processes that manufacturers routinely use to balance workload with corresponding labour and supply requirements, thereby optimizing the use of scarce resources in healthcare. These processes include:

- Forecast workloads – many departments within hospitals routinely use methods to predict workloads e.g. in surgical departments where surgical schedules are used to determine e.g. the number of patient admissions that are scheduled for a specific period. Each scheduled inpatient forecasts can be translated into potential workload for ancillary departments like clinical laboratory and pharmacy. ERP’s facilitate central gathering of information and dissemination to appropriate areas of the organization (Jenkins & Christenson, 2001).

- Managing human resources – by linking workload information to the scheduling and staffing systems, an ERP system can facilitate dynamic management of human resources at the hospital or healthcare organization (Donaldson & Mayes, 1999).

Despite advocating for ERP’s advantages in hospital service, these authors advice that it is essential that a hospital service provider has a clear idea of the core business processes that are intended to be integrated with the ERP
system and that these processes both are standardized and described in a formal language.

6 SAP® for Healthcare

The following analysis of SAP® for Healthcare is based on my interviews with SAP employees at the Healthcare Industry Business Unit in Walldorf, provided documents, information from the SAP website (www.sap.com) and from the SAP Ecosystem Summit 2008.

SAP® for Healthcare is presented as a comprehensive concept of IT-support that covers all functions in any healthcare organisation and a portfolio of concrete applications (figure 4). mySAP ERP (figure 3) is the core module of SAP® for Healthcare and provides application support for what is seen as the basic functions of any organisations. These functions are: analytics, financials, human capital management, procurement and logistics execution, product development and manufacturing, sales and services, and corporate services. Each of these applications supports specific work processes that are conceptualized on the figure as coloured boxed carrying different process names. SAP NetWeaver handles the integration between SAP, non-SAP and
legacy systems, as well as providing portal capabilities, components for electronic data transfer, master data management, and business intelligence (SAP AG, 2005). The current solution map for mySAP ERP as presented here on figure 3, is also a part of my SAP Business Suite (mention on page 12). The history of SAP ERP goes back more than 40 years and experience with more than 40,000 customers worldwide have fed into the development of the product and for more than 10 years SAP has developed and implemented ERP solutions in healthcare organisations.

In addition to the ERP core, SAP® for Healthcare (Figure 4) consists of industry specific solutions for healthcare.

![SAP’s Healthcare Provider Solution Map](image)

Figure 4. SAP for Healthcare. Source: www.sap.com

The applications that support clinical process that directly are related to patient care and treatment (work processes named in hypothesis nr. 3) such as medication ordering and administration, nursing and medical documentation, are provided by SAP partners, such as T-systems Austria and Siemens.

The healthcare industry specific solution provided in the SAP® for healthcare portfolio is the SAP Patient Management module. Previous versions of this solutions are referred to IS-H, which stands for Industry Solution – Healthcare,
and is sometimes still used as the technical name of the patient management solution. SAP Patient Management is the only application that SAP has developed specifically for the healthcare sector. This system supports billing of patients, patient administration (+ transfer and discharge), basic coding and provides information to insurance companies. A comprehensive set of forms and parameters come with the system, which the deploying organization must select the ones applicable to the organization. This is a complex process that requires extensive knowledge on the processes supported by the system as well as of the processes in the organization. Rules for billing of patients is different in each country, so the system has to be configured before use to support the local requirements of the country at hand. The integration between the different applications of the portfolio is based on standardized interfaces provided by the NetWeaver integration platform underlying all mySAP applications.

SAP® for healthcare most certainly gives the impression of being a flexible solution that can be fitted into the current IT-infrastructures of any contemporary hospital. The hospital administrators must to choose how the concept is instantiated in their specific hospital service, i.e. which modules of the portfolio are necessary for the organisation, which third party solutions to keep or acquire and how the integration to current IT-systems is made. 90% of the organisations that have deployed the concept SAP® for healthcare and are using SAP patient management are using SAP ERP. SAP reports to have more the 800 installations of SAP® for Healthcare worldwide (SAP AG, 2008a).

7 Information Systems in Healthcare

In this section I want to provide the reader with a picture of how and where SAP® for Healthcare might fit into what we in the domain of health informatics refer to as hospital information systems. In a classic textbook on medical informatics by van Bemmel & Musen, the function of an Hospital Information System (HIS) is outlined as being; to support hospital activities on
operational, tactical and strategic levels. As with ERP systems, there is no unanimity about which applications an information system in a hospital should contain to be allowed to carry the label “HIS” or which hospital functions an HIS should support and to what extent they should be automated (van Bemmel & Musen, 1997).

A common distinction is made between hospital functions that are specific for clinical department and functions that support processes in more than one department. Yet another distinction is made between functions that primarily support the administration of the hospital and functions that support the treatment of patients – the core processes. Figure 5 above, shows examples of the different subsystems in a Hospital Information System, with eight functional entities (written in italics) and the corresponding hospital functions mentioned below each. The figure shows how one part of the hospital information system supports functions of the hospital that are “patient centred” and another part supports functions that are “hospital centred”. The red line roughly indicates on the right side, which work processes the main building blocks of SAP® for healthcare, SAP ERP and SAP patient
management, support when related to a traditional HIS. The remaining functions are supported by solutions provided by SAP partners.

8 ERP in Action – Case Study at KBHS in Linz, Austria

In this chapter I will turn to the results of the empirical study where I observed how a specific instantiation of SAP® for Healthcare supports work practices in an Austrian hospital. The fieldtrip took place from June 9\(^{th}\) – 12\(^{th}\) 2008.

8.1 About the hospital

Krankenhaus der Barmherzingen Schwestern (KBHS) in Linz is the third largest hospital in Upper Austria. It is a part of the privately owned Vinzenz Gruppe Krankenhausbeteiligungs- und Management GmbH that owns and manages 6 other hospitals, 5 in Vienna, and 1 in Ried (http://www.vinzenzgruppe.at/). KBHS covers a broad spectrum of medical specialties such as cardiology and orthopaedics but its core service is oncology. The hospital has 719 beds and approximately 1700 clinical personnel (Vinzenz Gruppe Krankenhausbeteiligungs- und Management GmbH, 2007). The majority of the hospitals have used SAP ERP for many years as back-office systems (only used by administrators and management). In the year 2001 a new hospital was added to the Vinzenz Group that in addition to SAP ERP also was using the SAP Patient Management Solution. This was one of the motivators for the management at KBHS to choose the SAP Patient Management System and to further implement SAP ERP in the remaining hospitals.

8.2 Sites visited

Knowing that I had only four days to learn about the organisation, the IT-infrastructure and how the IT-systems support the clinical work processes that are mentioned in hypothesis nr. 2 (page 6), i.e. patient administration, and
booking \(^5\), I took outset in the organisational structure of the hospital. I visited the local sites — departments where the clinical personnel use the SAP systems to support their work processes. I conducted in-situ interviews with doctors, nurses, and secretaries. “In-situ” means that the interviews are conducted in the custom work environment of the personnel and they are asked to tell about typical work processes and how the IT-systems support these processes, while I observe and ask questions.

The sites I visited where the following:

- Out-patient orthopaedic clinic (in-situ interview with a secretary)
- Orthopaedic ward (in-situ interview with a nurse)
- Surgical department (in-situ interview with the head nurse)
- Intensive care unit and recovery department (interview with chief anaesthesiologist)
- Radiology department (in-situ interview with the leading medical technician)
- IT department (interview with Chief information officer (CIO), SAP application expert from the Clinical Information Systems group, and an it-architect from the Client Management group).

I also visited and interviewed personnel in the IT-department and a quality manager, responsible for nursing documentation at KBHS. These different departments are all located at separate floors of the hospital and the personnel are associated with one department. The IT-department consists of 11 full time employees that are divided into three specialized groups; a) Clinical Information Systems (CIS) group, b) Medical Technology (MT) group and c) a Client Management (CM) group. The clinical information group is responsible for SAP applications in the hospital, as well as other clinical information systems.

\(^5\) Booking is here used as a common denominator for different scheduling processes e.g. scheduling of admittance to the hospital, scheduling of outpatient visits, scheduling of surgical procedures, transfer of patients between departments, order entry e.g. of x-rays and results review.
8.3 IT infrastructure at KBHS and technical considerations

In 2000 KBHS management decided to renew some of the outdated IT-systems in the hospital. Different arguments were put forward as a reason for why the hospital needed a new IT-system but the main ones were a wish for higher integration between existing it-infrastructure and consolidation of dispersed it-systems in the 7 hospitals of the Vinzenz Group.

The IT-infrastructure at KBHS was previously based on a traditional HIS, but some of the other hospitals were using SAP ERP (SAP R/3) as back-office applications (only used by management and administration functions).
Therefore, SAP’s industry solution for healthcare became one of the four solutions that the hospital evaluated. The respective vendors introduced their products to the project groups and reference visits were conducted to hospitals using the different solutions. In the end of the selection process, the hospital director solely made the final decision.

Current IT-infrastructure at the Vinzenz Group hospitals comprises a classic view of contemporary healthcare organisation (figure 6 above) – a complex mixture of heterogeneous IT-systems, servers, and integration mechanisms.

The details in figure 6 are not all equally relevant for the reader, but the elements that I primarily want to visualise are the parts of the infrastructure that are provided by SAP. The circles on the figure with the colours red, green, and blue denote different physical IT-systems that are located in different hospitals of the Vinzenz Groups. The location of the systems is specified as being in either, Ri for Ried, Li for Linz, or Wien. The specific instantiation of SAP® for Healthcare at KBHS consists of the components SAP ERP and the SAP NetWeaver (is a part of SAP ERP, but not explicit on the figure), SAP Patient Management (IS-H on the figure) also called SAP PAS, and i.s.h-med which is an IT-system provided by SAP partner T-systems Austria, for documentation of medical notes. The other third party systems are integrated with the SAP components of the IT-infrastructure in different ways as indicated by the lines that connect one system to another. Furthermore the small letters along the lines give information on which data are delivered to SAP and which are made available to each system from SAP.

I primarily observed the use of SAP PAS but also other systems such as MCC (operating scheduling system made by Meirhofer), Syngo Workflow browser for planning and financials in the radiology department and nursing documentation system (Pflegendatenbank provided by a third party vendor). During implementation of SAP some changes in the core code were necessary to accommodate for needs for integration with the existing IT-systems. But it was an upfront strategy of KBHS to primarily implement the standard of the SAP. As the CIO said: “We only touch the standard SAP code if necessary
because it makes much trouble when we upgrade. It has been necessary in a small scale to get some functions to work for us”. At the time for my visit, two different version of SAP NetWeaver (versions 6.0 and 7.1) run in parallel due to compatibility problems between different versions of SAP PAS. Some of the previously functioning integrations did not work after upgrade of SAP PAS to a newer version.

The IT-organisation manages the daily operations of the IT-infrastructure and provides first and second level support for the customers. Also the IT-organisation relies on external consultancy (one person full time and 2-3 persons intermittently) to solve problems that need specialized SAP knowledge. The personnel in the Clinical Information System (CIS) group has the necessary knowledge and tools to make certain changes in i.s.h-med (system for medical notes) and in SAP PAS e.g. to add data fields on specific clinical forms. A clinical database for breast cancer is used for reporting of specific data nationwide and at KBHS. A form has been developed in SAP PAS to support this reporting and the data is automatically transferred from SAP PAS to the clinical database. If a new field is needed on such a form the CIM group can make the changes.

The department conducts an annual user satisfaction survey to measure and follow up on the customers satisfaction with the services provided by the IT-department. The customers of the IT-department are all the clinical personnel (nurses, doctors and nursing assistants) at KBHS and the administration (secretaries and management) of the hospital. The goal is to maintain a minimum of 95% satisfaction and this has been the case in the recent years. Another less formal but more frequent method for evaluating the customer satisfaction is through informal discussions with the doctors. Today, the CIO’s impression of this informal evaluation is that the doctors are relatively satisfied with what the systems have to offer. The vision for IT-infrastructure at KBHS is to advance from current mode of integration, data exchange and access to data, towards a service oriented architecture (SOA) and Portal access in 2012.
8.4 Observations – organisational issues

In this section I will provide several snapshots of how the personnel at KBHS use the IT-systems in their daily work processes.

The clinical\(^6\) and administrative\(^7\) personnel at KBHS have used IT-systems in their work for many years, so the medium – the computer – is a common part of carrying out daily work activities. System use is also an integrated part of the clinicians’ and secretaries’ work practices. In the outpatient clinic the patient flow on a normal day is approximately 80-90 patients. The patients are referred to the clinic from several sources; some come directly from home, referred by general practitioners; others come from the orthopaedic department for control and check-up of wounds; and still other come from other departments in the hospital if they have orthopaedic problems. The clinic has five treatment rooms in all. Two of which are dedicated to bandage change and are primarily staffed with nurses and three that are dedicated to examinations that are staffed with specialist doctors.

The SAP Patient Management System is the IT-system used for support of patient flow in the outpatient clinic. The system supports e.g. admittance of patients, waiting list management, transfer of patients to other departments, and discharge. It provides the secretaries and the clinical personnel with overviews (lists) that provide information on the status of the registered patients e.g. if the patient is waiting for x-ray examination, if he/she has returned from x-ray and is back in the waiting room etc. In this way the system supports the necessary functions of the outpatient clinic that needs to be able to effectively manage the patient flow. Furthermore, I observed advanced use of task-lists in all the sites visited at the hospital. The lists contain specific tasks that are targeted to certain groups of personnel e.g. all nurses in group 1 at the orthopaedic ward, or they are targeted individual. The lists are based on data gathered in the Patient Administrative system and are accessible on every pc-workstation throughout the hospital.

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\(^6\) When I use the term "clinical personnel" I’m referring to both doctors and nurses.

\(^7\) The term "administrative personnel" denotes secretaries and management.
The secretary in the outpatient clinic says that she has now gotten used to the system but in the beginning she found the system complex and illogical to use. Especially she was not impressed with the graphical user interface. She also complained that the system sometime is very slow. For an uncomplicated registration of a newly arrived patient including scheduling of an x-ray examination, information for the insurance company, diagnosis, and name of the general practitioner, she normally gets all the registration done in less than three to five minutes. But when the system is slow this process gets prolonged and especially on Tuesdays where the patient flow increases to 120-130 patients pr. day due to acute function of the clinic, every delay disrupts the work processes. I did not try to uncover the underlying reason or reasons for this impaired system performance, as it was my aim to unravel how the personnel get their work done at KBHS with support from the used IT-systems and at times, e.g. when the system responds slowly, the secretary cannot carry out timely registration of new patients and provide information on those patient for the doctors in the treatment rooms.

The registration done by the secretary in the reception of the outpatient clinic is used throughout the hospital in the different wards that handle the patient. In the radiology department for example, the radiologists looks at the list of ordered x-rays as provided by the SAP Patient Management System. She prints out the list and manually types the orders into the radiology information system – the Syngo Workflow Browser. This activity, she explained to me, is essential for securing that the right data are documented for each examination. Too advanced and automatic system integration becomes an issue of patient safety – human integration mechanism is necessary here in order to control the correctness of data and is used for quality control. Systems integration and data integration are important issues in the digitalization of hospitals and local needs must be considered in the process. When the statuses of the x-rays examinations are updated an automatic message is sent from the Syngo Workflow Browser to the SAP Patient Management System and new lists of available x-ray results are
automatically printed in the respective wards where the patients belong.

The head nurse follows me to the orthopaedic ward and explains that they are very busy today because they have too many patients and extra beds need to be found. My informant, an orthopaedic nurse, is working at the nurses’ station and today she is responsible for registering new patients that are admitted to the ward. Typically the patients arrive on the day before their scheduled surgery but some patients arrive and go home the same day. The planning of activities (e.g. time and date for surgery, x-rays, blood tests and EKG and if the patient is expected to stay at the recovery ward etc.) for each patient is done in the SAP Patient Management System – only two months ago the planning routine was to follow standardized paper based checklists of examinations (x-rays, blood exams, EKG) for each specific type of surgery. To ensure that all personnel can access the list of inpatients which is used frequently during all shifts, e.g. to locate the room number for a specific patient and to look up which surgery was performed on another patient, it is printed from the SAP Patient Management System once a week and put on the table in the nursing station. The nurses manually supplement the list during the week with all kinds of information relating to the patients status and new patient names also are added to the list. The list of inpatients is used as an access point to other relevant information on the patients and when a new patient arrives he already exist on the list as planned for admittance. The nurse then prepares a “journal” for the patient which is a paper folder holding several documents. The patient is asked to answer a standardized questionnaire for surgical patients and the form is kept in the journal folder. Then the standard examinations for orthopaedic patients (EKG, x-ray and blood test) are ordered through the SAP PAS and she also marks that the orders are done on the standardized paper checklist mentioned earlier. Nursing documentation is done in a separate system – Pflegendatenbank (PfDB). Access to PfDB is provided directly from inpatient list in SAP patient management but the integration between the two systems is very primitive. The nurse can click on a tab denoted to PfDB in SAP Patient Management System but than she must log on again and relocate the patient she needs to
document on. In that way, integration with third party systems is often simple, sometimes only providing the patient name from the SAP Patient Management System to the third party system. There are probably different reasons for this state of affairs at KBHS. What we may learn is that even though it is possible to integrate different IT-systems from third party vendors through SAP it can be a complicated affair and too expensive for the organisation. Cost-effectiveness is not always achieved and therefore more pragmatic solutions are taken into use leading to cumbersome work practices – in this case for the nurses.

In the intensive care unit (ICU) SAP Patient Management is used to plan admittance of patients to the ward. The management has required that medical documentation i.e. the daily progress notes is done in i.s.h-med and furthermore registration of specific patient scoring is done in SAP PAS. All other documentation is on paper. The ICU does not have a patient data management system (PDMS) but several times projects have been started to evaluate the possibilities of acquiring a PDMS and integrate with SAP to support the needs in the ICU. This also includes integration with the patient monitors. Each time the management has chosen not to realize such a solution for economic reasons. Consequently to date the ICU personnel document the same data in many different systems both paper based and IT-based.

In the mixed surgical department the SAP Patient Management is not used for planning of surgeries. Here all data are registered in a separate surgical scheduling system (MCC) provided by the German vendor Meierhofer. A primary surgeon in each of the eight different surgical departments at the hospital does the planning of surgical procedures for its respective patients in MCC. It is then the job of the surgical head nurse to make the daily surgical schedule fit to the available resources in the Operating Theatre. Sometimes the primary surgeon fails to take into account the duration of a specific surgery and that makes it difficult to optimize the utilization of available operating theatres. The head nurse must contact each primary surgeon
before she makes changes in their bookings and achieve accept from the surgeon to her suggested changes. This is a very time consuming process and requires profound negotiation skills. The head nurse documents statistical data on the ineffectiveness of the current booking procedures but so far her initiative has not provoked changes in the way booking is carried out. The MCC is not integrated at the moment with SAP Patient Management or SAP ERP so all management reporting in the surgical ward is done via “self-knitted reports” in Excel as the head nurse puts it. This illustrates again that unless the overall rationale of a system is understood and accepted by its users and unless their work processes are redesigned, the system will not lead to the expected results.

I expected to observe ERP in action during my visit at KBHS, but instead I saw SAP Patient Management System in action. The SAP ERP system is not used directly to support the clinical processes at KBHS but the Patient Management System is the primary application provided by SAP that is used by the clinicians and provides a link between the administrative processes and the clinical processes carried out in the hospital.
Conclusion and discussion

In this chapter I will relate my overall conclusions to the three hypotheses we sat out to study and highlight some of the elements that should be taken into consideration in relation to Enterprise Resource Planning Systems in general and in relation to SAP® for Healthcare when we discuss the potential role for ERP’s in Danish Hospital Service.

The first hypotheses that we put forward was:

1. We expect that Danish Hospital Service can utilize SAP® for Healthcare in following functional areas:

From the literature review and interviews with personnel at SAP headquarters it seems reasonable to conclude that our expectations as put forward in the first hypotheses, that SAP® for Healthcare can be used in the following functional areas of a Danish hospital service; finance, human resource management, procurement, logistics, asset management and maintenance holds true. What this study further reveals is that several issues need to be taken into consideration before implementation of ERP system is decided upon. The challenges related to the implementation of ERP’s expose several prerequisites that need to be in place at the hospital and that thus are critical for the success of an ERP implementation. As an example, hospital administrators must accept that the organisation has to adapt to the work processes dictated by the system, especially in cases where the organisation cannot provide detailed formal and standardized description of its work processes. The consequences of mismatches’ between the system and the needs of the organisation are often not revealed in the beginning of an implementation process, which is the time where it’s cheapest and simplest to make any changes but surface as the personnel starts to work with the system on a daily basis.

The second hypotheses was:

SAP® for Healthcare

Is a comprehensive concept for it-support of healthcare organizations provided by SAP. It consists of several different applications provided either by SAP or SAP Partners, integration platform, Business Intelligence and tools for programming. The core component is mySAP ERP that is made up by several modules that all support different functional business areas of an organisation e.g. Analytics, Procurement and Logistics, Financials, Human Capital Management. The industry specific solution for healthcare is the SAP patient management. The partner applications support the clinical work processes e.g. medical record keeping and medication ordering. For further detail on SAP® for Healthcare please refer to chapter 7.

Source: www.SAP.com 2008
2. We expect that Danish Hospital Service might be able to utilize SAP® for Healthcare in following functional areas:

- Patient administration
- Booking\(^8\), order entry, and results review.

From the case study in Austria I gained knowledge that supports our second hypotheses. The hypotheses states, as repeated above, we expect that Danish hospital service might be able to utilize SAP® for Healthcare in the following functional areas; patient administration, booking, order entry, and results review. SAP AG provides an industry specific solution for healthcare, the SAP Patient Management System which supports general patient management requirements i.e. waiting-list registration, admittance, transfer and discharge of patients, basic coding of diagnoses, billing etc. Furthermore booking functionalities are provided in the system but those are also often provided in clinical information systems, e.g. in a operating room information system, and in radiology information system so the organisation must consider how to handle the future booking processes and whether they should be consolidated in one system or perhaps centralized in one function – or both. It is by no means given which components of SAP® for Healthcare are relevant for the hospital in question. Therefore the CIO’s and hospital administrators must seriously consider which applications of the SAP® for Healthcare portfolio they want to deploy, which ones they want from SAP partners and which existing IT-systems they want to keep and that should be integrated in to the solution. Integration with SAP Patient Management System is possible on different levels, and the desirable levels for a specific hospital is an issue for consideration in the implementation process. If the choice falls on the SAP Patient Management System one should be aware that SAP ERP and the NetWeaver are incorporated in the package and provide possibilities of tight integration between the administration of the hospital and patient

\(^8\) The concept “booking” denotes several different work processes in the hospital that all involve planning of some sort, e.g. planning of patient admissions, planning of surgeries and planning of medical image examinations.
administration. There is no obligation for the organisation to deploy SAP ERP but 90% of hospitals that use SAP PAS also use SAP ERP. Patient administration is a core function in every hospital and the same counts for booking. The functionalities provided by SAP® for Healthcare are comprehensive enough to support these work processes in Danish Hospital Service but no Danish hospital has yet implemented SAP Patient Management System and therefore considerable customization to the specificities of the country will follow the first implementation. In addition, to date Danish hospitals do not have formalized descriptions of their “core business processes” (to stay in the terminology of the ERP vendors) – which are the clinical processes. Such descriptions are provided by the vendors, based on “best practices”, i.e. implementation experiences from other customers cumulated by the vendor and used as reference models for new customers. By accepting such descriptions of “others’” work processes the hospital administrators might miss the opportunity of a thorough study of the work processes in their hospital and to make informed decisions on how the new work processes are to be designed. Ownership and devotion to the implementation process becomes an issue.

The challenge of reaching alignment between the requirements of Danish Hospital Service and the functionalities offered by the system should be handled as a process of mutual adjustments and ongoing negotiations which results will affect both the way in which the hospital service operates and the functions of the system. Such a process requires constant awareness of qualified personnel in the hospital that function as translators between the vendor and the customer.

Now, turning to the third and last hypotheses that was stated as the following:

3. We expect that Danish Hospital Service can not utilize SAP® for Healthcare in following functional areas:
   - Medical/Nursing record keeping, medication ordering, and medication administration and hereto related work processes.
A univocal answer has not been found in this study that either fully confirms or rejects this hypotheses. SAP® for Healthcare, as a concept for healthcare organisations, purports to support the work processes of; medical/nursing record documentation, medication ordering and medication administration - but in my study these processes were supported by third party vendors. Some of those vendors are SAP partners and integration to their product i.s.h.-med (used for medical documentation of doctors notes) and the SAP ERP system was good. A third party vendor provided the nursing documentation system and medication ordering and administration was not at all supported by any IT-system. ERP systems do not support any of these processes.
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10.1 Contact information

For questions regarding the contents of the report please write to:

Hrönn Kold Sigurdardottir, PhD candidate
Research group Design of Organizational IT (DOIT)
IT University of Copenhagen
Rued Langgaards Vej 7
DK-2300 Copenhagen
E-mail: hrsi@itu.dk
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