Business Intelligence in Healthcare Organisations

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Abstract

Business Intelligence (BI) has been adopted in large enterprises but there is a lack of in-depth research on using BI in healthcare organisations, and nowadays they are becoming an important beneficiary of BI systems. The need for a more systematic and deliberate study on BI and the factors that allow for success in BI initiatives in healthcare organizations is crucial. Therefore, this study attempts to identify the possibilities of using BI systems in healthcare sector and the benefits as well as the challenges occurred due to BI systems implementation. Benefits achieved when health care organisations using BI systems are consolidation and protection of data, efficiency improvement, increase revenues and reduce costs, reduction of medical errors and improved patients safety, resource planning and scheduling, improved transparency, decision making, margins, monitoring, patient satisfaction, patient treatment and care. The healthcare sector has many limitations related to the implementation of BI namely challenges to handle information systems, quality and data standards, selection of information and identifying key areas requiring support and IT infrastructure and technologies.

Keywords: Business Intelligence, healthcare organisation, Hospital Information System.

Chapter 1- Introduction

BI and the many analytics systems that support demand management, predictive analytics, revenue modelling and role-based intelligence within organisations are critical for any organisation to survive in today’s incredibly turbulent marketplace. It is being used to mitigate risk and increase certainty and BI systems proved to be an essential component of modern company information infrastructure which ultimately it contributes to its success and competitiveness. The use of BI refers to certain skills, technologies, practices, and processes that are employed as part of supporting decision making in an organisation. The applications of BI technology have historical, contemporary and even predictive view points of the business undertakings of an organisation. This technology contains certain unique functions that are intrinsic to the particular systems. Thus, the adoption of BI systems is aimed at the support of better quality decision making within an organisation.

BI has been used in many sectors, but recently it gained interest in health sector as this sector is one of the most developing sectors of the contemporary economy. BI systems proved helpful to managers of healthcare organisations who need to find out solutions that would allow them to improve decision-making, business processes, communication between doctors, patients and the administration, as well as effective access to different data. Therefore, this paper reviews BI models and outline how BI is used to support the decision-making process in organisations in the healthcare sector.

The main purpose of this paper is to show how organisations can increase their performance as well as profits when BI systems are deployed properly and how BI systems can be used in health sector. This paper will highlight on BI models and the use of BI in the health sector. Therefore, the main objective of our study is to identify the BI models and identify possibilities of using BI systems in health sectors. The paper is structured as follows: Section 2 overviews the literature on BI; defines BI, talks about the BI architecture, emphasises on BI benefits and determinants of success with BI systems while Section 3 stresses on BI in healthcare sector. Section 4 talks about BI benefits in healthcare sector. The challenges of HBI are details in section 5 and finally section 6 concludes the paper.
Chapter 2- Literature review

2.1 Definition of BI / Essence of Business Intelligence

In literature, the original BI evolved from Decision Support Systems (DSS) which is a computer based support system for management decisions makers (Watson, 2009). DSS belongs to independent systems within an organisation and had a shaky relationship with other systems (Rouhani et al., 2012). According to Google Ngram Viewer (2011), the term ‘business intelligence’ has been in use since 1800, but Hans Peter Luhn, an IBM researcher, used BI in a scientific context in 1958 where he described an “automatic method to provide current awareness services to scientists and engineers” who needed help to cope with the growth of scientific and technical literature. However, the concept of BI became widely in used during 1990s. With the development of decision support applications, a term BI is introduced by Howard Dresner in 1989 which is based on DSS and its related techniques (Rud, 2009). Compared with DSS, BI creates comprehensive decision- support environment for management (Lonnqvist and Pirttimaki, 2006). The definitions of BI range from one-dimensional definitions, where BI is viewed as a set of technologies or as a process, to multidimensional definitions where Davenport (2006) defines BI encompasses a wide array of processes and software to collect, analyse, and disseminate data, all in the interest of better decision-making.

BI, however, is comprised of both technical and organisational elements (Watson et al., 2006). In the most general sense, BI presents historical information to its users for analysis to enable effective decision making and for management support (Eckerson, 2003). But, one of the classic BI definition categories is proposed by Ghanzanfari et al. (2011) who classify BI definitions into three approaches- managerial approach, technical approach and an approach which referred BI as an enabler of enterprise systems. Managerial approach define BI as a process in which data collection from internal and external the enterprise, then integrated for generating information related to the decision making process, while technical approach is the way of using BI as a collection of tools that supports the strategic decision-making process, which focuses on the technologies, algorithms and tools relevant to the analysis of data and information instead of strategic decision- making process (Petrini and Pozzebon, 2008), and the enabling approach concentrates on value- added capabilities in support of information (Rouhani et al, 2012), while adopting value added features and functionalities in enterprise systems, the organisations will have a better decision support environment.BI plays a critical role in this transformation, through the development of methods, systems and tools that have enabled the collection, storage and analysis of this vast quantity of data recognised as BI systems and applications (Kalakota and Robinson 1999; Liautaud and Hammond 2002; Rasmussen et al. 2002). It is a process of gathering, storing, and analysing data through the use of different technologies and applications, which is relevant for decision-making. Thereby BI process models are referred to a symbolic tool to demonstrate how a BI system enables business information management. Below are the models of BI.

2.2 BI Architecture

1. Novintel’s BI process model (Viva business Intelligence Inc, 1998)

Novintel Inc, one of BI vendors with whose former name is Viva Business Intelligence Inc, came up a BI cycle process model. The whole process can be divided into eight phases as shown in Figure 1.
As shown above, Novintel’s model begins with need analysis phase. This model highlights utilisation and feedback phase, without this phase, users cannot utilise information in an efficient way and become lack of understanding of their cover external and internal organisational environment.

2. Thomas Group’s BI process model (Thomas Jr, 2001)
Another famous BI process model is proposed by Thomas Jr (2001), who developed a cycle BI process model which indicates six phases namely planning and direction, data collection, information processing and storage, analysis and production, dissemination and intelligence users and decision makers, as shown in Figure 2.
Figure 2: Thomas Group’s BI cycle

Figure 2 depicts Thomas Group’s BI process model which is a cyclical process where sources of data play a critical role. Planning is the first phase of BI process, this clearly identify the decision-maker needs, while the second phase is the data collection stage; this is done through both the organisation’s internal sources or external or both sources, in terms of primary or secondary data (Pirttimaki, 2007). The information processing and storage phase, basically involve, gathering data and according to Watson and Wixom (2007) “it is the most challenging aspect of BI”. In the analysis and production phase, data are carefully analysed by employing analytic tools and methods with the ultimate aim to interpret, explain and make sense of discovered phenomena’s, which will enable the individual to make strategic decisions. The dissemination phase enables the valuable intelligence produced to be made available, with tools and in a form (reports, intranet, internal databases, newsletter or portal). Finally, the whole process ends only successfully with all preceding phases functioning up and right to enable decision-makers to fully access the system to address their respective needs adequately. The cycle starts or continue again as the need arise. Thus, BI is a systematic process which collects analyses and organises the flow of critical information by focusing on important strategic and operational issues.

3. Choo’s (2002) BI process model

This model describes information management processes as a continuous information management cycle. Hannula and Pirttimaki (2003) treat this model as the basis for all the business intelligence processes. This process model provides a practical way for BI to deal with managing information and knowledge efficiently therefore make better decisions. Figure below shows the Choo’s BI process model.
The Choo’s model focuses on the practical problems, as it takes into account the gathered information and produced knowledge have to be applied to practical problems to make decisions efficiently. It helps an organisation to improve its competitive advantage through monitoring the business environment, avoid surprises, and proactively seek out opportunities. Figure 4 depicts the related concepts of BI.

As shown in above figure Competitor intelligence (CpI) is narrow in terms of scope of information gathering (Choo, 2002) and mainly at the product level (Freeman, 1999). Competitive intelligence (CI), however, is in the middle, focusing mainly on the competitive environments. BI’s scope of information gathering spans from the micro to the macro environment (Cavalcanti, 2005). CpI activities which centres on tactical operations of an organisation has a shorter-term planning orientation as to the long-term planning dimension of BI, whose activities have strategic benefits.

4. Microsoft’s BI process model (Vitt et al, 2002)
Microsoft is a well-known software vendor and has presented its own model for a BI process in 2001, by just simplifying the BI process cycle into four phases namely insight, action, measurement and analysis, as shown in Figure 5 below.
From the above BI process model, Microsoft’s BI is simple and the processes are easy to understand. It covers a broad range of technologies, software platforms, specific applications, and processes.

According to Eckerson (2003) organisations will benefit more from the BI system if the users are able to move from the reporting stage to the analytical stage. Eckerson’s (2003) study confirms that the most frequently use consists of viewing paper and/or online reports together with creating reports from predefined criteria, where a report shows only predetermined variables. Moreover, the data retrieved from systems, applications and the data warehouse must somehow be translated to be useful in decision making and analytics, as shown in Figure 6.
From the above diagram, Eckerson (2003) illustrates BI as a ‘data refinery’. When the data have been extracted and loaded into the system, the user can analyse the data through certain analytical tools. The aim is to identify trends, patterns and exceptions and he argues that this analytical phase allows the user to turn information into knowledge. Eckerson (2003) argues that this behaviour becomes a cycle which repeats itself and makes the organisation into a learning organisation. When results constantly can be re-viewed and evaluated, the organisation will gain knowledge and insight of their own business. It also brings numerous intangible benefits, among which BI saves time, improves strategies and plans and improves tactical decisions more efficient. **Efraim et al (2008)**

In the year 2005, BI system started to include artificial intelligence and powerful analytical capabilities. The diagram below shows the interconnectivities of features that lead to BI.
Thus, it can be concluded that all above BI models is an on-going cycle, which means BI is more than a management philosophy or an enabling technology (Vitt et al., 2002). Further to this, BI process begins with the needs analysis, which is the critical phase in the whole process to run successfully when the requirements are accurately described with efficient information management. In addition, data analysis, collection and storage phases do not make big difference. However, the process models from Novintel’s and Thomas Group’s emphasise the dissemination of information. Thomas Jr (2001) interprets that when intelligence is valuable that information should be disseminated in a form which is advisable to be clear enough for organisational managers. They have the same structure which makes BI process keep going in a cycle way.

### 2.3 Benefits of BI

According to Thomas Jr. (2001), BI is both an offensive and defensive system as it provides a better understanding of the competitive environment and acts as a protection for intellectual property. Gibson et al. (2004) group benefits of BI into tangibles namely return on investment and cost savings and intangibles namely better information, better strategies, better tactics and decisions, and more efficient processes. They further argue that the intangibles benefit out-weighs the tangibles, since BI falls under IT, where its benefits cannot be clearly identified. BI influences the strategic activities largely and the success rate is very low when traditional evaluation techniques are applied to projects with strategic benefits (Irani and Love, 2001).
Productivity paradox, according to Gibson et al. (2004), investments in IT are yet to produce significant improvements in industrial productivity. Moreover, Parker and Benson (1988), finds that traditional methods like net present value and cost-benefits analysis have not succeeded at identifying and measuring the benefits of IT investments and techniques like: return of management (Strassmann, 1990); negotiation and imputation (Remenyi et al., 2000); information economics (Parker and Benson, 1988); investment feasibility framework (Willcocks, 2001) have been proposed by researchers. For Ritacco and Carver (2007), tools in BI enable possibilities for users to rapidly discover information to queries relating to their work. Timely answers to business questions, improve operational efficiency, eliminate report backlog and delays, negotiate better contracts with suppliers and customers, find root causes and take action, identify wasted resources and reduce inventory costs, leverage investment or DW, improve strategies with better marketing analysis, empower sales force, provide quick answers to user questions and challenge assumptions with factual information, are some of the benefits to be gained from BI implementation.

2.4 Key Determinants of Success with BI Systems

BI success is the positive value an organisation obtains from its BI investment (Wells, 2003). The organisations that have BI also have a competitive advantage, but how an organisation defines BI success depends on what benefits that organisation needs from its BI initiative (Miller, 2007). In order to attain strategic plans and to deliver competitive results from BI systems and processes, the isolated databases, data marts and data warehouses have to be combined. The area of DW is where many of the advances are being made in both legacy system and inter process integration.

Using the concepts of BI applications including data mining, manufacturers are able to better understand the key success factors in creating new products. A critical success factor of BI implementations is the ability to create a real-time analytics link between the demand management, channel management, production planning and production operations. Another critical success factor can be seen regarding BI implementations is the need for accurately capturing the sales forecast and sales operations data in real-time which will enables manufacturer to react accurately and quickly to consumer demand.

Porter, (1986) defines the value chain network as a strategic to compare the contributions at a cross-functional level of organisations, a key take-away emerges, and BI forces which inter process system and process integration. BI acts as an enabler of integration across the primary and secondary or tertiary activities throughout the value chain framework. Moreover, the common characteristics of
successful BI solutions are business sponsors who are highly committed and actively involved; business users and the BI technical team working together; BI being viewed as an enterprise resource and given enough funding to ensure long-term growth; static and interactive online views of data being provided to the users; an experienced BI team assisted by vendor and independent consultants; and, organisational culture reinforcing the BI solution (Eckerson, 2003, Howson, 2006). Furthermore, BI success can be measured by an increase in an organisation’s profits (Williams and Williams, 2007) or enhancement to competitive advantage (Herring, 1996).

Chapter 3- BI in Healthcare sector
Maria and Abdel-Badeeh (2010) point out that healthcare organisations are information-intensive enterprises, while healthcare personnel requires sufficient data and information management tools to make appropriate decisions. Clinicians assess patients’ status, plan patients’ care, administer appropriate treatments, and educate patients and families regarding clinical management of various conditions. Primary care physicians and care managers assess the health status of new members of a health plan. Medical directors evaluate the clinical outcomes, quality, and cost of health services provided. Administrators determine appropriate staffing levels, manage inventories of drugs and supplies, and negotiate payment contracts for services. Governing boards make decisions about investing in new business lines, partnering with other organisations, and eliminating underutilised services. Collectively, healthcare professionals comprise a heterogeneous group with diverse objectives and information requirements.

Further to this, HBI reduces operating cost namely cost of healthcare professionals, lab equipment & consumables, pharmaceuticals/ medical material, treatment per diagnosis related to groupings, medical intervention while maintaining a consistently acceptable level of patient treatment in terms of reducing risks during treatment, give evidence based medicine, accurate diagnosis and efficient treatment, on time admittance in hospitals and healthcare treatment, capture medical history of patient to support evidence based medicine. HBI systems can be used to improve decision-making. BI enables knowledge-based processes, data sharing, integration of disparate systems and real-time analytics, which enable faster decision-making, a critical capability for heart attack patients, among others. Health systems cannot improve quality significantly, support service standards, reduce costs and develop a competitive strategy across numerous organisational fronts, large, geographically dispersed.

Moreover, competitive pressures have increased enormously over the last decades in the healthcare industry (Beeknoo 2015). This forces healthcare providers to use Information Systems Technology in order to control costs, increase efficiency and to make strategic decisions (Kim & Michelman, 1990). Hamdan & Rogers (2008) found that investments in IT-resources contribute to an organisations’ performance and continuously confronted with changes in the environment where they are present. Further to this, Havinghurst (1986) and Reynolds (1986) identified a change from cost-based reimbursement to fixed fee payment structures. This forced healthcare providers to put more emphasis than ever on the efficiency of the patient or client care delivery process. In short, there are three priorities on which healthcare providers need to focus; firstly they need to focus on the insight in care-quality and the possibility of measuring the quality of the offered care. Second, increase the participation of clients in the care decision making process. And third, increase the safety of provided care.

Hence, HBI can enable data integration, application of sophisticated analytics and delivery of information to the right stakeholders. Most healthcare organisations perform some form of data integration. However, ad hoc approaches do not provide the scale and flexibility to perform analytics. Relevant data sources tend to be dispersed across hospitals, so an enterprise-oriented approach to data integration is needed. In addition, advanced analytics can lead to increased stakeholder value and healthcare providers can shift their focus to the manner in which they are deployed and produced with data gathered from various sources and advanced analytics. It is critical to evaluate each stakeholder’s
needs to deliver relevant information or reports. Thus, BI in health care institutions proves to be fruitful. According to Yorozu et al. (1987) health care organisations typically prescribe how their processes have to be performed; especially those processes that represent complex routine work, that involve many persons and organisational units. In the context of BI, medical processes are those activities and work practices within a healthcare institution and focused on the health services delivery while business processes comprise activities that are needed to effectively run the healthcare organisation and support processes are used from both kinds of processes but only have an indirect impact on medical and business activities (supply of materials) as shown below.

Moreover, the recent HBI framework was developed by Mettler and Viimarlund (2009), where they found that BI helps in administrative management and clinical in the understanding of the capabilities available in the firm and facilitate decision making by integrating a variety of internal and external actors which result from a wide spectrum of processes, as shown in Figure 10. The HBI framework considers the internal and external processes, the actors and information as well as technology in use. Curtis et al. (1992) define processes as a group of partially coordinated and ordered tasks, while Davenport and Short (1990), define HBI processes as principal trigger for information, data collection, processing and distribution, thus, HBI processes are very important.

The differentiation in medical, business and support processes is logical aid. Medical processes can be defined as those activities and work practices within a healthcare organisation which primarily focussed on the healthservices delivery. Support processes are used from both kinds of processes but they have an indirect impact on medical and business activities. However, there are two important characteristics which constitute the nature of all types of processes namely processes which customers have and this may be either internal or external actors to the healthcare organisation, and processes cross organisational boundaries. Moreover, in the paper of Vassilacopoulos & Paraskevopoulou (1997), they prescribe how processes should be performed in health care organisations, especially those processes which represent has compound regular work.

Figure 9: Healthcare process in health care institutions
Source: Yorozu et al. (1987)
Figure 10 illustrates that processes have a key role in HBI. Furthermore, within the health care sector, Scott (2002) find that there is a long-standing exercise of including information and data beyond the usual boundaries of a single organisation for understanding the medical, business and support processes. In addition, both internal and external actors play an important role in HBI. The internal actors consist of the personnel of the health care organisation who make use of the personalised services and up to date information which are provided from the BI system while external actors group all stakeholders who have a strong influence on the health care organisation namely insurance companies, suppliers, governmental authorities and they sometimes have a limited access to the BI system. Thus, these actors provide optimal health services. But, Checkland (1999) find that these actors may cause problems when developing and using a BI system as diverse actors viewed the same information differently, but it is a crucial to involve as many actors as possible when designing or reappraising the BI system. The next important component of the HBI is information. According to Bode (1997), information stands for facts, concepts, or instructions in a formalised manner which enlightens proper communication, interpretation, or processing by humans or by automatic means. Furthermore, there are three different types of data sources in a health care organisation namely clinical data sources which include all kind of medical data (patient records, laboratory results needed for health service delivery to the patients), administrative data sources containing the entire business data (personnel data, financial data which is required for running the health care organisation) and finally, external data sources which can either be clinical or business data from an external provider in terms of statistical data, medical reports, insurance forms. Technology also plays a vital role in health sector as it is seen as enabler for analysing, giving access, storing, and visualising the great amount of data. Thus, a wide range of expert systems, OLAP and data mining tools are used in a BI system, and
technology proves to be the base for BI, as it provides an integrated analysis of both internal and external data.

**Chapter 4: BI Benefits in the Healthcare Industry**

BI tools make the healthcare industry’s shift to a technology driven and patient-centric system. The advantage of correlating technology and healthcare is the ability to manage various forms of data within user-friendly systems that help drive decision making. Thus, HBI is a technology-based approach. It increases the amount of data and regulation and reduces labour costs by eliminating expensive customised integration of computer system in healthcare organisations (Chee et al. 2009). HBI improves patient outcomes, reduces costs, brings efficiency and ensures the future of healthcare industry which will in turn helps in decision-making. Costs of healthcare professionals, lab equipment and consumables, pharmaceuticals/medical material, treatment per diagnosis related grouping and cost per type of medical intervention can be reduced (Panayotakis, 2012). In other words, HBI delivers transparency across organisation and information system boundaries by providing a clear view of data and quick access to disparate data. According to Jinpon et al, (2011), an effective healthcare practice relies on the availability of public health data sources and assessment tools which communicate information to investigators, practitioners, policy makers and the general public. Therefore, the population benefit from an improved health service.

HBI also provides high-quality data for decision maker; patient treatment is information-based which enables efficient staff scheduling, healthcare professionals have easy access to patient’s data and they can create a variety of classifications/reports based on their historical data, this will in turn helps doctors by applying efficient treatment with reduction of risks during treatment, therefore patients will accurately diagnose. Thus, HBI also helps in providing timely and effective clinical decisions. Users can access any type of information with a fast and consistent response time. It also consolidates and analyses clinical, administrative and financial data which in turns increases the efficiency in the data/work flow. Patient data are better protected.

BI is also use in the healthcare sector to focuses on revenue, expenses, utilisation, and quality but also uses BI information to influence the behaviour of physicians, patients, government, insurance companies, hospital administrators, pharmacies, to name a few. Moreover, Cucoranu et al. (2013) find that BI operations can be a challenge for any company but it adds layers of complexity such as privacy issues in healthcare organisations as it collects and analyses sensitive data about patients that is governed by privacy rules. Yi et al (2008) pointed out that in today's healthcare environment there is no shortage of data, as organisations are reeling in an ever deeper pool of data, and the challenge is how to convert the immense amount of available data to valuable information and knowledge.

Medical errors can be reduced. Improved decision making can be reached with monitoring the performance of doctors, departments and medical material requirements. Multiple groups or individuals can be put together by emphasizing the analysis and accuracy of data, which in turn will bring all actors in health care sector closer to the point of service in order to enhance decision-making. The consumption of drugs, medical supplies, and use of medical equipment, medical personnel and movement of patients can be better monitored through HBI. Furthermore, HBI helps to improve gross margins of healthcare organizations. Optimised utilisation of outpatient clinics and independent areas by coordinating handling with waiting lists and allocating beds

**Chapter 5: Challenges in the Healthcare Industry**

HBI which is technology-based approach also has to overcome some challenges, since there are still a range of factors that have prohibited new systems from transforming the healthcare industry. One of the major obstacles is the difficulty in implementing technology into current practice. The healthcare industry is very dependent on information. So far no technology has been developed to take data and convert them into information. Leonardi (2008) points out that the data themselves are little more than
useless. Only HBI technology has been able to focus on key indicators easily and quickly to provide valuable information for healthcare organisations. This information can be used in the daily work of medical facilities for clinical diagnoses, financial decisions, and the order of providing healthcare services and medicines and equipment management.

As for Takvorian (2007), some experts note that high initial costs for BI technology implementation deter providers, especially those in small group practices, from adopting new technologies. Even with the government mandate for healthcare providers to put EMR into action, by providing incentive programs and assistance with implementation, the broad adoption has been slow, as Takvorian (2007) finds it rare that they are using a fully operational system capable of collecting patient information, displaying test results, allowing providers to enter medical orders and prescriptions and helping doctors make treatment decisions. The technology based systems must be fully operational and incorporate all areas of patient health to manage population health successfully. Therefore, BI tools can be used for a deeper understanding of healthcare, but the healthcare sector has many limitations related to the implementation of this technology. The challenges on the use of HBI can be grouped as follows:

I. IT infrastructure and technologies:
   - Healthcare organisations need computerisation;
   - The infrastructure needs to be complete and integrated;
   - All the processes and medical units require infrastructure and technology support;
   - Problems with costs of infrastructure, his systems, bi system, infrastructure maintenance and also employee training.

II. Medical staff to handle the information systems:
   - The systems and applications are viewed as a black hole as there are too many projects with many complex systems with several sources for them to deal with; therefore, it is difficult for healthcare managers and health professionals to get a clear picture of the data in real time;
   - Reloading data systems makes it difficult for doctors to find time and focus on their main goal – patient care;

III. Quality and data standards:
   - A very large amount of data are collected but very often they are of poor quality data;
   - A large part of the data is still stored in paper form or scanned documents, rather than in the digital form, which makes data collection and sharing them in different geographic locations difficult;
   - The data come from various sources as currently there are few defined standards for data in the healthcare field, which makes it difficult to aggregate data, construct a data warehouse, load data into a rules-based engine in order to get access to actionable information and generate reports and ad-hoc analyses;
   - Relevant qualifications and classification of data are a key element condition for continuity of decision-making;

IV. Selection of information and identifying key areas requiring support:
   - Quality of healthcare is achieved by doing the right thing at the right time, in an appropriate manner and for the right person; so every day it is necessary to identify the key actions that health professionals have to perform, to determine the order, time and manner of their execution,
   - Identifying the data helps to understand and interpret them by physicians meeting the challenges of everyday life, because medical data are increasingly difficult to manage on a daily basis.
Chapter 6- Conclusion

To summarise, using BI systems in healthcare organisations many benefits can be achieved. HBI systems help to see the overall picture of the hospital and allow the detection of all kinds of irregularities, inefficiencies and reduce duplication of work. Data collected by organizations can be converted into useful knowledge due to the use of advanced data warehousing and analytics tools. Practice shows that the implementation of BI systems in hospitals brings measurable results, it reduces costs associated with changes in diagnoses and reduced the outflow of trained personnel, provides reliable and consistent information from all the areas of organisation activity, allow for efficient budgeting, the rapid assessment of the effectiveness of the organisation and the acquisition of information needed to make investment decisions and restructuring. Thus, the healthcare organisation can make more effective decisions based on the information collected; this improves patients’ outcomes and the quality of medical services. But the healthcare sector has many limitations related to the implementation of this technology in terms of quality and data standards, IT infrastructure and technologies, selection of information and identifying key areas requiring support and handling the information systems by medical staff. Shortage of IT personnel is another area of concern in the design and implementation of good HBI.

References


