Dissertation Title
"Requirement of a BI/DW Tool by a Healthcare Provider:
Essential or Not?"

A Dissertation Proposal for

Post Graduate Diploma in Health and Hospital Management
By

Shweta
Roll No. PG/10/049

International Institute of Health Management Research
New Delhi
Date

Requirement of a BI/DW Tool by a Healthcare Provider: Essential or Not?

**A dissertation submitted in partial fulfillment of the requirements
for the award of**

Post-Graduate Diploma in Health and Hospital Management
by

**Shweta
PG/10/049**

Under the guidance of

Dr. Vivek Sahi   Prof. Indrajit Bhattacharya
Principal Consultant   Professor HealthCare-IT
Dell Services, Noida   IIHMR, New Delhi

International Institute of Health Management Research
New Delhi -110075
May, 2012

Certificate of Internship Completion

Date:……………..

TO WHOM IT MAY CONCERN

This is to certify that Ms. Shweta has successfully completed his 3 months internship in our organization from December 19, 2011 to March 19, 2012. During this intern he has worked on Requirement of a BI/DW Tool by a Healthcare Provider:

Essential or Not? under the guidance of me and my team at Dell Services.

 (any positive/negative comment)

We wish him/her good luck for his/her future assignments

(Signature)

_____(Name)

_____Designation

ACKNOWLEDGEMENT

Certificate of Approval

The following dissertation titled "**Requirement of a BI/DW Tool by a Healthcare Provider: Essential or not?"** is hereby approved as a certified study in management carried out and presented in a manner satisfactory to warrant its acceptance as a prerequisite for the award of **Post- Graduate Diploma in Health and Hospital Management** for which it has been submitted. It is understood that by this approval the undersigned do not necessarily endorse or approve any statement made, opinion expressed or conclusion drawn therein but approve the dissertation only for the purpose it is submitted.

Dissertation Examination Committee for evaluation of dissertation

Name

Signature

_____ _____

_____ _____

_____ _____

Certificate from Dissertation Advisory Committee

This is to certify that **Ms. Shweta**, a graduate student of the **Post-Graduate Diploma in Health and Hospital Management**, has worked under our guidance and supervision. She is submitting this dissertation titled "**Requirement of a BI/DW Tool by a Healthcare Provider: Essential or Not?** " in partial fulfillment of the requirements for the award of the **Post- Graduate Diploma in Health and Hospital Management**.

This dissertation has the requisite standard and to the best of our knowledge no part of it has been reproduced from any other dissertation, monograph, report or book.

Prof. Indrajit Bhattacharya   Dr. Vivek Sahi

Professor – Healthcare IT   Principal Consultant

IIHMR   DELL Services

New Delhi   Sec. 125, Noida, UP

Date   Date

ABSTRACT

Requirement of a BI/DW Tool by a Healthcare Provider: Essential or not?

The healthcare environment is generally perceived as being 'data rich' yet 'information poor'. There is a wealth of data available within the healthcare systems. However, there is a lack of effective analysis tools to discover hidden relationships and trends in data. Data warehouse and Business Intelligence Tools have been adopted by many businesses; healthcare is relatively a new member of it. Valuable knowledge can be discovered from application of such tools in healthcare system. The huge amounts of data generated by healthcare transactions are too complex and voluminous to be processed and analyzed by traditional methods. BI/DW Solutions provide the methodology and technology to transform these mounds of data into useful information for decision making.

This dissertation addresses the need to deploy a BI/DW Solution in context of health care. Therefore, the main objective of the study was: *To examine the relevance of using a BI/DW Tool by a healthcare provider.*

For this a survey was conducted in a Multi-Specialty hospital located in New Delhi. The sample population consisted of Clinicians, Medical & Hospital Administrators, Financial Analysts and Nurses. The data from the survey was analyzed using MS Excel and represented in the form of graphs and pie-charts. The survey points out that knowledge regarding such BI Solution are very less among the employees, especially clinicians. Many clinicians assume that BI only involves financial management.

Although their current decision-making process is based upon factual data and reports, effectiveness of these decisions is not satisfactory. Several business cases were studied as part of the dissertation project to show how BI Solutions helped hospitals worldwide. At the end a case study was done of a new BI Tool in the market, Ideal Analytics Solution to further understand the functioning of a typical BI.

Requirement of a BI/DW Tool by a Healthcare Provider

Table of Contents

List of Appendices

List of Figures

Abbreviations

BI	Business Intelligence
CFO	Chief Financial Officer
CIO	Chief Information Officer
CNO	Chief Nursing Officer
COO	Chief Operating Officer
DIKW	Data Information Knowledge Wisdom
DM	Data Mining
DRIP	Data Rich Information Poor
DW	Data Warehouse
EHR	Electronic Health Record
EMR	Electronic Medical Record
HIS	Hospital Information System
HR	Human Resources
IT	Information Technology
KPI	Key Performance Indicators
LOS	Length of Stay
SAP	Software Application Products
SQL	Structured Query Language

Chapter 1

INTERNSHIP

REPORT

1.1 Organizational overview:

Dell Services is an information technology services provider based in Plano, Texas, USA. Peter Altabef has served as president and chief executive officer since 2004. For more than 26 years, Dell has empowered countries, communities, customers and people everywhere to use technology to realize their dreams. Customers trust it to deliver technology solutions that help them do and achieve more, whether they're at home, work, school or anywhere in their world.

On September 21, 2009, Perot Systems agreed to be acquired by Dell for $3.9 billion. The acquisition resulted in a compelling combination of two iconic information-technology brands. H. Ross Perot and eight associates founded Perot Systems in June 1988 after having sold Electronic Data System (EDS) to General Motors. Before its acquisition by Dell Inc., Perot Systems was a Fortune 1000 corporation with more than 23,000 associates and 2008 revenues of $2.8 billion. Perot Systems maintains offices in more than 25 countries around the world, including the United States, Europe, India, China and Mexico

As a top-five finisher for the third consecutive year, Perot Systems was named to the Fortune magazine "Most Admired Companies in America" list for IT Services in 2008. Dell Services is the No. 1 healthcare information technology services provider in the world according to the latest IT services worldwide market share report by Gartner, Inc. The report also ranks Dell second for computer hardware support in the Education market.

The expanded Dell is better positioned for immediate and long-term growth and efficiency driven by:--

- Providing a broader range of IT services and solutions and optimizing how they're delivered

- Extending the reach of Perot Systems' capabilities, including in the most dynamic customer segments, around the world

- Supplying leading Dell computer systems to even more Perot Systems customers.

It provides a portfolio of services to help hospitals identify and take advantage of EHR through the implementation of EHR.

Healthcare delivery and administration continues to become more complex. Uncompensated care is on the rise, demographics are changing, and patients are demanding more for their healthcare dollars. All the while, there continues to be a shortage of healthcare professionals to address the ever-demanding needs of consumers and patients.

To meet these challenges, Dell Perot Systems provides the right combination of clinical and business process improvements, coupled with technology to help hospitals and health systems achieve an environment that is interconnected, streamlined, efficient, and patient-focused. Its vision for the healthcare industry is simple: It wants healthy people to successfully interact with a safe, efficient, and consumer-friendly healthcare system.

Their team of physicians, nurses, and clinicians, as well as healthcare consultants and technologists are experienced in end-to-end hospital operations and understand how to develop, design and implement processes and technologies that bring about real provider transformation. They apply their extensive experience and expertise for:

- Clinical Transformation - Healthcare providers today are facing the challenges of increasing the quality of care delivery and enhancing services while reducing costs. By implementing advanced clinical systems combined with care transformation programs, organizations are finding ways to fund new change initiatives while improving quality. Dell Perot Systems joins with the staff to

improve care delivery processes and achieve measurable results.

- Information Technology Solutions — Operational performance can be improved only when information technology is planned, designed and implemented to support an efficient way of doing things. Dell Perot Systems can help improve the productivity and quality of your services, as well as enhance the usefulness of clinical, HR, patient accounting, and administrative applications. Their global technology capabilities and Solution Centers deliver concentrated expertise for Cerner, McKesson, Meditech, Lawson, and Siemens solutions to name a few. Implementing, integrating, and supporting the right infrastructure automates clinical and administrative processes and in turn enhances the quality of care delivery

- Revenue Cycle Solutions — Whether the organization is financially distressed, has limited access to capital, high volumes of low-yielding accounts, or simply wants to improve the overall performance of their revenue cycle, Dell Perot Systems has the expertise and solutions that improve all revenue cycle metrics, with the realization that increasing cash is key because it provides the financial resources that allow for improving patient care.

It delivers the best healthcare possible. Whether it is a hospital, health system, or physician practice providing care, a health plan paying for care, or an integral part of the healthcare supply chain, delivering the best healthcare possible requires being responsive, efficient, accurate, and innovative in a constantly changing industry.

Every day around the globe, its mission is to provide the full spectrum of infrastructure, application, and business process solutions that are the best service possible. By leveraging its extensive expertise, they are able to provide the organizations with creative, integrated, and innovative solutions that best meet their tactical and strategic objectives. For 20 years, other organizations have put their trust in Dell Perot Systems to deliver solutions that improve the business of health so they can transform care.

1.2 Learning:

The internship period was from 2nd January 2012 to 30th March 2012. During this internship period worked as an intern in VistA Project.

	Jan 2-8	Jan 9-15	Jan 16-22	Jan 23-29	Jan 30-Feb 5	Feb 6-12	Feb 13-19	Feb 20-26	Feb 27-Mar 4	Mar 5-11	Mar 12-18	Mar 19-25	Mar 26-30
Project Overview	■												
VistA Pharmacy Training	■	■	■										
Field Visit				■									
Hands On Practice				■	■								
HIS, BCMA, CT Training					■								
Hands On Practice						■							
Automatic Failover Testing						■							
UpgradingCPRS presentation							■	■					
Hands On Practice									■	■			
Vista Lab Module Mapping											■		
Enhancement of BRDs												■	■
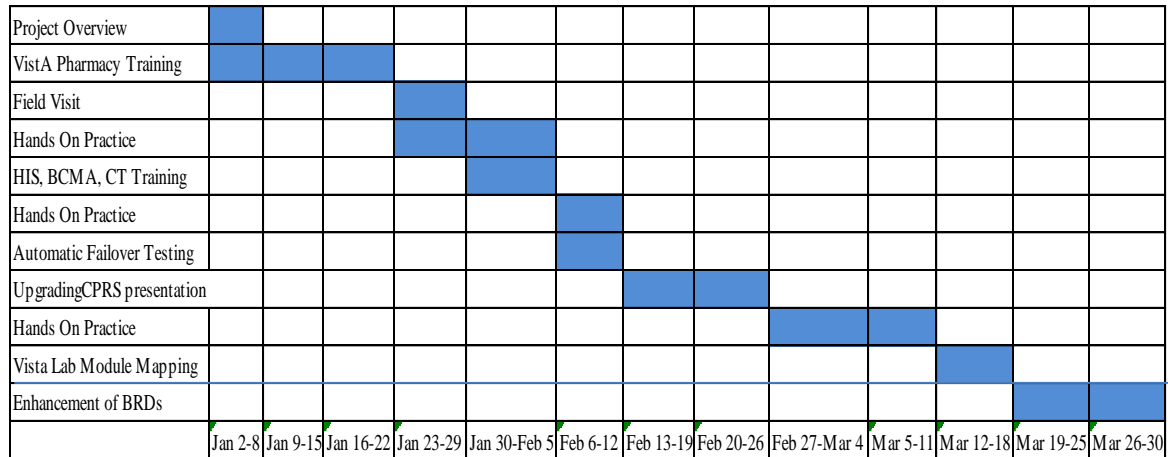
Figure 2: Gantt chart showing work done during Internship period

1.3 Internship Report/ Area of Engagement

The internship period was from 02nd January 2012 to 30th March 2012. During this internship period worked as an intern in VistA Project. Received training on various modules of VistA and also Hospital Information Systems (HIS). The training was for a period of forty five days which was then followed by Hands on Practice sessions.

VistA Project overview

The Veterans Health Information Systems and Technology Architecture (VistA) is an enterprise-wide information system built around an electronic health record, used throughout the United States Department of Veterans Affairs (VA) medical system, known as the Veterans Health Administration (VHA).VistA, is an integrated system of software applications that directly supports patient care. By 2008, the VHA was the largest single medical system in the United States, providing care to 5 million veterans, employing 180,000 medical personnel and operating in 163 hospitals, over 800 clinics and 135 nursing homes. By providing

electronic health records capability, VistA is thereby one of the most widely used EHR in the world.

The VistA system is a public domain software, available through the Freedom of Information Act directly from the VA website, or through a growing network of distributors. The VistA software alliance is a non-profit trade organization that promotes the widespread adoption of versions of VistA for a variety of provider environments. VistA is a collection of about 100 integrated software modules. Name of few modules of VistA are mentioned below.

- CPRS – Computerized Patient Record System

- BCMA – Bar Coded Medication Administration Module

- Pharmacy Module

- Lab Module

- Diet Module

- Radiology Module

Initially received training on VistA Pharmacy module which included front end and back end operations. The front end operations included the verification of the orders prescribed by physicians from VistA CPRS. Verification process for inpatient, outpatient, and emergency drug orders were taught. The back end operations included drug build up, mapping of the drugs & wards etc.

After the training on VistA Pharmacy module, the ordering/ indenting process for the drugs which has reached reorder level and also general pharmacy work processes were taught. The entire VistA Pharmacy module training was for a period of 3 weeks which was followed by 4 days of hands on practice session.

At the end of first month, a field visit to the Customer site was organized to give an exact idea about the work processes and also the optimum space utilization in the department. This field visit gave the idea about the work process before Go Live. A mini knowledge assessment test was conducted by the Pharmacy Subject Matter Expert (SME).

After the training on Pharmacy process and VistA Pharmacy module, training on other modules like BCMA Module (Bar Coded Medication Administration), HIS (Hospital Information System), CPRS (Computerized Patients Record System), Diet and Laboratory module etc was given. This was followed by training on Clinical Transformation and Down Time policies.

BCMA training gave an overview about how the nurse will administer drug to the patient with Bar Code Scanner at patient bed side. The training session demonstrated most of the possible scenarios which a nurse can face while administering drug to the patient. HIS training gave entire idea about the features & functionalities present in it.

CPRS training gave idea about how the Physician works on the system. It explained how a physician enters chief complaint, allergies, examination details, places medication, lab, radiology, Admission, Discharge & Transfer orders etc. This training also included how nurses enter Assessment details, vitals and other details into the system.

After the training was completed on various modules explained above, one week of time was given for exploring and practicing on the same. This helped to understand more about the modules and the functionalities & features present in it. This Hands on training sessions gave an in depth knowledge about the various features and also to understand more about the application.

All the training sessions were very interactive which gave a chance to critically analyze various scenarios and ask questions to the trainers. Discussions during training sessions helped to actively participate during the training sessions which helped to increase interest on VistA.

Knowledge assessment tests were conducted at the end of the training session and feedback was given on it. Feedback about the training sessions was taken after the training sessions were completed.

Support Team Operations

After implementation of VistA at the Customer site, it is important to keep it alive. It takes time to stabilize an application in any organization. It's the same with

EHR. EHR deployment requires routine care and maintenance. There are numerous tasks that need to be undertaken on daily or weekly basis. Integrating EHR into an organization after a successful launch presents its own unique challenges. Continuing to ensure system integrity, organization compliance and overall usability decides the eventual outcome of this huge investment. Eventually Success or failure largely depends on the amount of support an organization provides.

During Internship it was observed, how the support team provides support to the customer's end users. Support team quickly resolves the incidents affecting the Customers' business. For this project a tool called OPAS is used.

The following types of support were observed:

1st line support   :   Project executes Service Desk function.

2nd line support :   Project receives Tickets (Incident or Requests) from the Service Desk and works on the Tickets or, if needed, sends them to 3rd line support, which in this case can be the customer or another supplier.

3rd line support :   Team gets involved only if specialist application knowledge is required. This is often done when the case requires changes in coding.

Automatic Failover testing

Automatic   failover   is   automatic   switching   to   a redundant or standby computer server, system,   or network upon   the   failure   or abnormal termination of   the   previously   active application, server,   system,   or network. Failover and switchover are essentially the same operation. The mild difference is that failover is automatic and usually operates without warning, while switchover requires human intervention.

Systems designers usually provide failover capability in servers, systems or networks requiring continuous availability and a high degree of reliability.

As VistA Project team member was involved in Automatic failover testing to check whether failover is working in the right way.

Upgrading CPRS training material presentation

After 45 days of Internship which included rigorous training on various VistA modules, task was assigned to upgrade training materials of VistA CPRS module. This task was really challenging as the objective was to add animations to the existing presentation and also to use new screen shots of the CPRS application wherever required. The old CPRS presentations were prepared on the basis of US scenarios. For this upgrading work new screen shots were taken and new presentations were made to demonstrate step by step process which user has to follow. Animations were added to the presentations to make presentation user friendly. For doing this MS Power Point was used.

Enhancement of BRDs

After receiving training on various modules of VistA, a task was assigned for making enhancement in the existing business requirement documents (BRD). If customer wants any alteration in existing process, vendor has to present an enhancement of business requirement document to the customer for their approval. BRD contains details of existing process, changes in process and its effects. My involvement was in BRD development of the Pharmacy module.

1.4 Project work plan:

Task	January 2nd-8th	January 9th-15th	January 16th-22nd	January 23rd-29th	January 30th-Feb 5th	February 6th-12th	February 13th-19th	February 20th-26th	February 27th-Mar 4th	March 5th-11th	March 12th-18th	March 19th-25th	March 26th-30th
Topic Selection and Finalization	■	■											
Literature Review			■	■									
Study Design & Framing Questionnaire					■	■							
Survey and Data Collection							■						
SPSS Coding and Data Entry								■	■				
Analysis										■			
Report, Dissertation Writing											■	■	
Draft Preparation													■
PPT Presentation													■

Figure 2: Gant chart showing work done during dissertation

Besides getting training on various modules of VistA, the dissertation project was also done. The dissertation topic was selected based on the topic which will benefit the organization and its customer. The topic was selected after doing complete research on ongoing project of the organization. The selected topic was approved by the mentor in the organization & Institute. When the final approval was received from the Institute, an in depth literature review was done on similar topics and also topics related to the objectives of the study. This literature review gave an idea about the real need of the study, what studies has been conducted on it till now etc. Based on various literature reviews questionnaire was framed.

Once the questionnaire was approved by the mentors, survey was conducted in hospital. Clinicians, Administrators, Manager were interviewed and responses were collected in the pre designed questionnaire. This survey continued for four days.

The responses received from the survey were then entered into MS Excel for analysis. Then the analysis was done and documented in the reports. All the other requisites were added in the report and the draft of report was made. After that print out was taken. Then finally the presentation was made from that draft of report.

Chapter 2

DISSERTATION N REPORT

2. Introduction

EMR/HIS are the current buzzwords in the healthcare provision sector nowadays with more and more hospitals adopting these information systems in their work practices. It is evident silos of data will be produced. This data holds informative potential which both clinicians & managers can use to make clinical & business strategic decisions.

Business intelligence, as the name suggest is a concept which helps in acquiring the intelligence to proliferate a business. With advent of health informatics and quality regulatory bodies, healthcare provider organizations of all types are under tremendous pressure to improve performance and the quality of the care they provide. They must make their services financially affordable for patients, while still providing a decent return for shareholders or taxpayers. "*How do they contend such a task*", is the question which will be addressed in this paper.

BI is made up of two facets, one is collating and disseminating the precise data required which is through development and deployment of DW. Another is using the information derived from DW to make better and informed clinical and business decision.

Every patient that interacts with the provider is a unique case altogether, so amount of data a healthcare provider produces after every transaction is much greater than data produced by a non-healthcare organization. These avalanches of data keep on piling up with every subsequent patient encounter, Hence the need for having a data ware house is becoming more than ever.

Business intelligence can help healthcare providers or hospitals in gaining competitive advantage, not just in formulating smart business solutions and enabling better business decisions, but also more effective clinical decisions, leading to targeted and improved patient outcomes.

Business intelligence solutions are already being used by lots of organizations for finding new revenue streams, reduce costs, effective resourcing, and improve

operational efficiency. In the healthcare industry such solutions will make the best use of massive amounts of information available, allowing them to operate more efficiently and improve patients' well-being.

2.1 Rationale of the study:

The disparate nature of Healthcare Information Systems inhibits a hospital from getting an integrated view of their business & clinical operations. Hospitals looking to improve their acute, ambulatory and financial operations need to understand that informative data is critical for reaching heights. Business Intelligence provides an integrated view and enables decision makers to drill down and understand improvement opportunities within the hospital.

2.2 Problem Statement:

Electronically storing data doesn't enable it to be used by the decision makers. To extract information, firstly the data has to be stored in a structured format in the databases. A database (depending on the system) can be clinical or administrative. Managing it to get a correct complex report, at the correct time can be an arduous task, therefore data warehousing is required. Many healthcare organizations fail to understand the importance and rewards of data warehousing due to which they fail to utilize it in business / clinical strategy development making them "Data Rich Information Poor". Such organizations need to be made aware of BI/DW tools.

This study aims towards assessing the current process of decision making used in a healthcare setting and evaluating the scope of deploying a BI/DW solution for them.

3. Review of Literature

3.1 Background of the study:

Data will soon become a healthcare organization's most critical asset. "Two factors--accountability for care and an increased adoption of interoperable electronic health records (EHRs)--will significantly increase the importance of data for healthcare organizations." [44]. Organizations have started learning the importance of this data, but whether they use this data effectively is still a dubious question. As said by (*Burn and Loch, 2001)* "Although the volume of information available is increasing, this does not mean that people are able to derive value from it"

"Healthcare providers that invest millions in growth—require sound competitive strategies. Often, that means excelling in four key areas:

- Optimum care delivery
- Developing a reliable financial baseline
- Employing rigorous business planning and
- Increasing market share.

All of these can be achieved by adopting the Healthcare Business Intelligence approach abbreviated as "HBI".

"The hospitals in India are getting transformed by the use of Healthcare IT. Healthcare industry experts predict that IT spending will grow 7.5 percent annually, led by demand for BI applications." [37]. According to him time is the most important factor when people are stricken with heart attacks. A solution which presents results with a click, within microseconds to help in taking decisions will prove to be a boon for these patients. No doubt that real-time analysis and decision-making literally saves lives.

Rewards of using a BI/DW solution don't stop here, not only it helps in taking decisions but it also gives the power to gain competitive advantage over other organization or hospital. This is achieved by analyzing the market share and trends. Since more and more healthcare organization are striving for excellence

and be the No.1 healthcare provider, a software like BI has become more desirable. "As the healthcare industry matures, competitive advantage becomes an imperative feature. BI provides services with high added value, bringing high business value and competitive advantage." (*Rajterič, 2010*). *Del Hyo-Barbolla and Lees* [14] also mentioned that " in a competitive climate, if healthcare organizations are to keep their customers, knowing and managing information about them is essential and organization realized that it is crucial to access viable and timely data. Integrating data from the different sources and converting them into valuable information is a way to obtain competitive advantage"

Dr. Vivek Sahi from Dell Services quoted that "It is a known fact that certain hospitals have been automated in 17's which have huge amount of data. But this data is not utilized aptly which leave them data rich but information poor (DRIP). If they start using this data they can obtain financial and operational efficiency. Not only that, it can improve their patient management as well. This can only be achieved by adopting a BI/DW Solution."

Since the data generated by a healthcare organization is heterogeneous (in form of images, patient's interview, laboratory data, physician's interpretation and views) there is a greater need to store them in a database in a structured format. Hence the need of a "data warehouse" [5]

3.2 Data warehouse

A Data Warehouses (DW) integrates data from multiple heterogeneous information sources and transforms them into a multidimensional representation for decision support applications. [7622]. A data warehouse may be defined in several different ways. These definitions are often based upon the company using the data warehouse and the way the data warehouse is structured.

"A data warehouse is thus a repository for long-term data, often in a summarized form. The data is collected from multiple heterogeneous sources but is made

consistent prior to storage in the warehouse. It seldom changes and is generally considered read only. The structure of the data warehouse and the format of the data is such that it facilitates querying and analysis." [24].

Earlier data was stored by an organization in form of reports, files or spreadsheets. This data often held the knowledge to make better business decisions but extracting that knowledge was cumbersome. Time and labor was required to take out those reports and analyze the data that time. But with more and more hospital adopting IT in their processes, storage and extraction of this kind of data is much easier. If the data is stored electronically in a structured form, extraction of information is just a click away.

A Data Warehouse is a semantically consistent data store that serves as a physical implementation of a decision support data model and stores the information on which an enterprise needs to make strategic decisions.

3.3 Features of Data Warehouse

In his book "The Data Warehouse Toolkit", Ralph Kimball identifies the goals of a data warehouse as:

- The data warehouse provides access to corporate or organizational data.
- The data in the warehouse is consistent.
- The data in the warehouse can be separated and combined by means of every possible measure in the business.
- The data warehouse is not just data, but also a set of tools to query, analyze, and present information.
- The data warehouse is the place where we publish used data.
- The quality of the data in the data warehouse is a driver of business reengineering.

It is important to understand how each of these can be applied to the clinical data environment. As stated by *Rajan and Ramaswamy (2010)*, because health data are derived from different environments there is a significant probability of errors and uncertainty. Moreover, many factors such as poor data quality, inconsistent representation and complicated domain knowledge etc., causes clinical decision-making to be a labor intensive and error prone task *(Zhou et al, 2010)*. Therefore effectively integrating health data from different sources is becoming recognized as a crucial factor *(Shams & Farishta, 2001)*. Data warehousing is such a technology that helps in integrating the health data from different sources and store it in a single repository.

3.4 Advantages of Data warehouse:
Some of the common advantages of data warehousing are listed below.

1. A data warehouse may uncover new business intelligence and thus provide a strategic advantage to the company.

2.   Since data from all over the company is brought together in the warehouse, one can have access to all the relevant data from various departments at one place.

3.   The heterogeneous data is now in a homogeneous form and can thus be compared and used efficiently.

4.   The consistency of data facilitates querying and quickens analysis thus providing larger horizons for data mining.

5.   The data warehouse construction phase may help identify duplicate effort within the company to maintain the same data. This can be eliminated leading to increased profitability.

6.   Data warehouse construction helps discover if any important data collection is being overlooked by any of the business processes. Care can then be taken to ensure that this data is indeed being correctly collected thus improving effectiveness.

7.   Building an independent data warehouse reduces the administrative costs. Administering a single system that takes care of transactional and analytical processing would have resulted in an increased overhead; the overhead due to the efforts required for the maintenance and surveillance of the system that actually has contradicting requirements for the different types of processing.

The implementation of the data warehouse is preceded with a thorough analytical process that involves understanding the business, identifying the requirements and determining which reports would be needed and would help in making intelligent business decisions. The idea is to understand how the construction and use of the data warehouse will prove beneficial to the organization. This analysis results in the identification of the dimension tables and fact tables, which drive the actual design of the data warehouse.

Once the data is stored in a structured format, it is easy to extract the information from this database and use it to make decisions; be it clinical or administrative. Without an effective data warehouse, organizations cannot extract the data required for information analysis in time to facilitate expedient decision-making

A study by Pubudika Kumari Mawilmada[1] in healthcare concluded that developing a data warehouse will maximize the usefulness of data with greater efficiency and help to answer more complex questions about the patient management and efficient health service management. Once data warehousing has been done, this data can be used to make informative business decisions, a concept known as Business Intelligence.

3.5 Business Intelligence

All healthcare organizations are swimming in data. Much of this data is still locked in paper, files, in standalone spreadsheets and desktop databases, in three-ring binders or even in people's heads. Healthcare organizations already own invaluable "intelligence" locked within this data.

In an effort to improve quality of care and reduce costs, these healthcare providers are increasingly turning to IT-enabled business strategies. This is evident by the striking increase in the implementation of electronic medical record (EMR) and related clinical applications. The next wave of IT investment by providers will be built on this foundation and a key component will be business intelligence (BI) applications that combine data from clinical, financial, and other applications. These applications are essential in order to achieve operational, financial, and clinical benefits from their EMR investments.

3.5.1 Other definitions by various studies:

Many different definitions of BI has been found in the literature review depending upon the industry in concern.

Business Intelligence (BI) is most often about avoiding surprises and minimizing exposure to risk. *(Sawka 2002).*

BI systems offer historical, current, and predictive views of business operations, using data that has been put together into a data warehouse or a data mart. "A

data mart is simply a scaled-down data warehouse — that's all." *(Hammergren and Simon (2009), Data Warehousing For Dummies,2ⁿᵈ ed, Wiley Publishing, Indiana and Canada)*

BI is the commercial equivalent of evidence-based clinical decision-making. One uses clinical evidence to support diagnoses to develop care plans and to evaluate outcomes for patients. It promises to improve patient care by driving better decision making throughout the organization.[11]

The data in any healthcare organization is spread across a number of systems (e.g., encounters, labs, pharmacy, membership, finance, claims, billing, etc.). BI extracts data from these systems and brings it into centralized, secure, historical repositories, which is organized for business users to slice, dice, sort and sum it efficiently for use in making business decisions.

The value of BI is in using the same data across the organization for a variety of decisions on clinical performance, business performance and strategic as well tactical initiatives. When ten people view data from ten different perspectives, its value increases exponentially through new insights, new answers as well as new questions.

A paper published by Rouhani et al in 2012 specified BI as a managerial concept "Business intelligence is a managerial concept which refers to a set of programs and technologies that provide capabilities of gathering, analyzing and accessing data of organization's processes" "The ultimate goal of business intelligence systems in any organization is to help making optimal decisions as soon as possible and in all organization's levels." [38].

Therefore, BI is a process of using information and analyzing them in order to support decision-making and using different methods helping organizations to forecast the behavior of competitors, suppliers, customers and environments to stay alive and survive in global economy.

Tyson (1986:9) identified the BI concept as an analytical process by which raw data are converted into relevant, usable and strategic knowledge and intelligence.

In his definition, Tyson emphasizes the need for the continuous monitoring of customers, competitors, suppliers, actors and forces in other fields.

According to him, **BI comprises a variety of types of intelligence**:

- Customer intelligence
- Competitor intelligence
- Market intelligence
- Technological intelligence
- Product intelligence
- Environmental intelligence

3.6 Importance of Data in Hospitals

James G. Spahn says "No clinician – no matter how thorough and intelligent he or she may be – has the ability to personally acquire enough factual information when compared to that which can be obtained from technology and statistical models. It is partly by the collection, analysis and reporting of statistical information that a common body of knowledge is built and solidified."

Fig. 2 DIKW(Data Information Knowledge Wisdom) Hierarchy

This model above, also known variously as the "Wisdom Hierarchy", the "Knowledge Hierarchy", the "Information Hierarchy", and the "Knowledge Pyramid" explains the translation of data into knowledge. Typically information is

defined in terms of data, knowledge in terms of information, and wisdom in terms of knowledge.

Data in healthcare organization has never been this important as it is now. Hospitals can't deliver care or get reimbursed without an ever-increasing collection of information (data) that helps in measuring every aspect of operations. The rising importance of pay-for-performance reimbursement compels hospitals and physicians to collect even more information to show that patients received the right care at the right time. Health plans and consumers want to see data that show they get what they are paying for and providers will need related data for patient accounts and contract management. "Public health surveillance programs are requiring collection of more data. In addition, the growing importance of evidence-based medicine means that more information must be made available to caregivers. Government agencies and academic institutions also demand more numbers for their studies of health policy. Finally, the coming era of molecular medicine will add unprecedented volumes of data to patient records, as will the expansion of healthcare delivery to more points of care (e.g., clinics in retail locations and hospital-in-the-home programs)."[41]

While the quantity of data needed today keep on increasing, quality of this data is also a concern. Good decisions need good data. Working with bad data will be more risky that working with no data at all. According to *Kerr, Norris, and Stockdale (2007, p.1017)* "in the healthcare sector lack of data quality has far-reaching effects. Planning and delivery of services rely on data from different sources such as clinical, administrative and management sources. Therefore, if the quality of data is higher it helps to retrieve better information." Several factors define the quality of data and their value for decision-making. These are:

-               Reliability
-               Validity
-               Currency

Quantity of data can be enormous but if quality of that data doesn't meet the requirements of the organization then the data will be fruitless. An EHR will not

improve the effectiveness and efficiency of patient care if the record contains inaccurate information. This gives rise to the need of a BI/DW Environment.

3.7 Prominent BI Tools in the market

There are many renowned business intelligence solutions available in the market such as DeepSee, IBM Cognos, Microsoft Business Objects, Pentaho and Ideal analytics

Ideal Analytics Solution is the newest addition to this group which is capturing the market rapidly. Some of the features of this BI Tool give it an edge over the other BI Solution.

3.8 Desirable features in a BI Tool:

•   **Ad hoc Analysis:** Ad hoc analysis is a business intelligence process designed to answer a single, specific business question. The product of ad hoc analysis is typically a statistical model, analytic report, or other type of data summary.

•   **Ad hoc Query:** A query consisting dynamically constructed SQL usually constructed by desktop-resident query tools. These cannot be determined prior to the moment the query is issued.

•   **Ad hoc Reporting:** Powerful yet simple and user-friendly ad hoc reporting capabilities make it easy for workers at all levels, including executives and frontline staff members, to quickly build and run their own reports any time they need them.[8]

•   **API Availability:** An application-programming interface (API) is a set of programming instructions and standards for accessing a Web-based software application or Web tool. A software company releases its API to the public so that other software developers can design products that are powered by its service. An API is a software-to-software interface, not a user interface. With APIs, applications talk to each other without any user knowledge or intervention

•   **Benchmarking:**   Benchmarking is the process of comparing the cost, time or quality of what one organization does against what another organization does. The result is often a business case for making changes in order to make improvements.

•   **Budgeting & Forecasting:** The ultimate aim of performing budgeting and forecasting process is to establish a financial target which set the company's future direction. The forecast is a combination of actual results of the past months together with the budgeted figures of the future months to give a projected results for the year end.

•   **Dashboards**: A user interface that organizes and presents information in a way that is easy to read. The name refers to the fact that it can sometimes look like the dashboard of a car. Also known as cockpits or scorecards. [10]

•   **Custom User Interface:** Customizable User Interface according to their preferences.

       Drill Down/Up The act of moving from a summarized view of data into a lower level of detail or vice versa, particularly when performing multi-dimensional analysis

•   **Graphical Data Presentation**: Visually attractive data in form of graphs.

•   **Hierarchical Access Control:** Access based upon the roles. (RBAC)

•   **Legacy System Integration**: It's all about getting the most from existing IT resources while taking advantage of next generation technologies. Legacy system integration is:

•   **Multi-Language**

•   **OLAP:**   On-line analytical processing. OLAP is defined as providing fast access to shared multi-dimensional data. OLAP is a term used to

generically refer to software and applications that provide users with the ability to store and access data in multi-dimensional cubes. [12]

•   **Predictive Analytics**: Predictive analytics is business intelligence technology that produces a predictive score for each customer or other organizational element. Assigning these predictive scores is the job of a predictive model which has, in turn, been trained over your data, learning from the experience of your organization.

•   **Profitability Analysis:** An analysis of costs and revenue to determine whether or not a venture will make a profit, and, if so, how much. This is important information in deciding on whether to make an investment. The length of time required to repay the initial investment can be a critical factor

•   **RIA based User Interface:** Web applications which have the functionality and features of conventional desktop applications are known as Rich Internet Applications or RIAs. used to provide a number of enhancements to User Interface design; adding more sophistication and giving user interactivity an entirely new meaning. allows the creation of more user-friendly applications

•   **Remote Access on Smartphones:** Accessing data from Blackberry,iPhone, Android Apllication to make decisions anytime, anywhere.

Other than these functioning of a BI/DW Solution also depends upon the kind of database it uses.

4. Objectives

4.1 Main Objective:
❖   To examine the relevance of using a BI/DW Tool by a healthcare provider.

4.2 Sub-objectives:
4.2.1 Part A:

❖ To study the status of current decision making process in a Multi-Specialty Hospital.

❖ To analyze the issues faced currently in their decision making process.

4.2.2 Part B:

❖ To elicit how BI/DW Tools has helped organizations using Case Studies.

❖ To study the functionality and features of Ideal Analytics Solution.

5. Important Definitions:

BI/DW Environment - Any architecture or system that integrates data from multiple sources and gives business users the ability to query, report, analyze, monitor, or mine the data to make decisions, develop plans, or take action. The diagram below depicts a classic BI/DW environment.

DW - The back-end or IT-centric portion of a BI/DW environment. The tasks and processes involved in collecting, moving, cleaning, transforming, and loading data into a data warehouse or data mart.

BI - The front-end or user-centric portion of a BI/DW environment. The tools and processes that enable users to query, report, analyze, monitor, and mine integrated information to make decisions, develop plans, or take action.
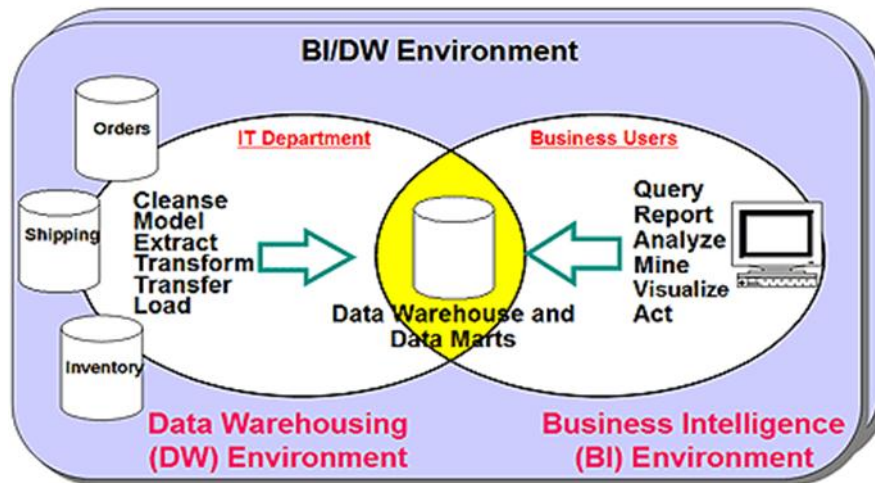
Fig. 4 BI/DW Environment

6. Methodology:

Study Design:

- The study was divided into two parts. Part A and Part B.

Part A:

- For this part a survey was done.
- Quantitative data from a cross-sectional population of a Multi-specialty hospital was obtained.

Sample selection and size:

- Simple random sampling was done.
- The sample size for the study was 48.

Nature of respondents:

➢ The respondents were employees of a leading multi-specialty hospital. It includes respondents from administrative staff, from financial staff, clinicians, nurses and marketing staff.

Primary data collection tool:

➢ A self-administered questionnaire was utilized to gather primary data for Part A of the study.

➢ The questions were formulated on the basis of existing questionnaire in various related studies.

➢ The questions were adapted to the context of the hospital being investigated.

Data analysis technique:

➢ The data was analyzed using Microsoft Excel 2007. Various pie charts, bar graphs etc. are used to represent the results fetched from the above survey.

Part B:

➢ Being qualitative in nature, this part involved thorough study of the literature including case studies where BI/DW implementation was successful.

➢ An in-depth study of the BI solution Ideal Analytics was done.

Primary data sources:

➢ Ideal Analytics Solution

Secondary data sources:

➢ Case Studies

➢ Literature findings

7. Results and Findings:

Part A:

1.   **Primary Work Unit of the respondent**

➢   A total of 48 fully filled questionnaires were obtained. Most of them were from the administrative staff of the hospital(42 %). (Fig. 1)
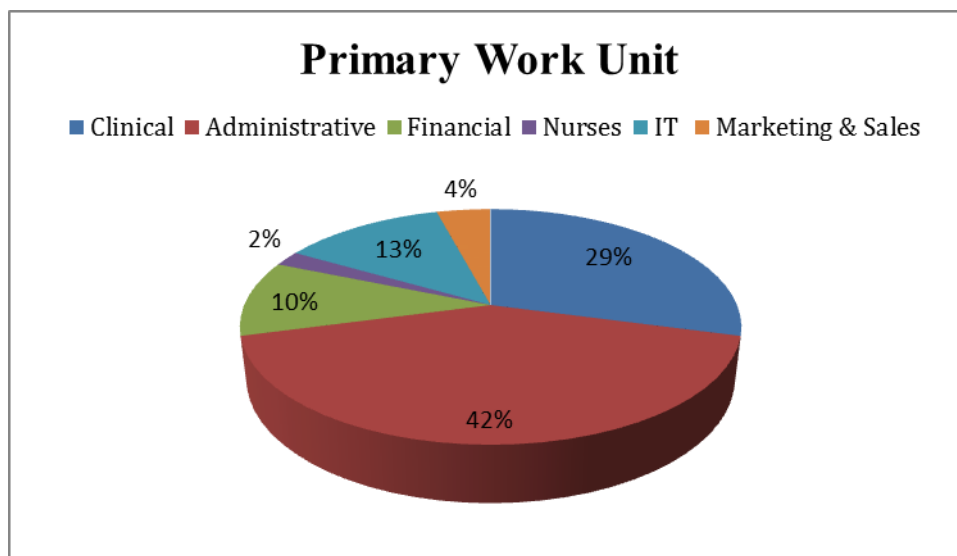

Fig. 5

➢   This bunch of respondents included various managers such as Assistant medical superintendent, Assistant Managers (Operations), Program Manager, Head of different departments (Nursing department, Biomedical equipment department, Finance department, Pharmacy department, HR department, Inventory and Purchase etc.)

2.   **Demographic details (Age Group)**

➤   To establish demographic variations age group and gender of the respondents was captured.(Fig.2 and Fig.3)

Age Group

■ 18-30 ■ 31-40 ■ 41-50 ■ 51-60 ■ Over 60
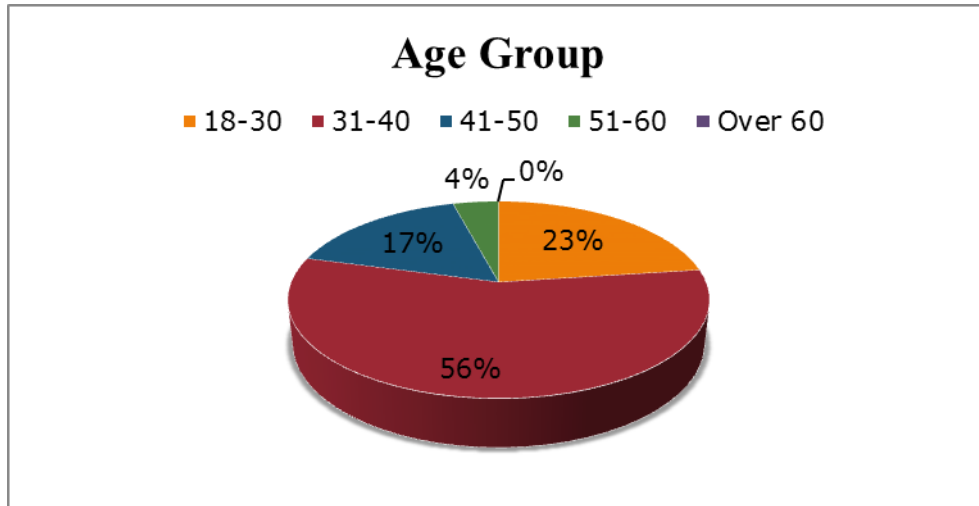
4% 0%

17%   23%

56%

Fig.6

➤   56 % of the respondents were in their 30s. 23 % from the age group 18-30 years and 17 % were between 41-50 years of age.

➤   Only 4 % of the respondents were between 51-60 years of age and nil above 60 years.
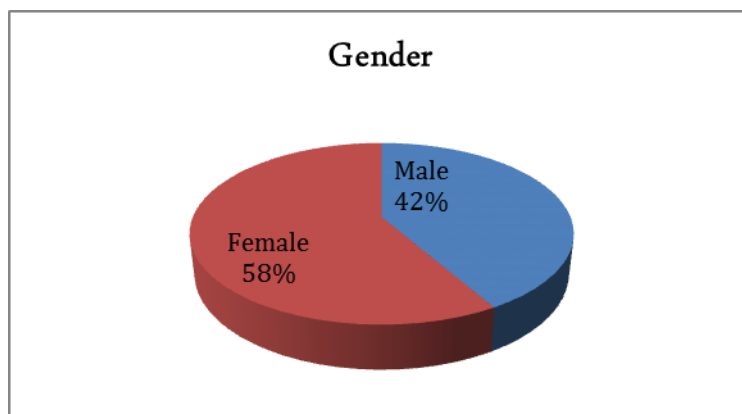
3.   **Demographic details (Gender)**

Gender

Male
42%

Female
58%

Fig. 7

- 58 % of the respondents were females.
- 42 % of the respondents were males.

4.   **Awareness question- (Do you know what Business Intelligence is and how it can be used in hospitals?)**
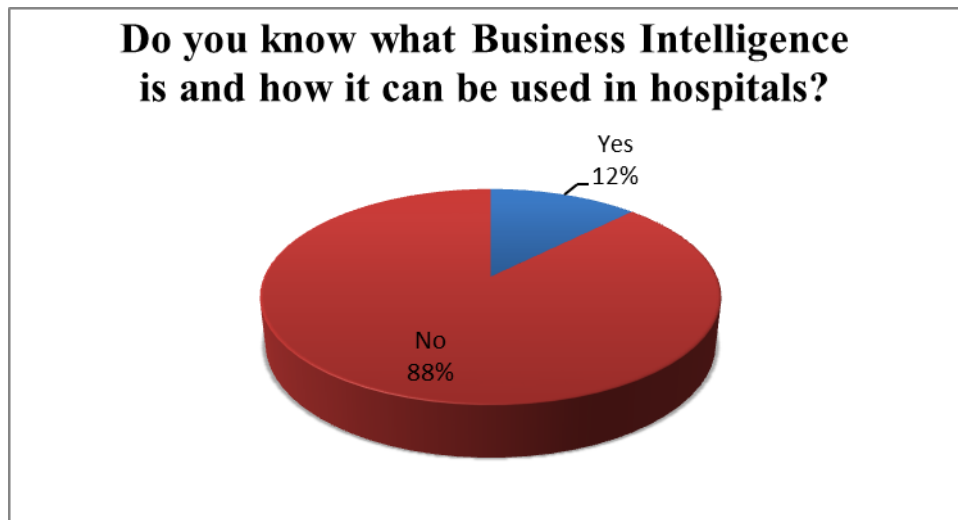

Fig. 8

- It was noticed that although they heard about the term "Business Intelligence" they did not know what it is actually. 88 % of the respondents answered this question as 'No'. Only 12 % were sure about the concept.
- The finance department, IT department and Marketing department looked well versed in their knowledge of BI. The lack of awareness was seen mostly among the physicians. Only 3 of them knew about Business intelligence. Data warehousing was an estrange concept for them.

5.   **Current decision making process**
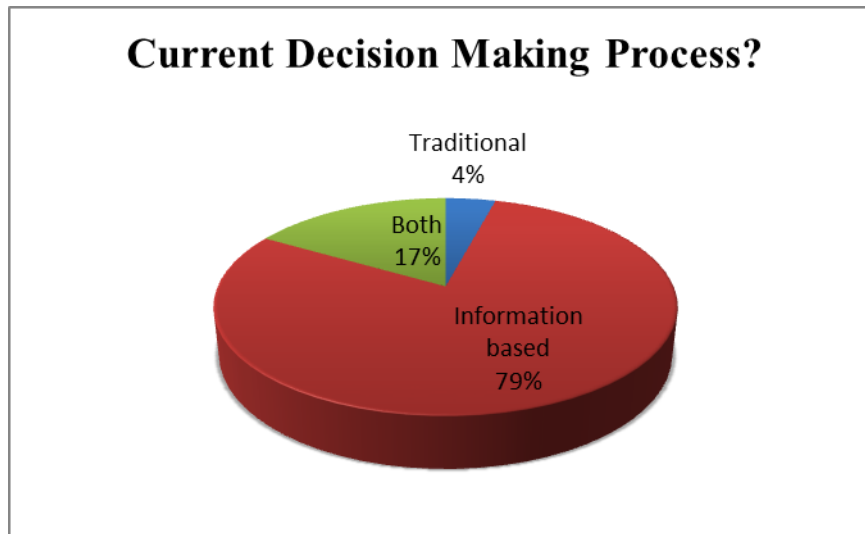**(What best describes your current decision making process?)**

Fig. 9

- 79 % of the respondents said they follow an information based decision making process where they have data and reports to help them in taking decisions.

- 4 % of the respondents said they use traditional method to take decisions i.e. decisions taken on the base of skills and experience of the pupil.

- Sometimes decision making is the combination of traditional and information based. 17 % of the respondents indicated this.

6. **Information Tool Used**

- According to the employees four different types of information tools are used currently. These were:

✓ Microsoft Excel

✓ HIS (Inbuilt Hospital Information System of Max)

✓ SQL Server

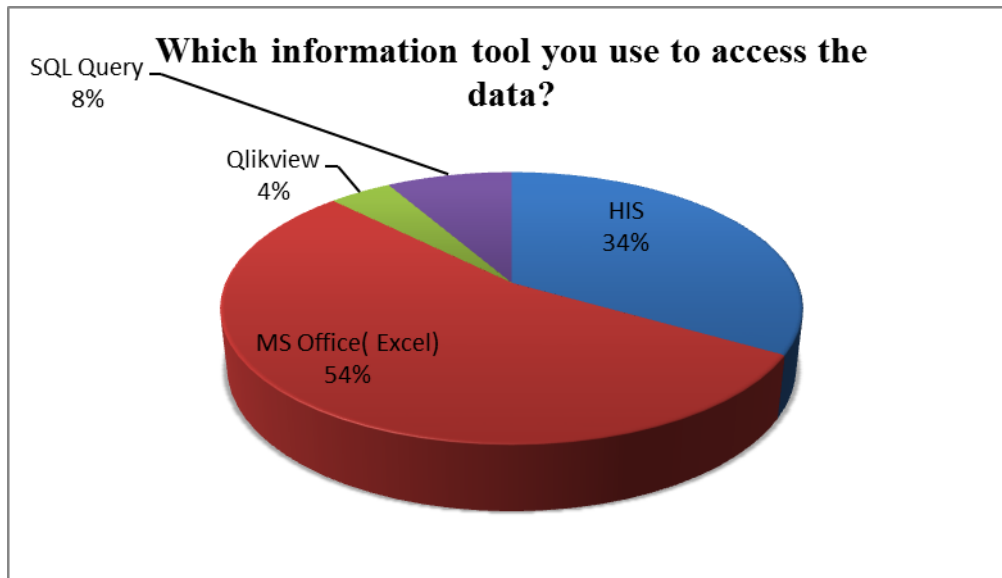✓ Qlikview

Fig. 10

- 54 % of the respondents asserted that they use MS Excel as their information tool.
- 34 % said they use their HIS to access all the information.
- 8 % said they use SQL query server while only 4 % said they use Qlikview.

7. **Issues in current decision making**

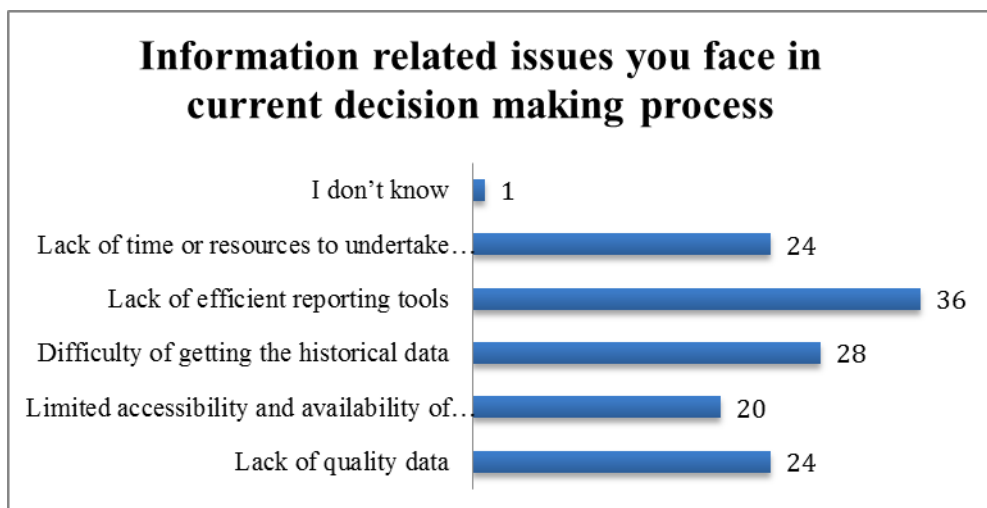(What are the information related issues you face in the current decision making process?)

Fig. 11

- The responses suggest that lack of efficient reporting tool is the most common issue faced.

- Difficulty in getting the historical data, lack of quality data and lack of time & resources to undertake analysis are among other common issues faced by them.

8. **Reasons for not deploying a BI/DW Solution**

(Why do you think a BI Solution has not been implemented yet?)

Reasons for not adopting a BI Solution?

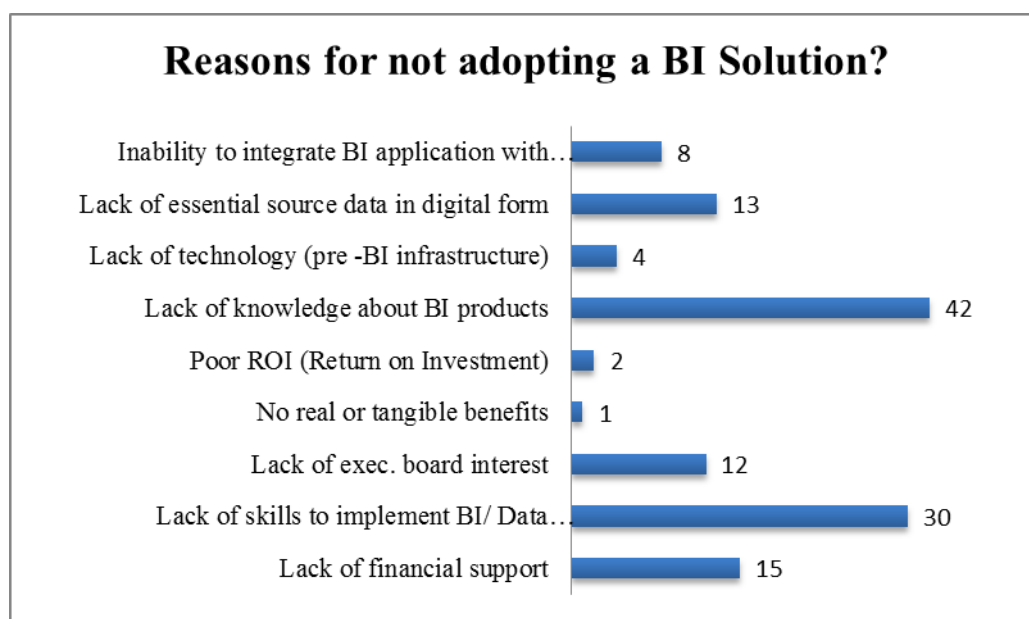| Category	Value
Inability to integrate BI application with…	8
Lack of essential source data in digital form	13
Lack of technology (pre -BI infrastructure)	4
Lack of knowledge about BI products	42
Poor ROI (Return on Investment)	2
No real or tangible benefits	1
Lack of exec. board interest	12
Lack of skills to implement BI/ Data…	30
Lack of financial support	15

Fig. 12

- Many possible reasons were thought of for not deploying a BI Solution. The result suggests that due to lack of knowledge about BI Products among the employees no such solution has been implemented yet. (Fig. 10)

- The respondents thought that they lacked the skills to implement a BI/Data warehousing solution in their hospital.

- Lack of financial support, lack of executive board interest in using a BI solution and lack of source data in digital form was also common reasons for not deploying a BI Solution yet.

- Few of them also said that due to inability to integrate the BI application with the current IT system they have not deployed a BI solution.

9. **Willingness to use a BI solution**

(Do you feel that reporting tool in form of summary reports, statistical graphing, analysis, score carding and dashboards will be beneficial in increasing the productivity of your department?)

Summary reports, statistical graphing, analysis, score carding and dashboards will increase the productivity of your department?
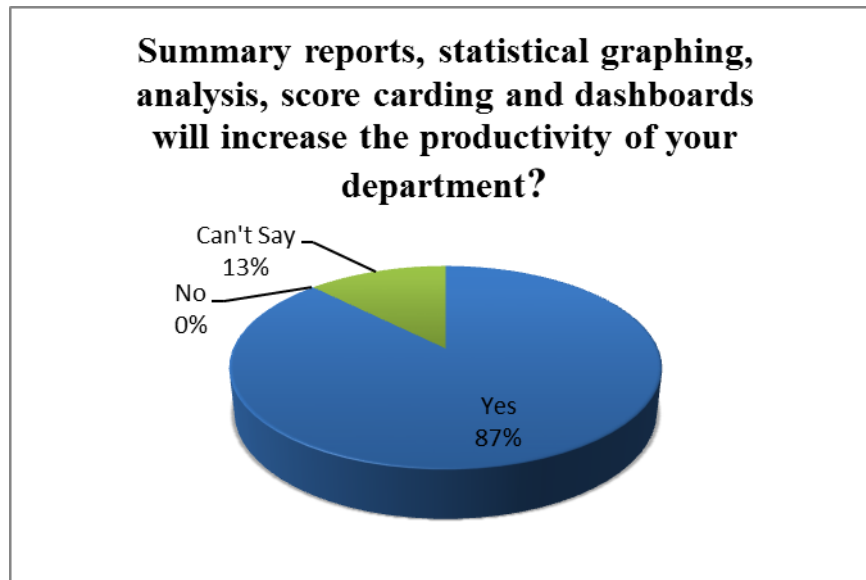
Can't Say 13%
No 0%
Yes 87%

Fig. 13

- Majority of the respondents (96 %) think that BI tools in form of summary reports, statistical graphing, analysis, score carding and dashboards will beneficial in increasing the productivity of their department.

10. Drivers of a BI Solution

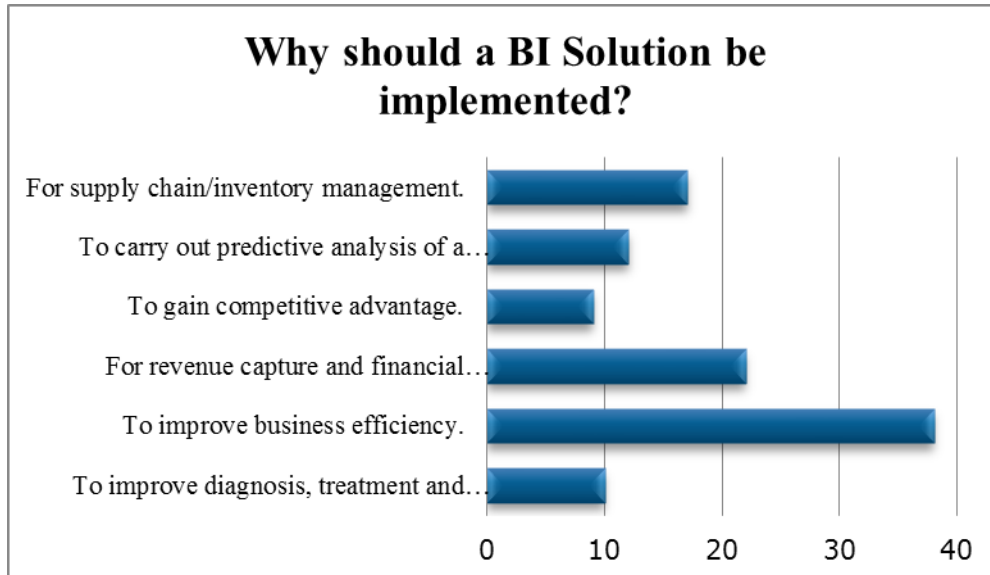**Why do you think a BI solution should be implemented?**

Fig. 14

- According to the employees a BI solution should be implemented to improve the overall business efficiency with a frequency of 38.

- The second most common reason for implementing a BI/DW was for revenue capture and financial performance having frequency 23.

- Supply chain/inventory management and to improve diagnosis, treatment and clinical outcomes were identified as other two main reasons with frequency of 17 and 10 respectively.

11. Primary users of a BI Tool

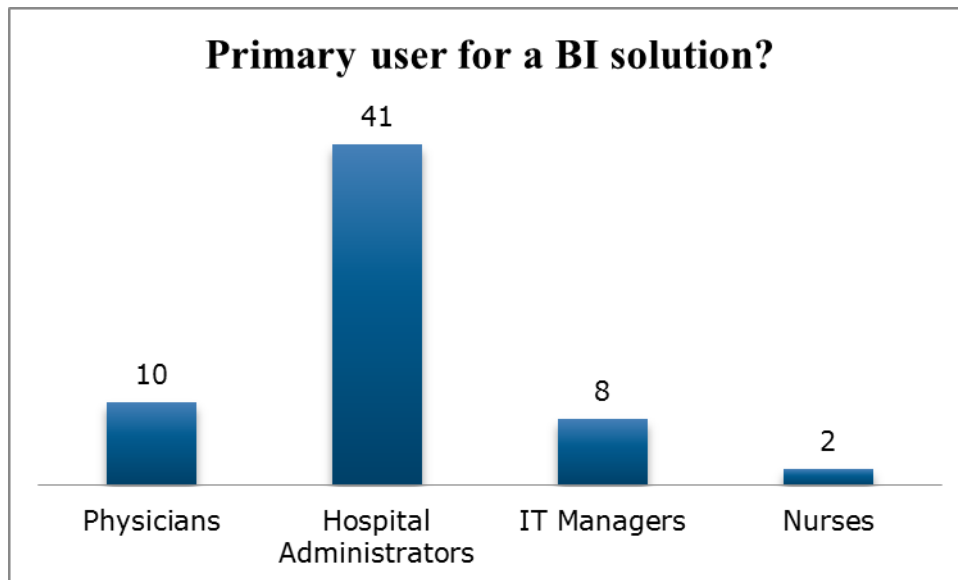(Who are or will be the primary users for a BI Tool in your organization?)

Fig. 15

- The graph indicates that mainly hospital administrators are the primary user for a BI Tool with a frequency of 38.
- 15 respondents said that physician and 12 said that IT managers will be also be the primary user of a BI tool.
- Only 3 respondents said that nurses will also be a primary user of the BI Tool.

12. Primary decision maker for a BI/DW solution in the hospital

(Who is the primary decision maker for a BI/DW Solution in your Hospital?)
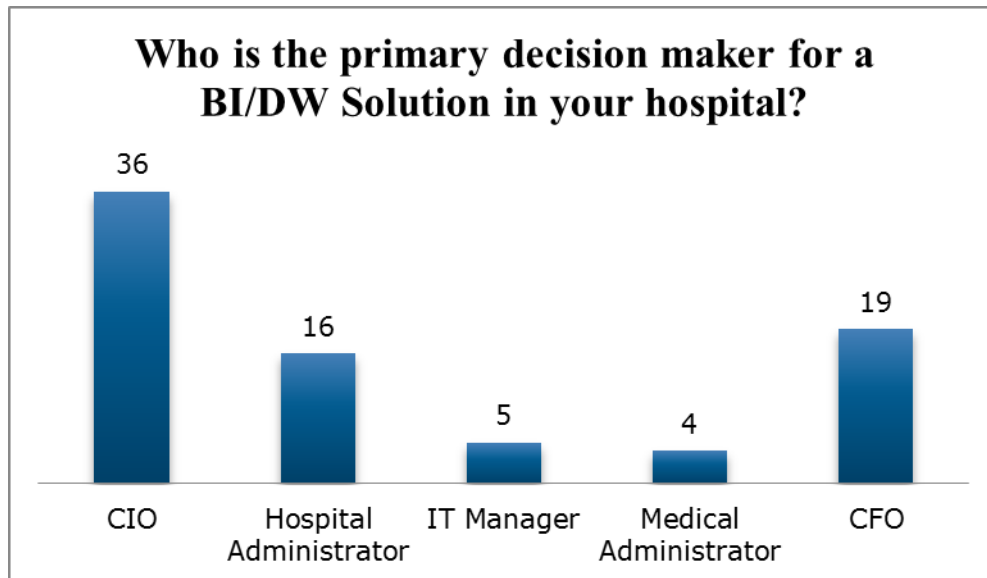
Fig. 16

- Most of the respondents said that the CIO and CFO are the key decision maker for a BI/DW solution in their hospital (36 and 19 respectively).
- 16 respondents said that hospital administrators take this decision. 5 said that IT managers are consulted for this decision while 4 respondents said it's the medical administrator who does.

13. KPI's desired

(What would you base your KPI's on?)

Fig. 17

➢   It was noticed that outcome related measure or KPI's were most desired than process related. However many respondents said that both are equally important.

8. Discussion:
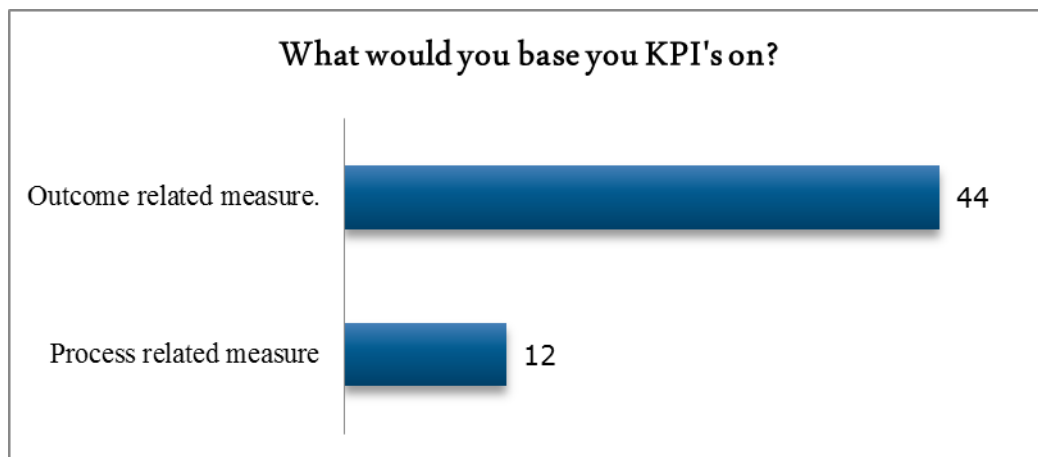
8.1 Part A:

➢   The survey suggests that knowledge regarding the BI/DW is lacking among employees.

➢   The administrative, IT and finance department is comparatively more knowledgeable than the clinical department about BI.

➢   Although most of the clinicians are not well versed in the concept, few of them had thorough will the concept.

➢   For this reason i.e. lack of knowledge, the hospital has not deployed a BI/DW Solution yet. Lack of knowledge gave rise to lack of skills to implement a BI solution.

➢   As far as the current decision making is concerned, majorly information based decision making process is followed in the hospital. Although the effectiveness of such a process is questionable.

➢   Most of the respondents assume Microsoft Excel as their business intelligence which clearly shows their lack of knowledge about BI.

➢   A very small percentage (4%) of the sample is aware of a reporting tool known as Qlikview which does partial work of a typical BI tool. Therefore, lack of an efficient reporting tool was the most frequently cited information related issue faced during current decision making process.

➢   Since the historical records or data was not stored in a structured format before, development and functioning of a BI/DW solution is even more difficult. This issue was also among the most cited informational issues experienced.

➢   The employees are convinced that adopting a BI solution will increase their departmental efficiency. Moreover, they feel that BI solution will improve their overall business efficiency, will improve clinical outcomes, supply and inventory and financial management.

➢   The decision of buying or deploying a BI solution is taken by the CIO (Chief information officer) and CFO(Chief finance officer) collaboratively.

Sometimes administrative staff is also involved. This is an irony because a BI/DW Solution should be driven by the end users.

➢ According to the present survey, mostly the primary users for BI are hospital administrators.

➢ The employees are more concerned to view and analyze their outcome related KPI's (Key performance indicator) than process related KPI's.

➢ Although there are generic KPI's such as ALOS (Average length of stay), bed occupancy etc. incorporation of KPI's in their dashboard depends upon their requirements which varies through hospitals.

8.2.1 Part B:

Many case studies were found over the internet where either a BI or a DW or both were implemented and benefits were derived from it. Few cases studies are cited below.

1.   Brigham and Women's Hospital

➢ *About the Hospital:*

Brigham and Women's Hospital (BWH) is a 777-bed teaching affiliate of Harvard Medical School. The facility has approximately 44,000 inpatient admissions and 950,000 ambulatory visits annually. It is the largest integrated healthcare delivery network in New England and one of the largest in the United States

➢ *The IT Initiative:*

They have an extensive portfolio of clinical, administrative, and financial applications. Much of its clinical system environment is internally-developed.

➢ *Introducing BI:*

Its efforts to develop a balanced scorecard began in early 2001 with strong support from the hospital's senior executives, clinical leadership, and the board of trustees. A steering committee was formed: Its members included the COO, CFO, CIO, CNO, three clinical vice presidents, and chairs of the clinical departments. The decision was made to expand the scope and engage the services of a software provider to support the data analysis and reporting process. In early 2002 a

contract was signed with SAS to provide the software tools and infrastructure to facilitate and expand the initial design.

➢ *Current BI Setting*

Today, BWH's balanced scorecards are created from more than 80 different data sources. The majority, about 75%, of the source data is extracted from about 20 different clinical, administrative, and financial transaction systems; an internally developed corporate quality reporting system; and a legacy financial decision-support application. The remaining 25% comes from more than 60 unique data feeds from local departmental systems and custom-designed desktop applications.

➢ The scorecards and related dashboards provide 24-hour, online access to information derived from more than 50,000 annual patient encounters to more than 1,000 authorized users at all levels of the organization, from front-line supervisors to attending physicians to senior executives and even trustees. Their metrics relate to key strategic goals in the areas of patient safety, patient satisfaction, service quality, service volumes, resource utilization, financial performance, operational efficiency, and staff satisfaction. Users also include more than 200 surgeons and obstetricians, who can view their own scorecards that compare their facility utilization, case costs, infection rates, patient satisfaction, and other outcomes against established benchmarks pertinent to their specialties.

➢ BWH has incorporated BI as an integral component of its ongoing efforts to improve quality and reduce costs. In the past three years, for example, the median LOS at BWH has declined by 0.3 days in the face of increasing case mix severity, while its Press Ganey inpatient satisfaction scores have improved from the 50th to greater than the 90th percentile compared with the scores of other national teaching hospitals.

2. **Lamington District Memorial Hospital**

➢ *About the Hospital:*

Lamington District Memorial Hospital is a community hospital dedicated to providing high quality patient care and service. As an Ontario-based hospital, the facility is required to report key performance and accountability indicators to the Local Health Integration Networks (LHIN), which has a mandate from the province for integrating and funding health care services and which oversees nearly two-thirds of the $37.9 billion health care budget in Ontario.

➢ *Introducing BI:*

To help ensure that the hospital's performance was aligned with allocated resources, Lamington needed a tool that that would help managers proactively set targets and help manage performance improvement towards those targets. To measure its services using key performance indicators, the hospital decided to implement a Microsoft business intelligence (BI) solution including SQL Server™ 2005, Office SharePoint® Server 2007 and Office PerformancePoint™ Server 2007. It now benefits from better business insight, greater flexibility and better analytic capabilities.

Leamington worked with Microsoft Certified Partner MediSolution to develop a new Business Intelligence (BI) platform. Together they decided on a solution that leverages SQL Server™ 2005, Office SharePoint® Server 2007 and Office PerformancePoint™ Server 2007 based on its flexibility, cost and key features including dashboard capabilities and performance management.

MediSolution worked closely with the key stakeholders to ensure compliance with pre-defined LHIN KPI standards. Once these were in place, the solution provider identified the different data sources, and how often data needed to be updated.

➢ *Current BI Setting:*
The new reporting capabilities give physicians and administrative staff the ability to access an executive-level view of performance across the hospital or, if need be, dive deeper into specific KPIs or departmental performance.

➢ *Benefits :*

✓ Enhanced business insight: The new Microsoft BI solution gives the hospital's board, physicians and management a more complete picture of their

performance and how initiatives are directly impacting that performance. The management team is also able to share information with their teams and use on-screen dashboards to walk them through problem areas.

✓   Improved data reliability: The new BI solution also provides staff with additional information that they can track and analyze in real time. This empowers staff to pay close attention to data for better business insight, which in turn leads to better business decisions and improved service delivery. "Monthly variance reports used to be siloed," says Padfield. "Now our management team can accurately report and analyze various KPIs like occupancy rates, volumes, absenteeism rates and cost-per-patient activity on one screen."

✓   Increased IT flexibility: The new BI solution is fully integrated with mission-critical databases with no need for any manual information uploads or maintenance. It is also completely web-based, allowing staff to access information from home or when working at remote locations. As Lamington expands its staff and services, key stakeholders have the confidence that its BI solution will continue to meet its needs.

"Having greater flexibility, increased accuracy and decreased workload within our reporting system has been a significant improvement for us," says Padfield.

3.   **Children's Hospital Boston, Massachusetts**

➢   *About the Hospital:*

Children's Hospital Boston (Children's) is a 396-bed comprehensive center for pediatric healthcare. Every year, Children's records approximately 22,600 inpatient admissions and schedules over 527,500 visits in its 204 specialized clinical programs. In addition, the hospital performs 23,000 surgical procedures and 170,000 radiological examinations every year.

➢   *Introducing BI:*

Because Children's is an incredibly complex operation providing highly critical pediatric care, strengthening its knowledge management infrastructure and processes is essential. Therefore, to find ways to improve quality of care, streamline our compliance processes, and be able to answer critical questions using trustworthy, in-depth business intelligence. To help them get there, Danny Shaw, their director of knowledge management and his team turned to SAP® Business Objects™ business intelligence (BI) solutions. Because of the incredible complexity of their data, IT has been building reports for departments and laboratories across the hospital. By establishing teams of super users from various departments, Children's could empower clinicians themselves to create the reports they need and ease the IT bottleneck. Implementation of the selected SAP Business Objects BI solutions took only six months.

➢   *Current BI Setting:*

With the successful implementation of SAP Business Objects BI solutions, Children's is leveraging its large, complex store of administrative, clinical, and research data to gain greater insight and information accessibility. Key personnel throughout the hospital now have the analytical support – including new clinical research and clinical operations metrics they need to make good decisions.

"We were always asking good questions," says Shaw. "We just didn't have good data to answer those questions; and as a result, competing versions of the truth

would emerge. Today we have validated data and analytics so that everyone recognizes a single version of the truth." The new software has helped the IT team be significantly more productive. Management recognizes the tremendous benefits to quality of care, efficiency, and cost containment that can be achieved through dashboards that fully integrate with our deployed BI solutions." As a result, Shaw's team is using Xcelsius® software to deploy two executive-level dashboards for operating room utilization and financials. Both dashboards track metrics and KPIs in real time and provide alerts when specific thresholds are exceeded.

Reaction to the dashboards has been positive, and Shaw's team will be bringing more of them online across key departments. "The data marts and key reporting were already in place to support our Xcelsius dashboards," says

Shaw. "Dashboard deployment is a great example of our continuing effort to leverage our data marts and SAP Business Objects software to provide fast, powerful insight to everyone in the hospital who needs it."

4. **Texas Children's Hospital**

➢ *About the Hospital:*

Texas Children's Hospital is a pediatric hospital located in the Texas Medical Center in Houston, Texas. With 639 licensed beds and 465 beds in operation, Texas Children's is the largest children's hospital in the United States. As of 2011, U.S. News & World Report ranks Texas Children's Hospital #4 amongst the pediatric hospitals in the nation, the highest rank for any Pediatric Hospital in the Southern United States.

➢ *Introducing BI:*

Executives of the hospital realized that improving the flow of patients through the hospital would reduce wait times and minimize, if not eliminate, "the census alerts"- meaning that they were operating at capacity. The clinical team identified a new challenge: The hospital lacked a consistent, comprehensive, and timely way to aggregate, analyze, and display patient flow measurements. This was a very practical challenge for the hospital's staff.

What the hospital needed, executives decided, was a centralized business intelligence (BI) tool, accessible to all staff, which would provide data on and analysis of patient flow measurements. Another requirement was that data and analysis had to be provided quickly enough for administrators and others to resolve patient-flow bottlenecks as they were occurring. Next-day reports would not be of much use. Some departments already used BI tools, although inconsistently and mostly for clinical research. The hospital considered using Business Objects reporting, primarily because the tool was included with the electronic medical record (EMR) system that the hospital already used. That EMR would provide most of the raw data for the new BI solution.

➢ *Current BI Setting:*

Solution uses Microsoft SQL Server Integration Services to pull flat-file data from the EMS system every 15 minutes, convert the data to a relational format, and deliver it to a SQL Server data mart. The SQL Server technology also pulls data from a custom bed-management database built on Microsoft .NET into the data mart with the same frequency.

The data then flows into a Microsoft SQL Server 2008 Analysis Services cube. Microsoft SQL Server 2008 Reporting Services uses the cube and the data mart to create 36 graphical reports. Hospital personnel view these graphical reports on a patient-flow dashboard that runs in a SharePoint intranet portal. The portal is part of each employee's personalized intranet home page and remains visible on select computers throughout the hospital (see Figure 16). Employees who want to explore and work with detailed patient-flow data do so by querying the cube and conducting "what-if" analyses using PerformancePoint Services and Excel Services in SharePoint Server 2010.
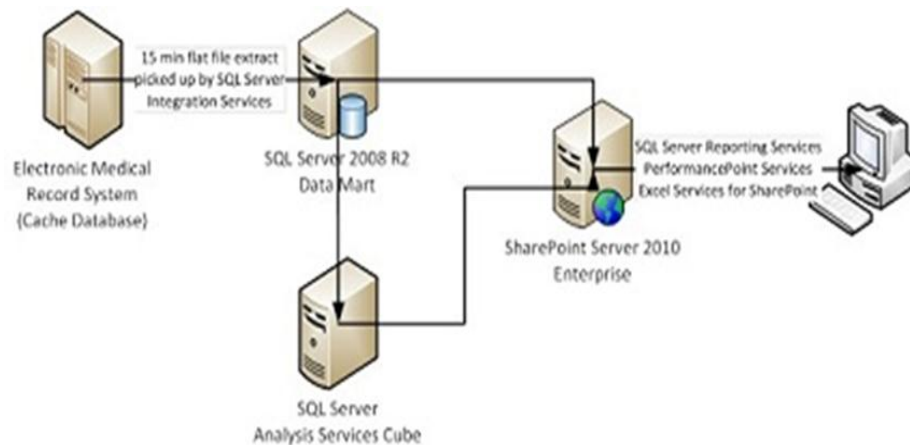
Fig. 18

Three key groups of employees use the patient-flow portal, each in different ways. Most are employees, from janitors to administrative and clinical assistants, who need to know how well their areas are performing at any given time, so that they can adjust their individual efforts as required.

➢ *Benefits:*

Texas Children's Hospital adopted a Microsoft BI solution based on SharePoint Server 2010 and SQL Server 2008 R2 Enterprise to treat more of the area population without having to build and staff new facilities. It succeeded. By using the BI solution, administrators could make better and timelier decisions. The solution was also easy for the IT department to adopt, because it fit in well with the technology that the hospital already used.

• Patient-Flow Bottlenecks Trimmed by up to 51 Percent.

The hospital has eliminated census alerts by minimizing potential bottlenecks—by 19 percent to 51 percent—in all of its key measures of patient flow.

• The hospital has achieved these reductions while keeping a careful eye on the quality of care, to help ensure that none of the hospital's new efficiencies has come at the expense of its core mission to serve children. Clinical outcomes such as infection rates are closely monitored. These measures confirm that the hospital is seeing more patients and operating more efficiently while maintaining its high level of patient care.

- Data Updated Every 15 Minutes, Spurring Better, Timelier Decisions

Hospital administrators are making better and timelier decisions by taking advantage of the near-real-time, updates produced by the system every 15 minutes, and by using the highly intuitive dashboard, which is based on PerformancePoint Services and hosted in the SharePoint portal.

- Familiar Technology Adopted Easily

Meanwhile, the Microsoft BI solution has fit easily and cost-effectively into the hospital's infrastructure. "Because this solution is based on SharePoint Server and SQL Server, we already knew almost everything we needed to know to make it work," says Sides. "We didn't have to hire a consultant to design and build this, and we don't need additional people to manage it. We can be flexible in how we staff it, because our IT staff already understands .NET. Spinning up a new database instance is a familiar task in our organization."

- "While we went with what we knew, the BI capability in SharePoint Server 2010 gave us the opportunity to provide value to the organization at every level," says Sides. "Now, that's a cool feeling." he said.

All these above case studies prove that with adoption of a BI/DW solution, a hospital can optimize its operations and reach indisputable success. It not only benefits the hospital but also its patients.

8.2.2 Business Analytics for Healthcare using cloud as well on premises.[2]

Ideal Analytics is a new member in the BI market. This BI tool has some unique features – it's completely based on open-source technology to provide a low-cost

and high quality solution to customers, it provides complete flexibility to the user to design the query and customize the reports and it uses cutting edge technology of column based database for lightning performance; on top of this IDEAL DASHBOARD is conceptualized on a SaaS model so that the customers get the benefits in a more cost-effective manner without going through the pains of hosting, maintenance and associated overheads.

Column-oriented and row-oriented databases:

A column-oriented DBMS is a database management system (DBMS) that stores its content by column rather than by row. This has advantages for data warehouses and library catalogues where aggregates are computed over large numbers of similar data items.

A row-oriented database serializes all of the values in a row together, then the values in the next row, and so on.

E.g.:

   1, Smith, Joe, 40000;

   2, Jones, Mary, 50000;

   3, Johnson, Cathy, 44000;

A column-oriented database serializes all of the values of a column together, then the values of the next column, and so on.

E.g.:

   1, 2, 3;

   Smith, Jones, Johnson;

   Joe, Mary, Cathy;

40000, 50000, 44000;

This is a simplification. Partitioning, indexing, caching, views, OLAP cubes, and transactional systems such as write ahead logging or multisession concurrency control all dramatically affect the physical organization. That said, online transaction processing (OLTP)-focused RDBMS systems are more row-oriented, while online analytical processing (OLAP)-focused systems are a balance of row-oriented and column-oriented.

1.   Column-oriented systems are more efficient when an aggregate needs to be computed over many rows but only for a notably smaller subset of all columns of data, because reading that smaller subset of data can be faster than reading all data.

2.   Column-oriented systems are more efficient when new values of a column are supplied for all rows at once, because that column data can be written efficiently and replace old column data without touching any other columns for the rows.

3.   Row-oriented systems are more efficient when many columns of a single row are required at the same time, and when row-size is relatively small, as the entire row can be retrieved with a single disk seek.

4.   Row-oriented systems are more efficient when writing a new row if all of the column data is supplied at the same time; as the entire row can be written with a single disk seek.

In practice, row-oriented architectures are well-suited for OLTP-like workloads which are more heavily loaded with interactive transactions. Column stores are well-suited for OLAP-like workloads (e.g., data warehouses) which typically involve a smaller number of highly complex queries over all data.

Compression

Column data is of uniform type; therefore, there are some opportunities for storage size optimizations available in column-oriented data that are not available in row-oriented data. Columnar compression achieves a reduction in disk space at the expense of efficiency of retrieval. Retrieving all data from a single row is more efficient when that data is located in a single location, such as in a row-oriented architecture. Further, the greater adjacent

compression achieved, the more difficult random-access may become, as data might need to be uncompressed to be read. Therefore, column-oriented architectures are sometimes enriched by additional mechanisms aimed at minimizing the need for access to compressed data

The entire system is divided into six main functions identified as the steps in data analysis life-cycle.

I. **DEFINE** your data

II. **IMPORT** your data from your system to Ideal Analytics

III. **ANALYZE** data

IV. **PERSIST** analytical views for later use

V. **EXPORT** analytical views

VI. **EXTERNALIZE** or embed analytical views to other systems.

I.   Define:

This function represents the process of defining your data for analysis. Data which is supposed to be considered as input for analysis must be well structured which means, there must be a data model behind the raw data. Modeling any transactional data includes classification and characterization of every single part of it. This way, a well-structured data turned to be usable for analysis.

This part is done by the Connecter Management functionality of the system.

Connecter Management:

-             Used to locate data:
-             Used in defining the format of the data source.

A connecter is a communication bridge between the data and the software used to fetch data.
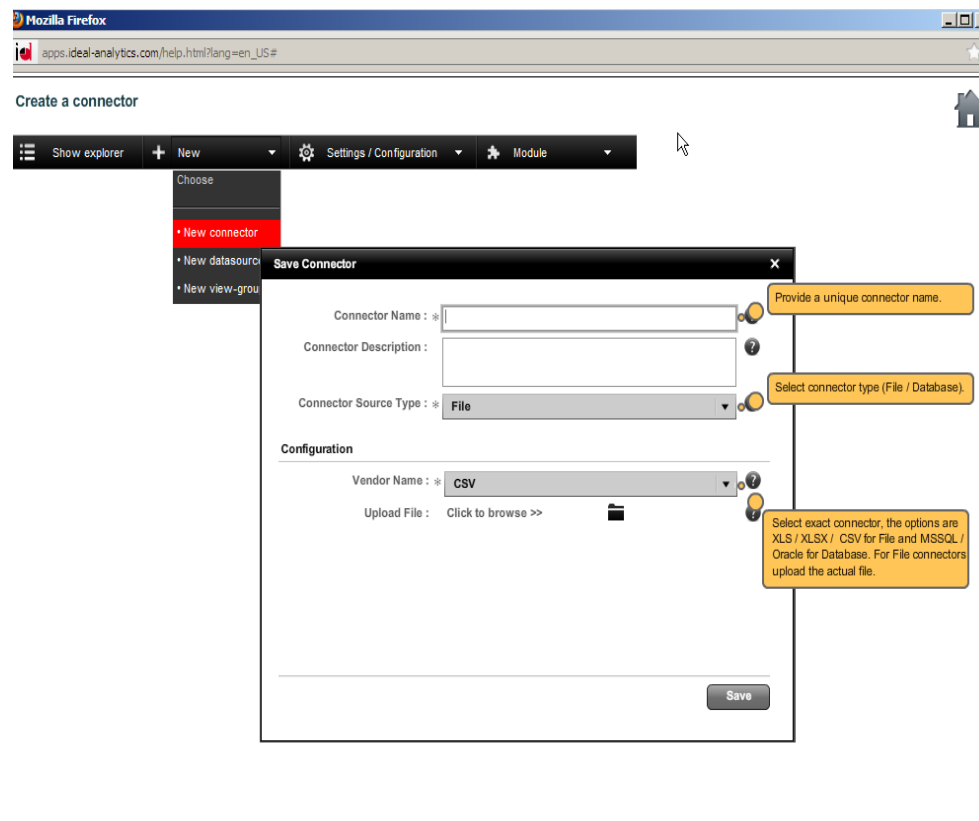
Fig 19. How to add a Connector in IA

The above image is the form for a database connector, i.e. the connector which has database as the source type. Database vendor needs to be selected (MySQL/Oracle/MSSQL Server) along with host (IP address of the computer with which the host machine may be accessible by Ideal Analytics server, port, user name, password and the database name which need to entered to create a database connector. There is a link at the bottom called "Test connection". This is used to test whether the connection parameters have been entered correctly. This way, database connectors can be saved in Ideal Analytics.

One can change, modify and delete a connector by right-clicking of the connector.

Connector management		
Connector name	**Type**	**Description**
data	Microsoft Excel 2007	akshay data
DATA2	Microsoft Excel 2007	Data
disertation repot final	Microsoft Excel 2007	disertation report for college
Dissertion Report	Microsoft Excel 2007	Dissertation Report
final now	Microsoft Excel 2007	
final now 1	Microsoft Excel 2007	
final1	Microsoft Excel 2007	
Hospital Analysis	Microsoft Excel 2007	
IlhmrData	Microsoft Excel 2007	
Jasmit Data	Microsoft Excel 2007	
Lpl	Microsoft Excel 2007	lpl
project	Microsoft Excel 2007	
Project 2 con	Microsoft Excel 2007	
Project con	Microsoft Excel 2007	
Random Sampling	Microsoft Excel 2007	RMS
Random Sampling 22	Microsoft Excel 2007	Random sampling 22
Ridhi analysis	Microsoft Excel 2007	
sample	Microsoft Excel 2007	
Surgery Details	Microsoft Excel 2007	Surgery Details
Test	Microsoft Excel 2007	Test
Test-Surgery	Microsoft Excel 2007	
test2	Ideal Analytics	test12

Context menu overlay:
Add connector
Edit connector
Delete connector
Settings...
Global Settings...
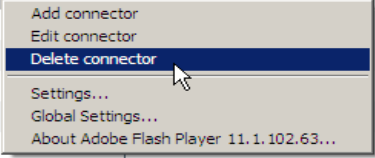About Adobe Flash Player 11.1.102.63...

Fig 20. Adding or edit the Connector

Data Source Management

After locating the external system (e.g. file, database etc.) you need to locate data residing in that system. For example, you need to specify the sheet name in an excel file or the SQL query using which your data will be identified in your external system. This can be done using data-source in Ideal Analytics.

Therefore, the data-source is an intermediate entity which recognizes the raw data you want to analyze using Ideal Analysis.

Like connectors, there are management functions to create, change or remove data-sources in Ideal Analytics.
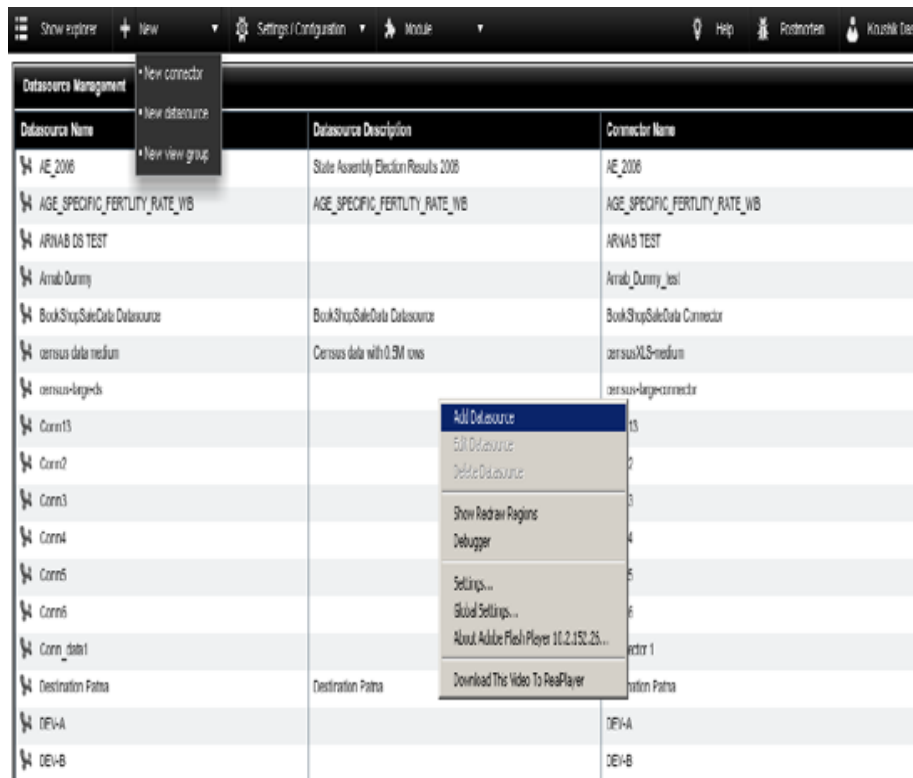
Fig 21. Adding a data source

II. **IMPORT**

This module states how to import data from already configured data-set. The importing is used to Analyze on data.
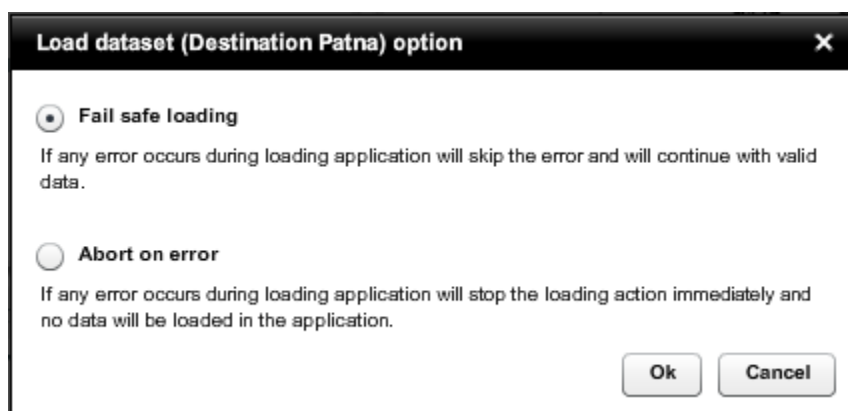

Fig 22. Loading the data set

This is a special type of loading strategy as given by the application. At the time of loading, if any error occurs, those will be avoided.

When the source column carries a particular data-type and the column defined in the data-set carries other data-type, then at the time of type casting or conversion, there is a greater probability to occur error.

III. ANALYSE

This is the most important module of this application. This carries the key aspects of application (for which, it is being used).
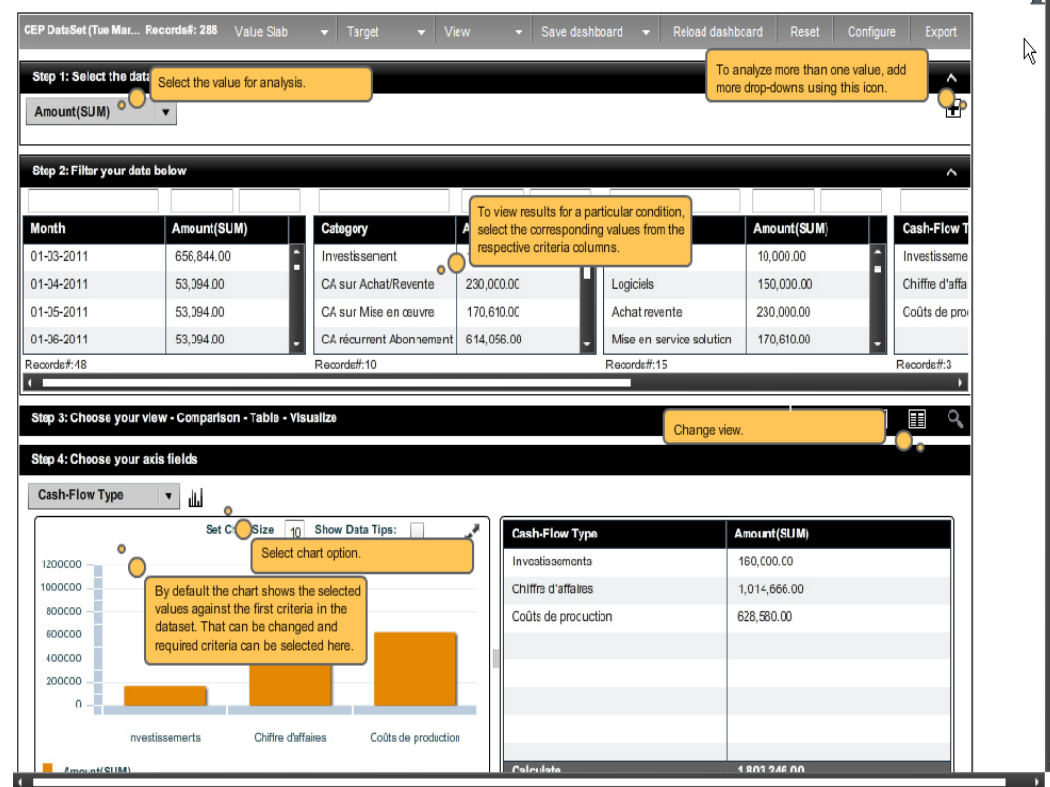

Fig.23. Exploring datasets

The explorer carries graphical analysis based on the data-set information. The Data-set Explorer is the objective of this property. The data-set explorer is available from the context menu option of Ideal-Analytics Explorer by right clicking on any data-set. One can also double click on the data-set to do the same thing. But the important matter is, data-set must be successfully loaded. And, one must reload a data-set after editing it to get the analysis on the updated one. The above image carries the snapshot of an explorer.
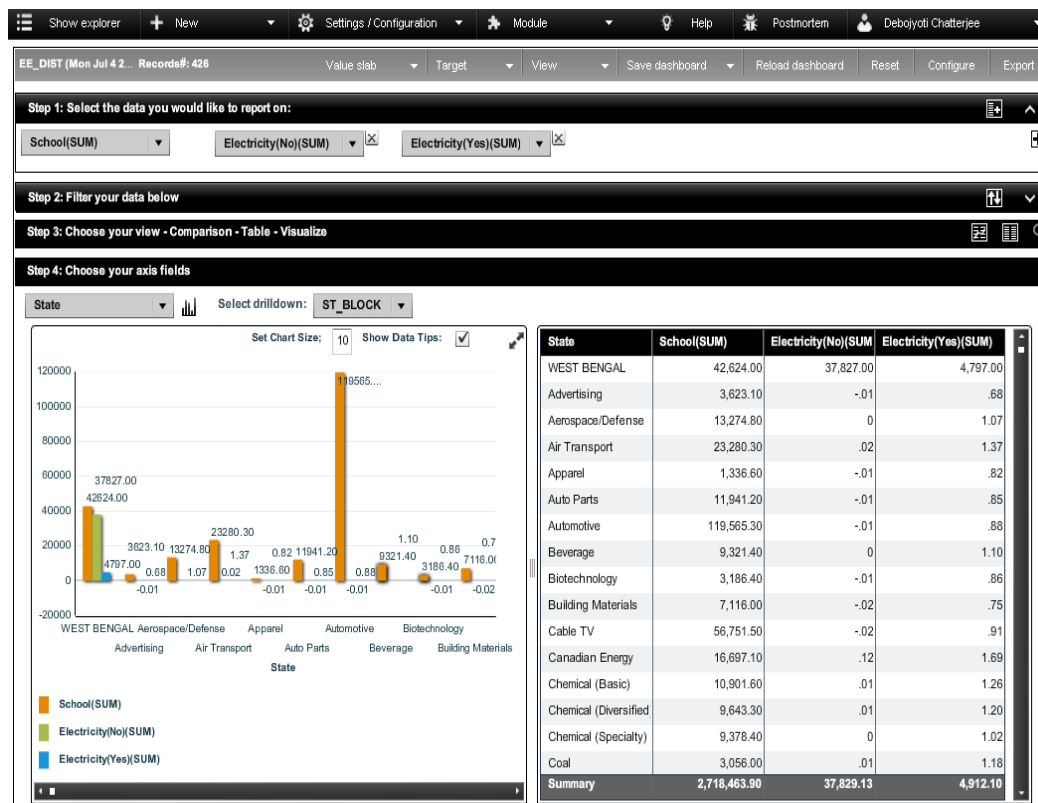
Fig. 24. Analyzing different dimensions

IV. **PERSIST**

This module describes how to save the analytical output (the views) into the system and load them on demand. It includes the view loading and saving into Dataset Explorer and Application Dashboard.

Loading Saved Views

To load a saved view or view profile, one should go to the 'View' option from menu bar items of Dataset Explorer and then go to the 'Load view(s)' option.

Dashboards

This section is an important one which can be said as most important among the Explorer module which is loaded after login if dashboard is already created. This section can be called as an important system function also where a user or multiple users can save their view associated with multiple view groups. A View Group is a collection of views. In the dashboard, different view groups are separated by different tabs. This section includes the different types of dashboard, adding views and view groups into it and removing those

Requirement of a BI/DW Tool by a Healthcare Provider
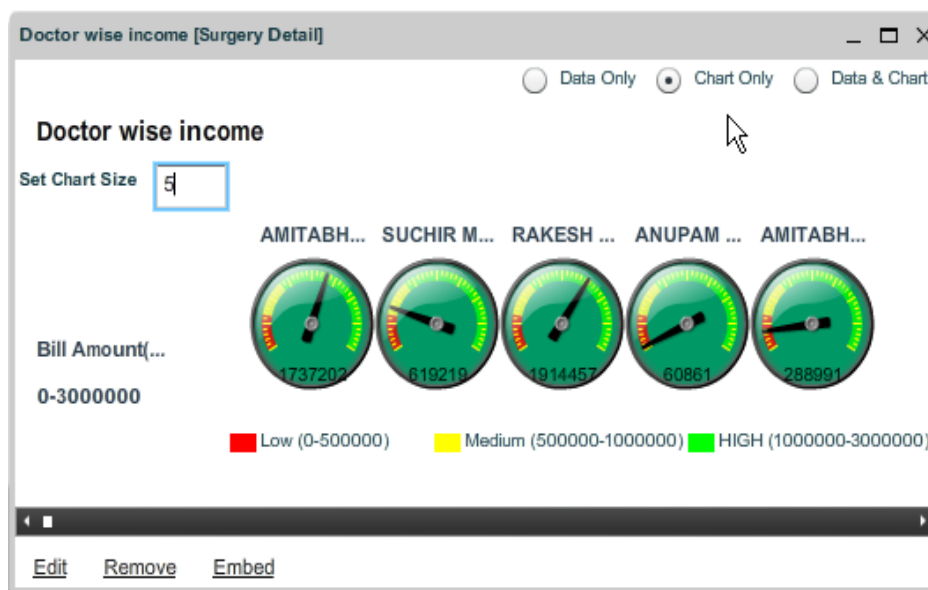
Two types of dashboards are there:

- Personal Dashboards:

- Corporate Dashboards:

Publically available dashboards are called corporate dashboards here.

A dashboard can be saved depending on the user if he/she wants it to be visible to others or not.

Fig 25(a) A Corporate Dashboard

Fig 25(b) A Corporate Dashboard

The corporate dashboard is the shared dashboard. Basically, the corporate dashboard is a common space for all users where they can publish or see the views. By default, this dashboard is loaded. The embed option is for externalization. A feature which will be explained in the next section.

Personal Dashboard:

The name of this type of dashboard carries its meaning. Each user has a separate personal dashboard. This dashboard can't be shared like the previous one. The options to switch over between these two types of dashboards are given at the top right corner.

V. EXPORT

This is the module where one can export/download the analytic view along with data for a data-set. It means after the analysis, user can download either the chart view, or the data-view or both of them. The 'Export' option is available from the menu bar items in Dataset Explorer
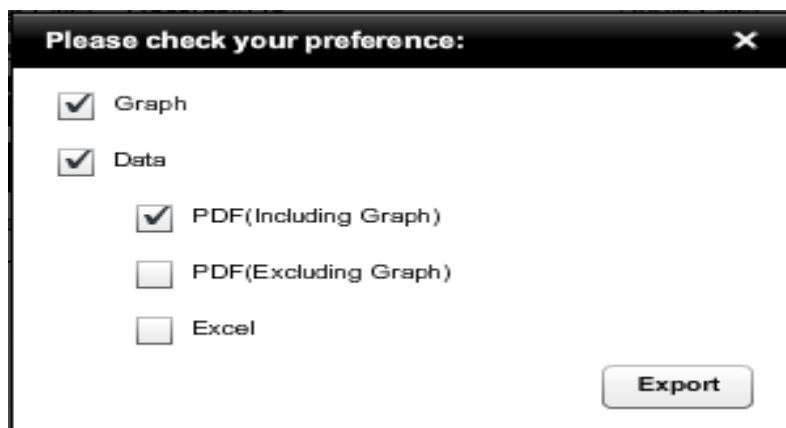

Fig 26. Export Options

Supported Formats

The supported formats for export gives various options in the previous pop up. For graphical view, only .jpg and .pdf formats are supported by the system. And data-view gives the options for different types of formats like .pdf, .xlsx etc. The .pdf format supports two types of feature. One is data including graph and the other is data view only

VI. Externalization:

A dashboard view can be externalized to a different web page in any domain. This way, any dashboard component can be made available in any external system with live data in effect through a unique and secured communication.

The option for externalization is available in the dashboard. Option is available as 'Embed' link button associated with every view-group. User can copy the text defined in 'Copy Embed URL' text area, and paste it in the html code of external application. The 'Copy' link button is the another way to copy that text.
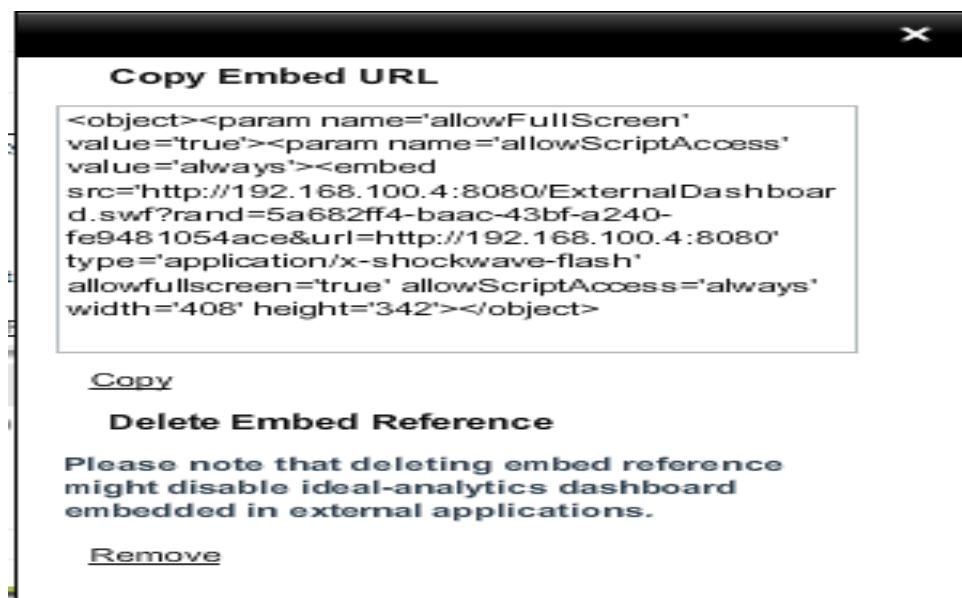
Fig 27. Embedding a Dashboard in external applications

To delete the external referenced area for a view, user can follow the 'Remove' button click for a view. The view will become unavailable from the external applications.

This Solution has many features which give it an edge over the other BI Solutions. Key features are as follows:

- **Multi-Tenancy:** The multi-tenant back-bone of the system architecture gives users options to choose their deployment scenario, wisely. Either you can subscribe to a hosted service or you can have the product installed in your private data centre.

Requirement of a BI/DW Tool by a Healthcare Provider

- **Web-based:** Completely web-based user interface containing multiple facts and dimensions present on the screen enables its users to do anything from anywhere, in real-time.

- Role-based definition of tasks controls participation of users within an organization or account.

- **Groups and Users:** Logical separation of your users helps you to hide your data across departments or designations or different positions in your organisation.

- Ability to load data from multifarious data-sources like DBMS, XLS(X),CVS etc.Hierarchical dataset repository to facilitate data organization as well as hierarchical access control to restrict users' domain of visibility

- Single window for multi-dimensional, multi-fact analysis

- RIA based user-friendly GUI, for filtering, drill-down, and view tables and charts immediately

- Export facility to export the reports in various formats

- One-click externalisation of dashboard items (for embedding in proprietary applications/web-sites/live documents)

- Forecasting and Trend Analysis over time-series data

- Mobile Access from Blackberry, Android, iPhone, Java phones and windows mobile based devices to bridge the last mile between users and system

- Column based Databases for performance improvement

- RIA based UI for better user experience.

9. Limitations:

- The target sample size for the survey was 60. But due to unavailability of respondents   it was reduced to 48. The sample population is unevenly distributed because of the same reason.

10. Conclusions:

The objective of the study was to show how relevant is a BI/DW solution in a hospital. By the results obtained from the survey it can be concluded that a BI/DW solution is the need of the hour for a healthcare provider. All users feel BI will give them increased business competitiveness and reduce financial and operational risk. So, deployment of such a tool must not be delayed.

Although the provider uses a reporting tool for quality control purpose, there is lack of data warehousing in the hospital. The current decision making process is based upon the data gathered from this reporting tool which takes a lot of time and effort. The results from the survey suggests that non-implementation of a BI tool is due to lack of knowledge about these of tools.

Healthcare executives should not waste time searching for information. They should not be overwhelmed with redundant and inconsequential data. They should have correct and consistent information. Therefore, a BI/DW tool is needed. It will improve their service quality and help them see trends in data. Overall it will help them make better decisions at a faster rate. This can be concluded from various case studies cited above. Adopting a BI Solution has helped many such hospitals. The literature review showed many instances of positive impact of the use of BI software specifically regarding the availability and accessibility of information, hence their incorporation into systems for decision support. It will not only help a hospital in financial management but also in managing the quality of care provided to the patient.

11. Recommendations:

1.   As per Primary Work Unit is concerned more clinicians should be made aware of a BI/DW Solution. A BI/DW tool can not only be used for the administrative purposes, but also for clinical purposes. The awareness and utility of such tool should increase for the clinicians and nurses.

2.   Talking specifically about the Business Intelligence awareness in the hospital, the awareness seemed to be very low therefore it needs to be increased 4 or 5 folds. This can be done by conducting workshops centered upon Business Intelligence.

3.   The respondents who use MS Excel as their information tool should get information from the BI/DW Tool.

4.   Adopting a BI/DW Tool will resolve the concern to have quality data and storing/retrieving of the historical data as well.

5.   The primary users for a BI/DW solution were indicated to be mostly hospital administrators in the study. It should be more of clinicians and nurses.

6.   From a financial perspective the decision maker to buy a BI/DW solution will be the CFO (Chief Financial Officer), but looking from the need perspective this decision should be taken by the Medical and Hospital Administrators.

12. References:

1.   Pubudika Kumari Mawilmada (Oct,2011), *Impact of a Data Warehouse Model for Improved Decision-making process in healthcare.*

2.   Bhattacharya I, Ramachandran A*, Jha BK. Healthcare Analytics on the Cloud. Online J Health Allied Scs. 2012;11(1):1*

3.   Michal Micklas, (2010) *Use of Open Source Business Intelligence Software in Hospital Management.*

4.   Kroch et al (2006), *Hospital Boards and Quality Dashboards, J Patient Saf, Volume 2, Number 1.*

5.   Hugh J Watson, (July,2005), *Data Warehouse Architectures: Factors in the Selection Decision and the Success of the Architectures.* Available at http://www.terry.uga.edu/~hwatson/DW_Architecture_Report.pdf

6.   Ghani and Soares, (2006), *Data Mining for Business Applications, SIGKDD Explorations Volume 8, Issue 2, Page 79-81*

7.   Wisniewski et al., *(Sep / Oct 2003) A Clinical Data Warehouse for Infection Control, Journal of the American Medical Informatics Association Volume 10 , Number 5, Page 454-462.*

8.   Frates and Sharp (2005*), Journal of Competitive Intelligence and Management , Volume 3, Number 3, Page 16-28.*

9.   Bayli, P (2009), *White paper* on *Better Healthcare with Data Mining.*

10.   Mettler and Vimarlund (2008), *Understanding Business Intelligence in the Context of Health Care*

11.   Gaddum, A. *iLink Systems, White paper on Business Intelligence (BI) for Healthcare Organizations.*

12.   Negash, S (2004). *BUSINESS INTELLIGENCE, Communications of the Association for Information Systems (Volume13, 2004) Pg 177-195.*

13.   Agha Khan et al (2009*),Drivers and Barriers to Business Intelligence Adoption: A Case of Pakistan.*

14.   Sahama and Croll (2007), *A Data Warehouse Architecture for Clinical Data Warehousing.*

15.   Del Hyo-Barbolla and Lees*, The use of data warehouses in the healthcare sector, Health Informatics Journal* March 2002 vol. 8 no. 1 43-46

16.   Infosys. 2009, *White Paper on KPI's for effective Real-Time Dashboards in Hospitals.*

17.   Prevedello et al., *2008, Business Intelligence Tools for Radiology: Creating a Prototype Model Using Open-Source Tools, Journal of Digital Imaging, Vol 23, No 2 (April), 2010: Pg 133-141.*

18.   Jing-song Li et al., *Data Mining in Hospital Information System*

19.   Sanders D, *Healthcare Analytics: Standing on the Brink of a Revolution,* Journal of Healthcare Information Management — Vol. 16, No. 4, Page 17-21.

20.   Siemens, *White Paper on Using Business Process Management and Business Intelligence to Improve Healthcare, 2010.*

21.   Pourshahid et al., *Business Process Monitoring and Alignment: An Approach Based on the User Requirements Notation and Business Intelligence Tools, 2007*

22.   Vassiliadis et al*., Data Warehouse Process Management.*

23.   Kaur and Wasan*, Empirical Study on Applications of Data Mining Techniques in Healthcare, Journal of Computer Science 2 (2): 194-200, 2006*

24.   Borker S*, Business Intelligence Data Warehousing: An open source approach, 2006.*

25.   *Orwat C, Towards pervasive computing in health care – A literature review, BMC Medical Informatics and Decision Making 2008. Available from: http://www.biomedcentral.com/1472-6947/8/26*

26.   Langman M, *Variance between laboratory and Point-of-care testing of Blood Glucose: Business Intelligence Tools for Patient Safety, 2009*

27.   Aberdeen Group, *Business Intelligence in Healthcare: Have Providers found a Cure, June 2008.*

28.   Zack Jourdan, R. Kelly Rainer & Thomas E. Marshall (2008): *Business Intelligence: An Analysis of the Literature , Information Systems Management,   25:2,   121-131.   Available   at* *http://dx.doi.org/10.1080/10580530801941512*

29.   Koh and Tan*, Data Mining Applications in Healthcare, Journal of Healthcare Information Management — Vol. 19, No. 2, Page 64-71.*

30.   Villiers P*, Clinical Data Warehouse Functionality.*

31.   Grant et al., *Integrating feedback from a clinical data warehouse into practice organization, International Journal of Medical Informatics (2006) 75, 232—239.*

32.   Ferranti J*, Bridging the gap: leveraging business intelligence tools in support of patient safety and financial effectiveness, J Am Med Inform Association 2010; 17:136-143.*

33.   Kolar, H.R. *(2001). Caring for healthcare. Health Management Technology, 22(4), 46-47.*

34.   Christy, T. *(1997). Analytical tools help health firms fight fraud. Insurance & Technology, 22(3), 22-26.*

35.   Taylor et al., *Design of an Integrated Clinical Data Warehouse.*

36.   Roberts A, *Can Health Informatics/ Business Intelligence be used to support the review and re-development of Care Pathways?, 2008*

37.   Dindigal P*, Article on Healthcare Business Intelligence: Saving lives through enhanced information.*

38.   Rouhani et al*, Review Study: Business Intelligence Concepts and Approaches, American Journal of Scientific Research ISSN 1450-223X Issue 50 (2012), Page. 62-75.*

39.   Gangddharan and Swami*, Business Intelligence Systems: Design and Implementation Strategies, Published in 26th International Conference Information Technology Interfaces IT1 2004, June 7-10, 2004, Cavtat, Croatia.*

40.   Luhn H, *A Business Intelligence System, IBM Journal, Page 314-319. October 1958.*

41.   Bauer and Polakoff, *The Growing Importance of Data in Healthcare, Executive Briefing & Exchange, Volume 3, Issue 2- January 22, 2007*

42.   Jeusfeld M, *Design and Analysis of Quality Information for Data Warehouses.*

43.   Holland M, *The Future of Business and Clinical Intelligence in the U.S. Provider Market, Report published in Health Industry Insights: Healthcare Provider IT Strategies: Looking Ahead. January 2009.*

44.   Glaser J, *The strategic importance of data, Available online at http://www.hfma.org/Templates/Print.aspx?id=4828*

Appendix:

Questionnaire

Requirement of a BI/DW Tool by a Healthcare Provider: Essential or not?

Part A

1.   Name (Optional): ………………………………………….

2.   Age group
 ( ) 18 – 30;
 ( ) 31 – 40;
 ( ) 41 – 50;
 ( ) 51 – 60;
 ( ) Over 60

3.   Your Primary Work Unit/Department

☐   Clinical Department
☐   Administrative Department.
☐   Finance Department
☐   Others………………

4.   Specify your position in the Hospital (Job Title)
 ………………………………………….

Part B

5.   Do you know what business intelligence is and how it can be used in hospitals?
☐   Yes
☐   No

6.   Which of the following best describes your decision making process?
☐   Traditional method i.e. following advice of experienced personnel
☐   Information based method i.e. by using data from various sources.

7.   If you use traditional method, do you think the decisions are effective?
☐   Yes
☐   No

8.   If information based, which tool do you use to access the data?

………………………………………………….

9.   Please tick the features of the tool used?

☐   Standard reporting and ad-hoc analysis
☐   Standard reporting and trends analysis
☐   Standard reporting, trends analysis and data mining (or knowledge discovery)
☐   Standard reporting, trends analysis, data mining (or knowledge discovery) and advanced analytics (or predictive analytics)
☐   Standard reporting, trends analysis, data mining (or knowledge discovery), advanced analytics (or predictive analytics) and text analytics
☐   Don't know

10.   Are you satisfied by the support provided by this tool in making decisions?
☐   Yes
☐   No

11.   Please tick the information related issues you face in current decision making process?
☐   Lack of quality data
☐   Limited accessibility and availability of data from repositories
☐   Difficulty of getting the historical data
☐   Lack of efficient reporting tools
☐   Lack of time or resources to undertake analysis
☐   Others………..
☐   I don't know

12.   According to you, what are the possible reasons for not adopting a BI solution?

☐   Lack of financial support
☐   Lack of skills to implement BI/ Data warehousing
☐   Lack of exec. board interest
☐   No real or tangible benefits
☐   Poor ROI (Return on Investment)
☐   Lack of knowledge about BI products
☐   Lack of technology (pre -BI infrastructure)
☐   Lack of essential source data in digital form
☐   Inability to integrate BI application with current IT system
☐   Any other, please specify…………………………………..

13.   Do you feel that reporting tool in form of summary reports, statistical graphing, analysis, score carding, and dashboards will be beneficial in increasing the productivity of your department?

☐   Yes

☐   No

14.   What would you base KPI's on?

☐   Process related measure

☐   Outcome related measure.

☐   If any other, please specify………………………………