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Chapter 10
Developing Strategic Capability Through Business Intelligence Applications:
A Case Study From the German Healthcare Insurance Industry

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ABSTRACT

Company performance can be measured at all levels across an organization, and in the German healthcare industry, business intelligence systems play a crucial role in achieving this. For one major health insurance company (discussed here as an alias – AK Healthcare), the deployment of business intelligence applications has supported sustained growth in turnover and market share in the past five years. In this chapter, these tools are classified within an appropriate conceptual framework which encompasses the organization's information infrastructure and associated processes. Different components of the framework are identified and examples are given: systems infrastructure, data provision/access control, the BI tools and technologies, report generation, and information users. The use and integration of business intelligence tools in the strategy development process is then analyzed, and the key functions and features of these tools for strategic capability development are discussed. Research findings encompass system access, report characteristics, and end-users' capabilities.

INTRODUCTION

Many companies have made significant investment in enterprise-wide information systems in an attempt to work faster and smarter. However, software packages such as Enterprise Resource Planning (ERP), Customer Relationship Management (CRM) and Supply Chain Management (SCM) systems often produce large amounts of data but little information. Companies are beginning to explore the potential of

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new Business Intelligence (BI) products and technologies, which can exploit their corporate databases to improve management control and assess the impact of key business decisions. A sound technology platform that supports integrated information systems is a key requirement that needs addressing as a company expands. To harness the full potential of corporate knowledge, the use of BI tools will be necessary in most market environments. Sound core systems and effective BI tools deployment are the pre-requisites for the management of corporate knowledge relating to new market and product development, quality standards enhancement and process improvement.

BI information and its exploitation for key decision-making can play a vital role in underpinning strategic choice and corporate profitability. Operational data must be processed, analysed and reported in order to control and measure the performance of a company and its management. Effective and timely business information is recognized as being essential for organizations to succeed, but also simply to exist in today's rapidly changing and challenging business environment (Lönnqvist & Pirttimäki, 2006). According to Pisello & Strassman (2003), companies can gain competitive advantage not just by focusing on implementing new technologies, but also by deploying technology to share, manage, and increase the level of knowledge throughout the organization.

To improve the BI process, senior management should be cognizant of the effects and impact of BI on their organization – and they can also be key players and stakeholders in the integration of BI tools into the strategy development process. Company performance can be comprehensively measured at all levels across an organisation, but BI tools can contribute to the management of knowledge in certain key strategic areas. They can be used to improve the way internal business processes are executed so that an organization performs the same activities better than its competitors (Hemmatfar, Salehi, & Bayat, 2010). They may also be applied to performance management to allow organizations to track, understand, and manage vital business information. Such improvements increase employee and customer satisfaction, quality and productivity, and decrease time to market.

This research focuses on the capabilities of Business Intelligence (BI) tools and technologies to support strategic knowledge management that enhances competitive advantage. It explores which BI technologies and tools are currently used within AK Healthcare (AKH), how they are used, how they can be classified, their interaction with the strategy development process, and the key elements of these tools that support effective knowledge management. The objectives of BI deployment are discussed and relevant BI products for AKH are reviewed.

THEORETICAL FRAMEWORK

Since Zuboff (1988) introduced the concept of automate-informate-transformate as a sequential process for applying technology in business, there have been many definitions and classifications of systems providing management information as the link between manual process automation and radical business transformation. The concept of management information systems (MIS) was central to many information systems strategies in the 1990s to "provide information for managing an organization" (Alter, 2002), by extracting and summarising data from transaction processing systems. Peppard (1993) took these concepts further by developing a grid for viewing application portfolios from a strategic perspective, and the early focus on mainly financial information was expanded to include a broader range of information to plan and control business operations. The balanced scorecard (Kaplan and Norton, 1992), for example, contains not only a financial view of a company, but also the customer view, internal operational infor-

mation, and human resource perspectives such as innovation and learning. Since the turn of the century, the concept of Corporate Performance Management (CPM) systems has emerged, which Gartner defines as "the combination of methodologies, metrics, processes and systems used to monitor and manage the business performance of an enterprise" (Buytendijk *et al*, 2004). Business Intelligence tools and systems have emerged as the key technologies to facilitate CPM and help organizations to manage, develop, and communicate intangible assets such as information and knowledge. It is often considered essential for organizations operating in the current knowledge-based economy (Alnoukari, 2009). BI is discussed by Gansor, Totok, & Stock (2010) as an analytical process that transfers internal and external data into appropriate knowledge to support decision-making. The term BI has also been defined as the collection, saving, analysis, and provision of data to support the decision-making processes of a company (Seufert & Oehler, 2009).

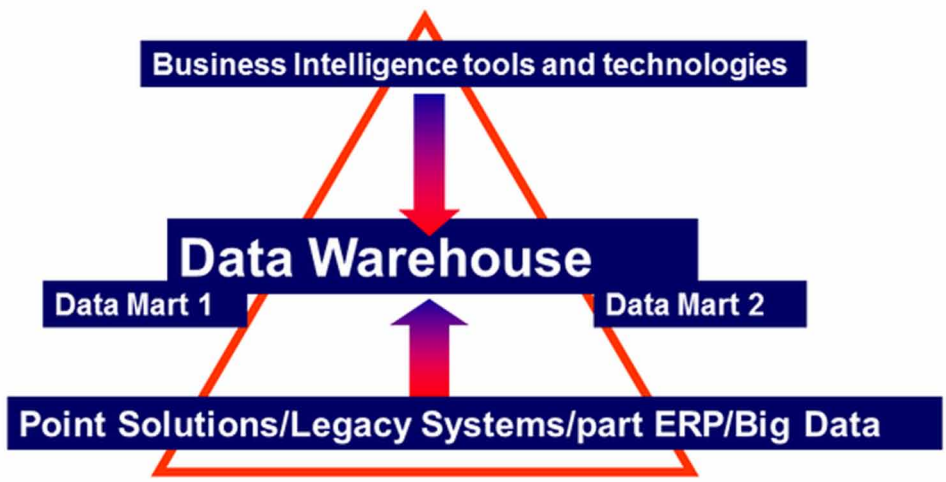
This paper assumes that relevant strategic data will be stored in a structured way in a data warehouse – a "subject-oriented, integrated and time-variant collection of data in support of management's decisions" (Inmon, 2002, p. 31). This is most likely to be the case in organisations that do not have one large integrated software package – an enterprise resource planning system - fulfilling their systems needs, where there may be less of a business case for a data warehouse. It is more prevalent in organisations – like AKH – where a best of breed systems strategy has been pursued, resulting in a range of different applications and data sources. In such situations, the data warehouse (DWH) is often a key component of overall systems strategy; and it is also the base infrastructural element of a BI system, allowing storage and structuring of data from various systems and external sources, supporting the provision of key management information (Figure 1).

"Big Data" is another relevant concept - large volumes of data from different data sources that can be identified and analyzed with the help of BI applications. Similar to analytics, Big Data should allow the generation of findings and insights that provide business advantage (McAfee & Brynjolfsson, 2012); and Big Data may also relate to specific subject areas and be stored in sub-areas of the DWH, often termed "data marts".

Strategic BI technologies and tools can be characterized by their ability to significantly change the manner in which business is conducted, providing an organisation with discernible strategic benefit (Turban *et al.*, 2006). BI technologies are perceived as instruments that generate the knowledge that supports or changes an organisation's strategy (Wiseman, 1985). Eckerson (2005) argues that BI must be able to provide data mining, planning, and modelling tools. BI includes a set of concepts, methods, and processes designed to improve business decisions, using information from multiple sources and applying past experience to develop a more precise understanding of business dynamics (Maria, 2005). It integrates the analysis of data with decision-analysis tools, with the purpose of improving strategic decisions. Although these tools may be used across an organization, it is often in the financial and management accounting areas of the business where BI applications are most in evidence. It is often these departments that are at the centre of strategic planning and knowledge management for the organization as a whole.

BI also encompasses predictive and explorative analytics, often collectively termed business analytics (Weber & Fohrholz, 2013). These tools follow on from the early online application processing (OLAP) tools that emerged in the 1990s, and their use requires multi-dimensional arrays or cube structures within the DWH as well as the more traditional relational database structures. These cube structures often relate to specific subject areas (e.g. customer profitability) and may be held as individual data marts. Predictive analytics are often used to forecast financial developments or consolidation activities with

Figure 1. Typical systems architecture underpinning BI tools deployment



the aim of sustaining competitive advantage (Siegel, 2010). Explorative analytics, on the other hand, employ analytical and optimization methods to enable BI end-users to improve their understanding and interpretation of corporate data and information, and thereby generate new knowledge.

BI can change the way people work as individuals, in groups, and in the organization. People perform their work following business processes that are embedded in BI (Watson, 2010). Benefits attributed to BI may be non-financial and intangible, such as the improved quality and timeliness of information. Although such non-financial effects may lead to advantageous financial outcomes, there is often a time lag between the acquisition of information from BI and the related financial gain. Measuring BI benefits can thus be extremely difficult in practice (Lönnqvist & Pirttimäki, 2006). Carver & Ritacco (2006) conclude that the users of existing BI technologies and tools often emphasise that non-measurable benefits are worth more than measurable benefits. BI can be considered an essential component of a successful business in the current knowledge-based economy arena (Alnoukari, 2009). Changes in corporate-positioning or strategy can be implemented quickly for better and faster decision making. The business user's role is strengthened by reliance on effective information delivered via BI solutions. Whether acting upon a report as an end-user, or performing analytics as a business analyst or employee in management accounting, the BI end-user role provides flexibility for information delivery (Volitich, 2008).

The strategy development process is the essential top level activity where enhanced knowledge management can have a major strategic impact. This process can be divided into four sequential but overlapping steps: information analysis, strategy development, strategy implementation and strategy review (Fueglistaller *et al*., 2005). By impacting upon this process, BI applications can make a major contribution to providing competitive advantage. For example, the incorporation of external data into BI applications and the DWH allows organizations to ascertain market reactions to competitors' sales campaigns. Health insurance companies may also develop and access critical information through BI tools deployment, in order to meet customer requirements in an increasingly complex world of processes and structures within the public healthcare sector. With this technology and business context as a backdrop, this article addresses three research questions (RQs), with specific reference to the AKH health insurance company:

- **RQ1:** How can BI technologies and tools be classified within an appropriate conceptual framework that encompasses the wider information management provision process?
- **RQ2:** How can BI technologies and tools be effectively used and integrated within the strategy development process?
- **RQ3:** What are the key elements of BI tools and technologies that are needed to support the knowledge management process?

RESEARCH METHODOLOGY

This research employs a case study method applied to one large case – the AKH health insurance company. Eisenhardt (1989, p. 534) defined a case study as "a research strategy that focuses on understanding the dynamics present within single settings." The case study can focus on a single case or a single organization (Easterby-Smith *et al*., 2008).

The research questions were used to generate sets of sub-questions for one-to-one interviews with twelve AKH employees, most of which are BI tools users. For RQ1, 18 sub-questions were generated, there being 8 more for RQ2 and a further 11 for RQ3. An interpretivist paradigm was adopted to attempt to understand what is happening in the company, developing ideas and theory through induction from this interview data. Relevant concepts derived from existing literature were also incorporated into the analysis of findings. As Gray (2009) states, pre-existing theories or ideas are beneficial when approaching a problem. A qualitative methodology was chosen to explore and understand participant perspectives as shaped through their experiences and respective business roles and views (Creswell, 2009).

The case study is based on two sources of evidence: the direct observation of the events being studied, and the interviews of the persons involved in the events. The strength of a case study such as AKH is that it allows a large variety of evidence to be reviewed, such as documents, interview material, and observations that would not be available in a conventional historical study. Concerning the selection of the AKH interviewees, nine employee types were identified as being of primary interest with regard to answering the research questions. Appropriate employees were selected being either BI end-users or having access to certain BI outputs or solutions, such as reports or analysis platforms. Structured in-depth interviews were conducted with twelve employees between July and November 2013 in the company's Hanover offices. Interviews were audio-recorded, and these files were transcribed after each interview. Interviewees included the authorized agent of the CEO, marketing director, BI consultant, management accounting employees, director of management accounting, performance analysts, director of management accounting for health care, director of health care management, and the director of physical therapy.

The evidence from the one-to-one interviews was analysed in two phases as recommended by Miles and Huberman (1994). First, the replies to each of the 37 sub-questions were summarised and some specific, distinct responses were identified. Then these responses were organised and oriented around the main research questions and synthesised in a table that summarized the findings for each research question. This allowed the identification of key statements and attitudes regarding current BI applications and their deployment. The drivers of successful BI deployment in different business contexts were classified into different categories, allowing an initial positioning of interview material against each research question. This process was repeated several times, expanding and refining the interview material relevant to each RQ as the conceptual framework for analysis was developed and confirmed.

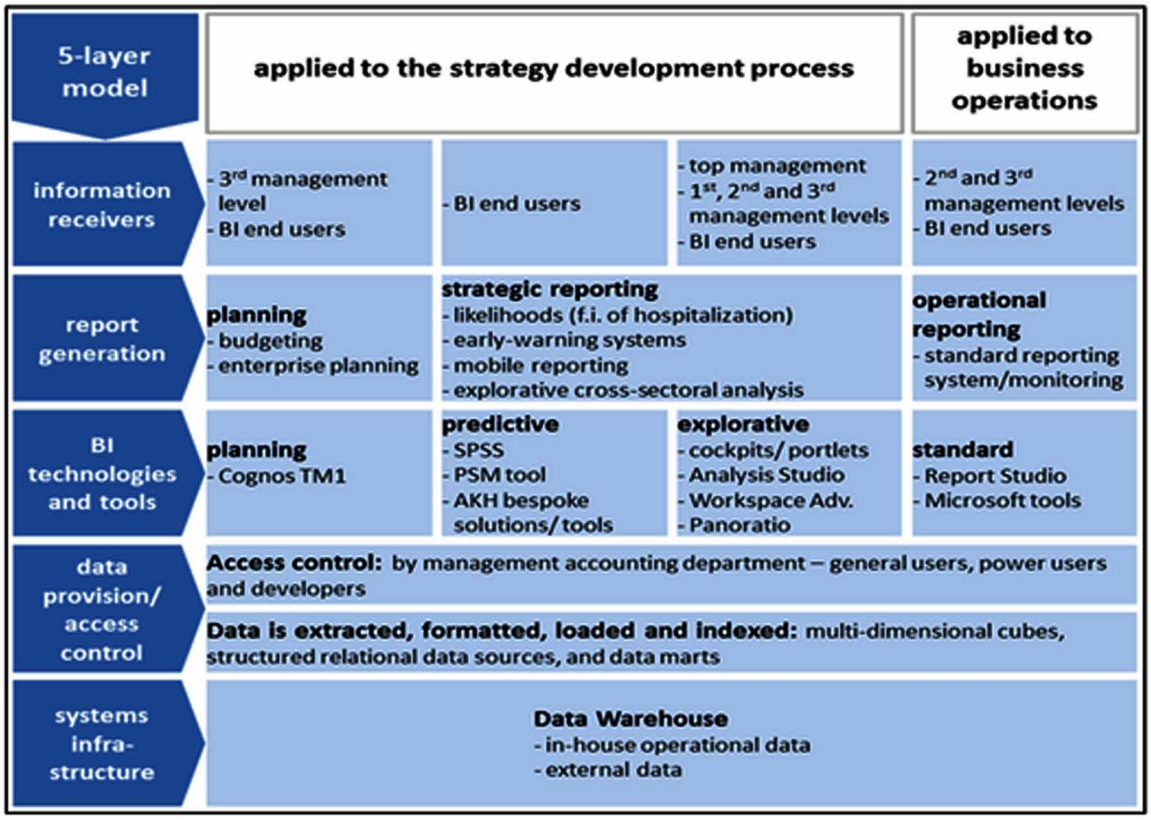
FINDINGS AND ANALYSIS

The case study findings are based on in-house observation and material from the twelve in-depth interviews with AKH staff noted above. The deployment of different BI technologies and tools in AKH is classified within an appropriate conceptual framework that helps us understand their role in the strategy development process, and also supports the identification of key features and functions that may further knowledge management within the organization.

The conceptual framework attempts to provide a mechanism for the classification and integration of BI technologies and tools at AKH (RQ1). Certain elements have been taken from the existing literature and have been further developed. This framework comprises five distinct layers: infrastructure, data provision/access control, BI tools deployment, reporting, and information receivers (Figure 2).

Infrastructure is the lowest layer in this framework. To develop qualitative reports and analyses, a consistent database has to be in place, and this is provided by the DWH. The interviewees stressed the importance of a common structure and definition for data drawn from different sources - internal operational systems and external scientific data bases, such as official health statistics of memberships or financial data for healthcare industry benchmarking. This data is organized in the DWH in aggregated forms for multidimensional cube access, as well as in relational forms to provide in-depth views and detailed in-

Figure 2. Conceptual framework for the classification of BI tools and technologies



formation presentations. The harmonization of data from different data sources is a major requirement for developing consistent reports and analyses. In the past, this was accomplished only with significant manual intervention by management accounting employees. BI end-users can now access centralized common master data structures and dimensions. Ratios can be used that are commonly defined so that reports in different areas of the organization can be compared and cross-referenced. Management accountants, as well as a wider cross-section of end-users, are able to access appropriately structured data.

The *data provision/access control* layer is integrally linked to the access control function of the company's management accounting department, working in liaison with the corporate IT support function. All data on the DWH is potentially available to all end-users, and management accounting controls tools availability and access for BI end-users, who can access analysis platforms to develop individual reports. In addition, some BI end-users receive print reports from management accounting employees.

Regarding the *BI technologies and tools* layer, interview statements suggest a classification according to their purpose or role – *planning, predictive, explorative* or *standard/general*. These tools can collectively be referred to as "analytics", and some can be used for more than one of these purposes. For instance, Cognos BI products, which were mentioned most frequently by interviewees, deliver analytics that all BI end-users can use to answer key business questions, and they can be viewed as both explorative and standard tools. Users can also develop individual analyses for specific cases. In order to enhance these analytics, management accounting employees are often required to support BI end-users in finding appropriate answers to specific business questions. Some more detailed examples of these four main BI roles are given below.

Planning

Cognos TM1, a major BI tool from IBM, is used for planning and forecasting for all "activity fields" in which AKH operates. (An "activity field" denotes a business area in which AKH is commercially involved). The entire planning cycle and its sub-phases are supported by this software. Key variables relating to price, customer age structures and other demographics are used to calculate forecasts and spending plans for each activity field. Multi-dimensional cube based planning can also be developed and deployed within this product.

Predictive

The propensity score matching (PSM) BI system was developed in-house by AKH to compare and evaluate different customer cost groups. It is designed to identify and calculate likelihoods of hospitalization or cancellations for patients, and is based on past diagnoses and ambulant or stationary benefits. SPSS, another BI product from IBM, is used in conjunction with the PSM tool to analyze specific data abnormalities, and to make predictions. Another area in which AKH is using this technology is for artificial intelligence for purposes of future hospital accounting. A predictive model is being used to determine the likely interaction between future hospital services automation and operational requirements. The model is in the early stages of development, and has still to be fully tested and evaluated from both informational and technical perspectives. Such applications require big data and complex predictive analytics. This in turn will likely need amendments to corporate data strategy, and commitment from senior management to a plan for executing the insights that are gained.

Explorative

Explorative BI tools are evident in a number of forms in AKH, and this is the most widely used BI purpose in the company. These tools can be seen on screen as a "portlet", a "cockpit", or the "corporate dashboard", depending on which tool is used, and what job role the end-user has. All levels of business management have the opportunity to use these tools to apply corporate ratios and trends to explore individual regional developments. These tools enable BI users to generate data and develop reports individually, and to get preferred analyses for their areas of responsibility. Cockpits are helpful in combining graphic displays with relevant corporate trends in comprehensive summaries of specific data and information. From a knowledge management perspective, these are very powerful, allowing all data, functions, developments, trends, and navigation opportunities to be integrated into one cockpit.

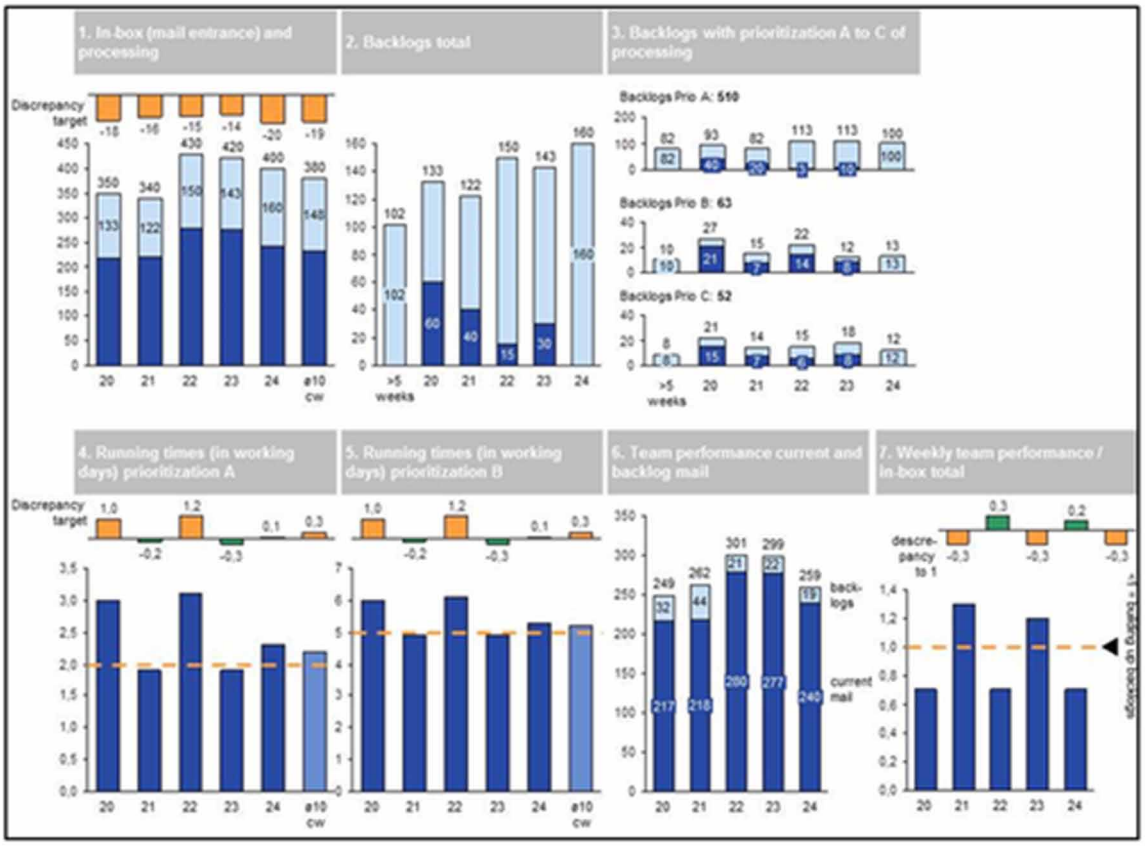
To maximise benefits for end-users, cockpits and dashboards have to be carefully designed and tested. Both the design and contents have to be critically checked and evaluated by professional leaders and employees in the respective area for which the dashboards are intended. Dashboards have the primary goal of enabling quick and direct information access; they are user-friendly and graphic oriented applications, providing insights into abnormalities. These abnormalities are usually evident visually on screen via graphic display, and allow relevant questioning from business managers, providing further information from the underlying data. For each area relevant drivers have to be identified with key ratios to measure them. For instance, efficiency in a business area could be measured by ratios of productive and non-productive mail or case progression. The aim and content of a dashboard revolves around "telling a story" in the respective business area. The type of questions that such dashboards can address include the following:

1. How much work is generated directly from customers or other business areas and how efficiently is it processed?
2. What work backlogs do we have in our business area and when did they appear?
3. Are these backlogs growing or reducing, do they concern mail processing, case progression or other work, and what is the trend of progress within my team?

Figure 3 illustrates how a dashboard may be used to respond to such questions, typically for regional business managers or directors.

Cognos Analysis Studio is an example of a specific explorative tool in evidence within AKH. End-users find it generally easy-to-use, allowing reasonably complex queries. AKH analysts use this tool for multi-dimensional analysis and the exploration of large data sources. An interactive drag-and-drop function is often used for exploring and analyzing data and making data comparisons such as actual versus budgeted results. In addition, Panoratio provide a range of BI tools that also allow analysis of multi-dimensional data sources, such as those contained in an OLAP cube. These products are viewed as being of strategic value for AKH, in particular for healthcare analytics. They can provide a platform for rough and ready, "first-cut", analysis of business opportunities, using multi-dimensional cubes and aggregated data structures. In this context, Panoratio tools are used for business analytics by a wide range of end-users to experiment with data and develop individual scenarios and data portfolios.

Figure 3. A dashboard layout to answer relevant questions regarding mail processing and team performance



Standard

Cognos Report Studio is used for operational reporting, which is generally short-term-oriented and highly detailed. Clearly structured reports with relevant ratios are needed to serve different but related perspectives – for example, quality, cost-efficiency, and customer satisfaction. Reports are generally kept as simple as possible, and are easily managed and customised by end-users. This standard reporting and data monitoring function serves as the main information source for management and analysts in the business divisions, to view past activity on a short-term basis, based on previously defined relevant ratios and trend views.

Standard reports can also build upon and incorporate data from explorative dashboards such as those discussed in the above sub-section. For example, the explorative dashboard application may enable the regional business manager to see team performance information at employee level. This may lead him/her to ask questions regarding the nature of employees' tasks, whether further training or qualifications are necessary or which employees can function as best practice examples for other team members? Some of this data and information can be incorporated into standard reports developed in Cognos Report Studio.

The *report generation* layer concerns the output material - the business intelligence itself - generated by these tools. AKH is striving to provide top management with a panoramic view of information in an

integrated reporting system. This includes external distribution, market and medical data from hospitals and doctors, which is summarized and cross-referenced. An example of advanced reporting capability which is more generally available in AKH is provided by Cognos Workspace Advanced, which is mainly used for explorative analytics. It allows basic developers, predominantly management accounting employees, to create reports and analyze different data sources in one interface. The product is designed to allow querying and analyses from a single interface, and it interacts with other Cognos products. It is used in business meetings to display structured overviews and trends, and can be manipulated to show further analysis and visual representations of information that aid decision processes in these meetings.

Mobile reporting from BI tools is a significant development being pursued at AKH. For certain tablet computers, mobile reports can be made available from the Cognos AKH systems. The company has developed tablet reporting solutions in the form of dashboards for the CEO, somewhat akin to the old concept of "executive information systems". From his tablet, the CEO can request detailed analytical reports and receive them more or less immediately, in real time. He can then customize the analytical views depending on what he needs to see, by swiping on the tablet. Improvements are being made in information availability, speedier report development, and optimal hardware utilization. It is expected that these developments in mobile BI, being piloted with the CEO, will be rolled out to support AKH's distribution and marketing functions. These mobile apps could be used, for example, to allow field based staff to enter doctor information that can then be transferred directly to the operational system for further analysis. So BI apps will be used for reporting, but also for field based data gathering and data entry.

The top layer in this model concerns the main users of this business intelligence information – the *information receivers*. This model refers to top management, operating at Board level, and then three further levels of management in the company, the first level being the most senior answering to Board directors. Planning reports and associated BI macros and applications are used by BI end- users and the third level of management. Strategic reporting is conducted by BI end-users, employing predictive analytics. It is likely that all levels of management will require increasing support from explorative analytics BI in future. BI outputs relating to business operations tend to be used by the second and third levels of management, as well as BI end-users (Figure 2).

We can now consider how BI tools and technologies can best be deployed and integrated within the strategy development process (RQ2). Based on the four phases of this process identified by Fueglistaller *et al.* (2005), interview analysis and internal documentation suggest objectives, BI activities and BI tools deployment for each phase (Figure 4). These tools are discussed in the context of their use at AKH, but others could be used in different business technology contexts. Some examples can be given to illustrate the overall picture given in Figure 4. In the *information analysis* phase, for example, SPSS serves as a predictive analysis tool for the calculation of probabilities and their relevant weightings. This encompasses possible customer cancellations and hospitalization rates. Such predictive data also aids the development of the appropriate strategy for relevant customers and thus optimizes AKH's business portfolio.

Central to the *strategy/concept development* phase, is the search for new activity fields and possible strategic direction changes. The definition of new project objectives, and any related process implications, is clarified at this stage. This is done with the help of explorative information searches, prediction models, and scenario generators. Panoratio is used to develop different scenarios for intervention. Concept development is supported by data analysis, using a number of BI tools, including Panoratio, SPSS and scenario generators.

In the *strategy implementation* phase, standardized monitoring from BI tools is used to show relevant ratios and cross-organisational implications for staff centrally involved in strategy development

Figure 4. Deployment of BI technologies and tools within the strategy development process (Phase -> Objectives->BI activity->BI tools deployed)

and implementation. Business strategy implementation is supported by reporting and monitoring that includes the relevant ratios to minimize uncertainties and support strategy evaluation. For standardized monitoring, Cognos Report Studio is used to provide access to all data packages – markets and customers, hospitals, doctors, pharmaceuticals and a number of related statistical ratios – and to prepare and present them appropriately. For more in-depth analyses, including countermeasure and adverse event impacts, explorative tools such as Cognos Analysis Studio and associated dashboards are used. The *strategy review* phase encompasses a number of periodical reviews which act as an early warning of any adverse results and analyses the potential impacts of appropriate countermeasures. Statistical evaluation BI tools, such as the PSM tool and Panoratio with its integrated statistical package, provide relevant ratios for achieving strategic objectives and milestones. In this way, the results of the strategy evaluation and review are communicated to the responsible divisions, for instance, health care management. A holistic evaluation of a healthcare project linked to overall strategy, for instance, will measures results to date against the defined financial objectives.

The role of these tools within the strategy development and implementation process can be illustrated in the context of the implementation of healthcare projects, which are developed and enhanced by different product teams. Current healthcare projects concern the insurance costs of certain medical conditions: depression, schizophrenia, and cardiac disease. They focus on the generation of cost or quality advantages and the targeted enhancement of healthcare structures in Germany. The basic conditions that are required in order to implement healthcare structures or models of specialized departments, hospitals, or cross-sectoral regional budgets in Germany can be found in Social Law regulations. AKH has to act within this political and legal framework. BI reports with traffic light systems of warnings and escala-

tion mechanisms provide evidence of whether certain healthcare projects are successful or not. These mechanisms can be used as the basis for decisions to review or adjust initial strategy choices.

As regards the key elements of BI tools and technologies (RQ3), the interviews suggested a range of factors that might improve BI deployment for knowledge management. These factors can be divided into five components: *technology element, software product, ways of access, report characteristics*, and *BI end- user communication.*

Technology

Interview feedback highlighted the need for BI technologies to be efficient, user-friendly, and custom- fit to the market and specific business division needs. Aggregated data structures for performance analyses (such as Panoratio databases and subject specific data marts) play a crucial role in certain business areas. For further in-depth data analyses, relational data technologies have to be available primarily for management accounting employees and certain BI end-users.

Software Products

The Cognos BI software is viewed as providing fast and efficient functions with planning, standard and explorative tools, and mobile cockpits and dashboards. Data mining products can play a key role here; their objective is to extract knowledge from a data set or structure and their function involves data base and data management, model and inference building, visualization and online updating. AKH provides data mining solutions to find correlations in different activity fields such as the likelihood of the withdrawal of target customers or identifying excellence in care provision. The key employees are trained in statistics and in data sciences. Data mining can be exploited using SPSS in combination with social media analytical platforms. This is a new area of knowledge management that will use social media data in conjunction with BI tools to analyze social behavior characteristics and the needs and attitudes of customers. This should be conducted with due consideration of privacy protection.

Access

There are many ways to access reports or analysis templates. The delivery can be an active transmission with management accounting support. For instance, a management report may be delivered via email in pdf format by management accounting employees. However, there are other options for standard reporting handling and provision. The management of AKH is now using a self-provision function available via a Cognos portal, where reports are available in fixed pdf format. The Cognos Event Studio can also be automated to schedule report delivery immediately following weekly data synchronisation. Self-provision via a self-service portal with provision for end-user pick-up is becoming increasingly important as a means of access in AKH. Some employees have mobile access to pre-prepared reports and corporate ratios via tablets. An “Event Studio” is also in use in the management accounting division for receiving reports after the weekly or monthly data synchronisation process. This automatic data provision process will be expanded in the future to free up resources for more focused strategic BI tasks. It is intended to roll-out the self-service portal to all divisions, making a wide range of reports and analysis available to end-users.

Reports

Interview feedback highlighted the importance of standard reporting procedures, consistent definition and use of key ratios, and well communicated processes for report generation and access. The value of interactive graphics for report analysis was also emphasized. Statistical functions should be clearly defined to allow evaluations of, for example, specific health care projects. Reports should provide flexibility so that BI users and management can access multiple views, trends, or data.

The visualization of information and Big Data plays a crucial role in this context. This development is logical because it is difficult to get an overview of the amount of available data and to identify structures and correlations within it. Today, it is not possible to identify all relevant data patterns with automatic algorithms. The skills of employees are necessary for this process. Thus, it is important to focus on certain analysis activities and platforms. Graphic presentations afford the opportunity to visualize structures and trends, as opposed to simple tabulation. The visualization process can be structured in four steps: data integration, classification, sorting, and coloration. Visual BI with different visualization options will be an important area of development in AKH and in the wider BI world in the future.

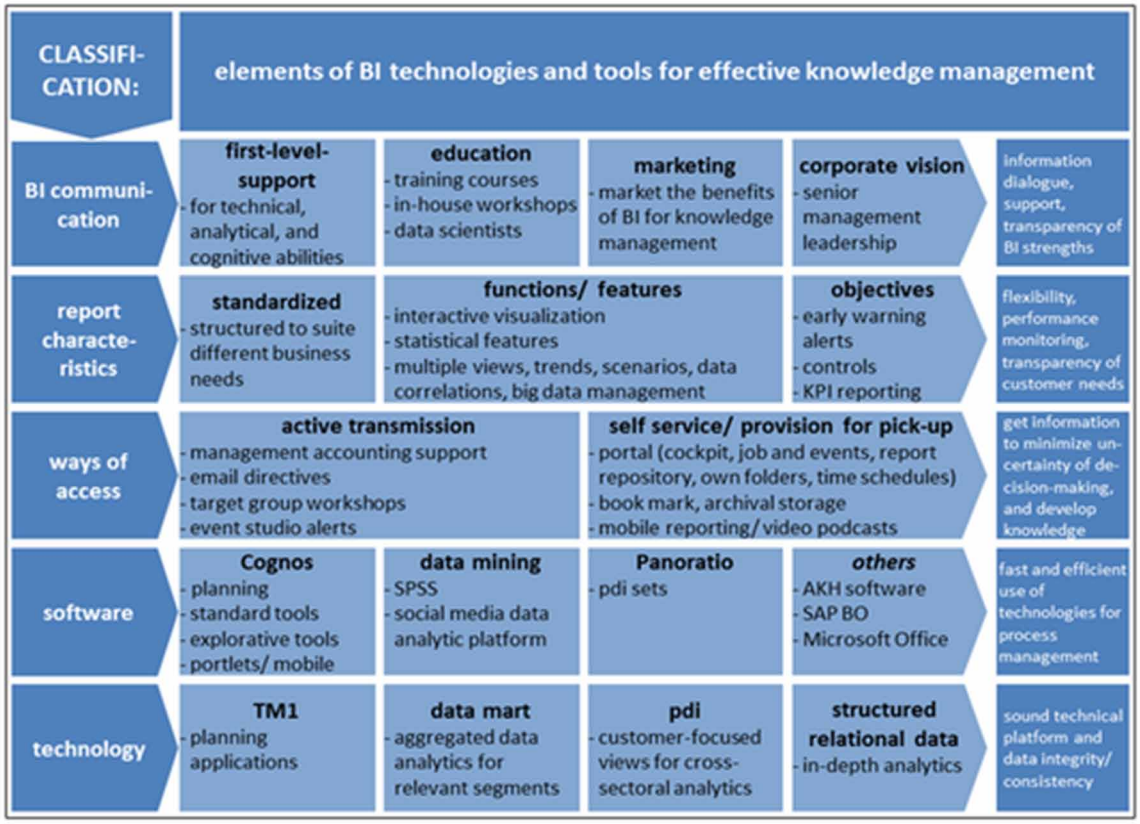
BI Communication

The effective in-house communication of BI developments is crucial and it is intended to strengthen this in AKH in the coming years. Interview feedback suggested that communication with BI end-users and BI customers within the company has to be more custom-fit on the basis of the corporate policies and individual needs. This communication needs to be aligned with first-level product support, the training and qualification advancement of BI end-users, and even cultural aspects such as corporate mission and vision aspirations. These guidelines and requirements for using BI for effective knowledge management are summarized in Figure 5.

CONCLUSION

The BI tools and technologies discussed in this article constitute examples of both MIS and CPM systems. The benefits provided to companies such as AKH are manifold. These systems encompass a variety of performance information that is relevant to different functions and roles within the organization, and they provide performance information on a regular basis and typically at shorter time intervals than purely financial information. This allows corrective action to be taken when under-performance occurs, before it is too late. In this context, BI systems are more than a mere sub-set of management information systems. They comprise not only a technology component and the information provision noted above, but also a number of related processes – planning, prediction and exploration, as well as standard reporting. There are also often procedures and guidelines for best practice deployment of these concepts and technologies. Plans should be developed in line with forecasts and should be reviewed on a regular basis, and corrective action taken whenever they are off-course. Reports may include key performance indicators or similar metrics, and both high and low performances should be addressed by exception with the overall process providing opportunities for learning by benchmarking. BI systems

Figure 5. Factors to engender BI technology deployment for knowledge management



should provide information that is consistent and comprehensive and culminate in concise performance reports that are made available to senior management and/or the Board. The provision of up to date performance information should facilitate performance reviews and discussions at all levels and enable effective action to be taken at the right time.

However, the research findings discussed in this paper come with certain qualifications. The methodological decision to rely in the main on in-depth interviews comes at the cost of limited representation as compared to quantitative surveys, for example. Further limitations arise from the national and cultural setting of the empirical research stage. The fact that the empirical study was conducted in Germany means that results are potentially biased by the local culture or regional traditions. While goal-oriented activities are executed in a specific way in the AKH region in the north of Lower-Saxony, these objectives may be pursued in significantly different manner, even in nearby regions that can vary greatly with regard to culture or even religion.

Through the extensive transcripts, English translations, coding and use of interview materials, and internal inquiries, the results of the case study have been reviewed and confirmed from different positions within the company. To allow wider generalisations to be made, the emergent models need to be applied and cross-checked in other organizational contexts. For other companies like AKH, there is the opportunity to become a totally networked and intelligent company exploiting the benefits of an appropriate set of BI tools and technologies. The conceptual framework shown in Figure 2 can be used as a

checklist to plan and monitor in-company BI deployment. Is there a technically sound and appropriately structured database underpinning BI operations? Is someone or some department playing the role of DWH manager to effectively control access to BI tools and data? Are you exploiting the full range of tools and technologies available? Whilst the *planning* and *standard* tools are reasonably well known and used, the *predictive* and *explorative* tools are less so, and this is where AKH has attained significant business benefit, as evidenced in the use of BI in the strategy development and implementation process. In a wider context, business processes have been enhanced through end-users creatively exploiting these tools to achieve their own goals aligned to corporate strategy. As regards report generation and the information receivers, are different levels of management getting what they need from BI? There may be a wealth of data available, but this needs to be effectively managed and made available in the right formats, using the appropriate tools. The enhanced analytical abilities of employees using BI tools and technologies should improve decision-making at all levels to engender process improvement and attain competitive edge.

To this end, Figure 5 can be used as a template that can be customized to individual organizational needs and circumstances. Whilst Figure 2 depicts *what* is required for effective BI deployment, Figure 5 illustrates *how* BI can be used. This is, however, specific to the AKH organizational context, and provides but one case example. Other authors have attempted to summarise and classify these factors. Gonzales (2011) identifies four main requirements for the successful deployment of BI tools for effective knowledge management - leadership, value, skill and infrastructure. In particular, steadfast and consistent leadership can play a key role in the sustainability of BI and its impact within an organisation. This resonates with the assertion of Woodside (2011, p. 557) that "BI is not a single product, application, program, user, area, or system, but rather an architecture of integrated systems that provides users with easy access to, and storage of, information for decision-making and learning." It highlights the significance for organizations of bridging the gap between theoretical knowledge and its practical application for decision support (Guarda *et al*., 2013).

BI products and their benefits for the organisation have to be marketed in-house to the professional business divisions. This may encompass a range of functions, processes and disciplines: new product development and innovation, for example, are becoming increasingly important to many organizations as they focus on new ideas capture, screening and prioritization to drive future growth, and BI tools can play a key role in these initiatives. Risk management is also now becoming an issue of strategic importance as increased regulation and the need for continuous improvement has brought renewed focus on strategic, process and programme risk management. Corporate governance is closely linked to risk management. There is now a significant amount of visibility and focus on the senior management team, who need to manage the business in a way that is both highly effective and compliant with regulations. This creates a need for information visibility and process control underpinned by sound knowledge management systems, of which BI tools are a key component. The ability to present the right information to the right people at the right time using well-constructed dashboards and analytical platforms is an important element of BI delivery. A single version of the "truth", delivered on a well- integrated and secure BI technical platform through transparent data management, is a key element of successful BI deployment. BI integrates information utilities and a decision support system that can help organizations to manage, develop, and communicate their intangible assets embedded in corporate information and knowledge.

Davydov (2001) has noted that the key to providing management information "is to integrate the whole set of enterprise wide applications into a single integrated information network". This is valid enough as an objective of corporate systems strategy, but the means by which it is achieved does not need to involve widespread systems replacement. For many companies, this level of investment is unrealistic; instead,

a pragmatic approach - that maximizes the value of investments already made - is likely to find more support from senior management and the Board. As Sweet (2003) noted, "organisations are starting to look at additional technologies and methodologies, which could provide better insights. These include business intelligence (BI) solutions, data warehousing, and a variety of management techniques, some of which are directly supported by specialist applications". The BI strategy adopted at AKH is a good example of this approach.

More specifically, this research has focused on professional practice development, which was established using a mixture of theoretical and practical frameworks. Theory must be supplemented with daily business practice at AKH. The first steps have been taken, but an increase in BI end-users would further engender an IT-driven self-service with BI technologies and tools at their core. Together, top management and BI end-users can generate new strategic capabilities as the findings and analyses of the research questions showed. If awareness and creativity can be raised by using BI technologies and tools, then BI solutions will generate fast, simple, and diverse advantages for AKH. In the different business divisions, a broad portfolio of BI applications and analysis tools is supporting and enriching the way opportunities are identified, and how key strategic and operational decisions are made and implemented in a better informed, appropriately qualified, and more transparent manner.

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