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Business Intelligence in Healthcare Industry

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Abstract:
Nowadays Business Intelligence applications are trending in different fields such as Healthcare, LifeSciences, ERP, Marketing, Retail, food industry, travel and transport industry etc. This paper mainly focuses on how we can use different ETL functionalities in order to ease the daily routine task used in different healthcare industries.

Keyword: DWH (Data Warehouse), DIKW (Data-Information-Knowledge-wisdom), ETL (Extract Transform Load), BI (Business Intelligence)

Introduction:
Business Intelligence (BI) is an umbrella concept; it is the term that refers to the set of technologies, architectures, practices, applications and processes for the collection, integration, analysis, and presentation of business information that drives profitable business actions. Making smart decisions based on factual data to achieve and sustain a business competitive advantage is the main reason behind investing in BI tools and technologies by providing decision makers with effective, clear, and timely information.Different Tools that are available in BI make it possible for organization to understand the market trends and make suitable decisions.
The DIKW Pyramid represents the relationships between data, information, knowledge and wisdom where each building block is a step towards a higher level - first comes data, theninformation, next is knowledge and then comes wisdom. Each step answers different questions about the initial data and adds value to it. The more we enrich our data with meaning and context, the more knowledge and insights we get out of it so we can take better and informed decisions.

Business Intelligence in Health Care Domain
Just like the advancement in volume of data in various sectors like the Banking and Finance domain, data in healthcare sector has also been increasing alarmingly. This sector is changing rapidly. In Healthcare sector the data is being generated is in structured, unstructured as well as semi-structured form. In order to deal with such type of data we need Business Intelligence tools and techniques.A general Business Intelligence architecture generally consist of various components or layers. A robust BI architecture framework consists of the following components :-

1. Data Gathering
2. Data Integration
3. Data Storage
4. Data Analysis
5. Data distribution
6. Data Driven decisions on generated insights[1]

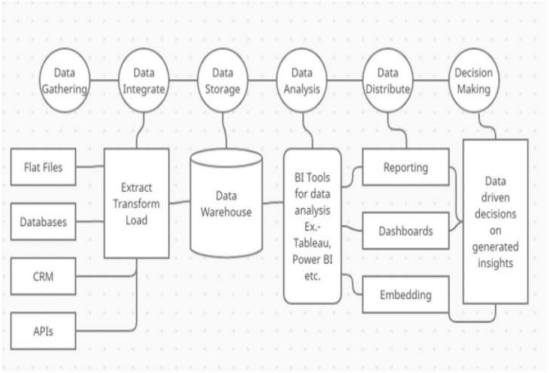

Fig1.1 Business Intelligence Architecture Framework

Data Warehouse Designing in Business Intelligence:

Effective decision-making process are highly dependent on the quality information. Data warehousing and Business Intelligence are the terms which are typically used to describe the process of storing all the company's data in external and internal databases from various sources with the prime focus on analysis, and generating useful insights via BI tools. A data warehouse (DWH) is a system which is used to store information for use in data analysis and reporting. Data marts are areas of a data warehouse which is further used to store information needed by a single department or even by an individual user.

The ETL process is used to add "new" data to the OLAP system on regular basis. ETL stands for Extract, Transform and Load. As the name suggest, it is the process of extracting the data from one or more data sources, and then transform the extracted data as per the requirement in order to fit our warehouse structure and then load final transformed data into the DWH.

A proper dimensional model in data warehouse is designed to summarize, analyze and read information. Dimensional modelling is a data structure technique which is used to optimize data storage in a data warehouse. Dimensional modelling uses two major key concepts that are fact tables and dimension tables.

ETL:

ETL tool that we are using is Pentaho Data Integration (PDI) .Pentaho Data Integration allows user to intake, blend, cleanse, transform & prepare diverse data from any source. It consists of visual tools in order to eliminate coding and complexity [2]. PDI uses steps or entries to create jobs and transformations. Each entry is connected by a hop which passes the data flow from one step to next step. Basic concepts of PDI are following:-

Transformations

A transformation is a bunch of steps, which further represents data flow.The main componentsassociated with transformations are following:-

1. Steps-Steps are known as the building blocks of transformations. In PDI total number of steps are 140. Each step is designed to perform its own specific task. Some categories of steps for different purpose are for input, output, utility, scripting, joins, lookup, data warehouse, Mapping etc. A step can have more than one connection.
2. Hops-A hop is data pathway or we can say a connecting network between two steps which passes the data flow from one step to another step.

Jobs

Jobs are workflow like models which is used for coordinating execution and dependencies of various ETL activities.

The process of ETL is made up of three major components which are as follows:-

Extraction: - It is the process of extracting the data from the various heterogenous sources. We can omit out the irrelevant data, by simply filtering out our input data. And this simply can be done with

the help of below mentioned Job.

For filtering the rows

This module describes an ETL for filtering rows. In this ETL along with filtering it also tells us about mapping and how to get an output in text file. This step that is filter rows step allows the user to filter the rows on the basis of some conditions, computations and comparisons. The next step is value mapper whose function is to maps string values that is to overrides the string values from one value to another.

Transformation:-Any transformation needed to provide data that can be interpreted in business terms is done in the second step. Data sets are cleaned with regard to their data quality. Eventually, they are converted to the scheme of the target database and consolidated.[3]

ETL for Data Transformation

This job describes an ETL for group by. This step allows the user to calculate the values overthe defined group or set of fields. This statement is often used with different aggregatefunctions. Aggregate functions are the functions that are applied over the values of differentrows to give a particular result or select the particular value from a row. The Group by step of pentaho ETL is works only for sorted input.

Loading: - Loading is our final step, in which the final transformed data is now ready to get loaded in the dedicated Datawarehouse.

Data Loading

The database lookup step is used to lookup values in a table created in database. Firstly for using this step, the user must to create a connection with database and then load the final transformed data to our dedicated Data warehouse.

We can also use various kinds of functionalities with the help of ETL tools. I am mentioning one major ETL job i.e., used for sending an email. This job will help out the dedicated end user to know whether the job is done or not.

ETL for email sending

We can further more enhance these steps, by using Pentaho Reporting. Pentaho Reporting is a suite of tools for creating pixel perfect reports.

Also, we can use multiple data visualizations tools for creating the dashboard of final loaded data in the database, which directly helps the end user to see and understand the flow of data, and helps the end user to take quick decision.

Benefits of Business Intelligence in Healthcare Industry

The major benefits of Business Intelligence in healthcare industry includes:-

1. Improve Decision Making
2. Manage Patient's data
3. Improve Clinical Decisions
4. Brings Transparency
5. Ensure data consistency
6. Enables a more efficient reporting process
7. Patient care and satisfaction
8. Better Cost Management
9. Helps in Inventory management
10. Maintaining the Data Quality :- The data quality process includes data cleansing, datavalidation, data manipulation, data quality tests, data refining,data filtering and tuning. It is a crucial area to be maintained inorder to keep the data warehouse trustworthy for the businessusers. ETL plays a major role in data cleansing and data qualityprocess as it helps automate most of the tasks [4].

Conclusion:

We can use Business Intelligence tools combined with Artificial Intelligence techniques in healthcare sector in the following ways

1. AI Chatbots: - Artificial Intelligence based chatbots can be used to address patient queries and also guide them to receive the appropriate help. This will directly ease the burden of medical professionals by providing solutions for simple medical issues.
2. Health care Dashboards:-A healthcare dashboard is a modern way to monitor healthcare KPI's (Key Performance Indicator) in the interactive way. It compiles the scattered data in a single glance, that enables healthcare professionals to access important patient

statistics in real-time to increase the overall hospital performance and patient satisfaction.

3. Patient Personalization: - Business Intelligence tools, software and applications helps in enhancing the accessibility of patient data. For example – if a patient was diagnosed with tumour in 2015 and then got cured in that year only but due to some reasons in 2019, another tumour got detected. Then with the help of BI tools doctors can track the patient's medical history.

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