REVIEW OF RESEARCH
IMPACT FACTOR : 5.7631(UIF) UGC APPROVED JOURNAL NO. 48514 ISSN: 2249-894X
VOLUME - 8 | ISSUE - 4 | JANUARY - 2019

CONCEPTUAL FRAMEWORK ON BUSINESS INTELLIGENCE AND ANALYTICS THROUGH BUSINESS PERFORMANCE MANAGEMENT

Palak Vaish[1] and Dr. Saurabh Shrivastava[2]
[1] Research Scholar , Mewar University, Chittorgarh, Rajasthan, India.
[2] Department of Mathematical Sciences and Computer Applications Bundelkhand University, Jhansi, U.P., India.

ABSTRACT :

Today companies are highly demanding management driven by metrics for achieving their long term goals, strategies and short term goals and targets. For such prompt and correct decision making and competitive intelligence, companies need extensive data analytics, business intelligence, data visualization and predictive analytics support and so Cloud, Data Warehouse, Data Miners, web architecture and advance analytical tools like SAS, R, Python, Teradata etc. are required. Data marts and Data Warehouse support extraction of meaningful and unknown information from raw data in bottom-up fashion but they fail in top-down enforcement. So, new approaches to Business Intelligence as Analytics, Business Performance Management are budding from this framework. This paper aims to study various aspects of BI, DM, DW and Analytics so as propose a BI framework and find out the need to develop BI tools for its acquisition, integration, search analysis, cleanup, and delivery.

KEYWORDS : *metrics, data warehouse, analytics, business intelligence, data mining.*

I. INTRODUCTION

Information sharing through network of systems provides knowledge integration and distribution which is essential for business intelligence. It provides vertical and horizontal information integration, data mining in internet and cloud-enabled warehouse and improved communications [26]. Data are the most basic depiction of activities, entities, events, and transactions that may be collected from internal and external sources. Raw data may be collected manually or by instruments like questionnaire, surveys, observations etc. Information is an organized and controlled data having some meaning and value for the decision framework. Knowledge is the processed data or information that provides solution to a problem or an activity by implying inferences, understanding or learning. Quality of facts can be ensured by number of parameters as usefulness, contextual meaning, accessibility, representation, robustness, accuracy, timeliness etc. but it is often neglected or not handled seriously during data summarization and processing that leads to usage of poor quality, incorrect data, poor indexed data, outdated data or unavailable data [1].

Solutions to have good quality data

- A systematic and automated data entry mechanism
- Quality checks on data generated
- Security alerts and programs to ensure data validation
- Web and cloud usage for correct, live and fresh data
- A system for rescaling, restructuring and recombining indexed data that is not of good quality
- Usage of multiple data marts and single or distributed data warehouses

- Search engines channelization and good selection
- Use of simpler or highly aggregated models
- Future data prediction

Data needs to regularly cleansed while populating warehouse, measuring results and preparing data quality action plan as there might be lot of data integrity concerns associated to completeness, uniformity, conformity, version and genealogy of data. Thus data integration requires accessing and monitoring of varied sources like dissimilar and diverse enterprise databases, artificial and intelligent agents, content and learning management systems, document and database management systems, commercial databases and XML.

II. OBJECTIVES OF THE STUDY

- To study management of data and its underlying issues.
- Understand role of Business Intelligence and its relevance.
- Understand need and framework of data warehouse and data marts.
- Examine how data manipulation and analytics can enhance decision making.
- Understand the relation between database technology and business analytics.
- Study and propose new framework for BI, BI & A
- Study emergence of Business performance Management (BPM).

III. DATA WAREHOUSE (DW)

It is a subject related, scrubbed, non volatile, summarized, may be redundant not normalized repository of data storage from both internal and external sources maintained so that data from varied and discrete sources are consistent and uniform. It includes both business data and semantic metadata [9]. Data mined from all pertinent sources and metadata repository is first cleansed and organized in consistent manner to detect problems in quality before data is transferred through data-transformation tools or programs into data warehouse for separate operation and decision support environments.

Based on back end data acquisition and front end client interaction, data warehouse may have one or more of following tiers-

- One tier data warehouse in which same platform is used to run all and so it is rare.
- Two tier data warehouse in which client DSS engine is shared with warehouse and so it is more cost-effective.
- Three tier data warehouse in which all functional parts are divided.

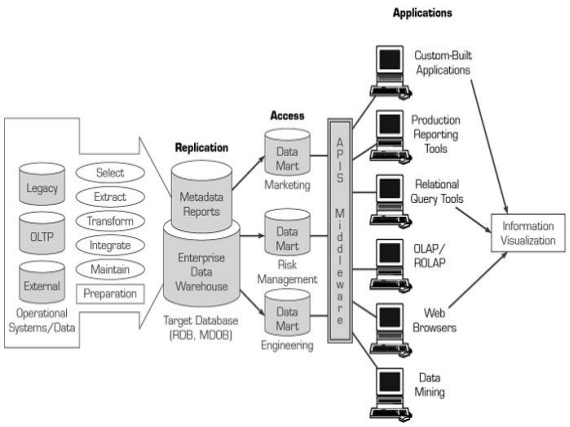

Figure 1. Framework and Views of Data Warehouse [26]

Data Marts

Data Marts are smaller, simpler and cheap version of data warehouse created and maintained for a department either as a replicated functional subset of warehouse or as independent multiple data marts which are difficult to integrate.

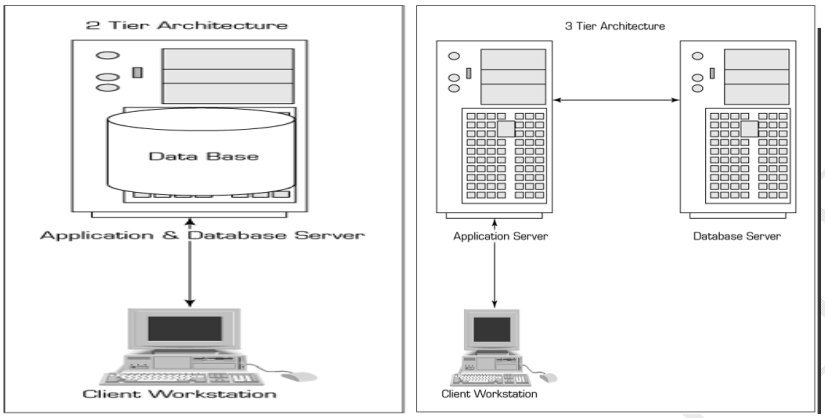

Figure 2. Architecture of a 2-Tier and 3-Tier Data Warehouse [26]

Data Warehouse can be developed using Top down, Bottom up, Hybrid or Federated techniques. It is mainly applied to provide scalability and flexibility to Projects which may be data centric or application centric based on number of Implementation factors like Organizational issues, technical issues and Project issues.

DW is a system that retrieves data in batches from the source and merges it into a normalized and dimensional data store or repository [16]. It helps in decision making from data that is related to subject matter, time frame, and need. It is a combination of all data marts within an enterprise. However, BI applications running on large databases pose a problem in reading and fetching of data. In such cases, various possible solutions are-

1. Extraction, Transforming and Loading (ETL) – Required data from several diverse operational databases is extracted and then transformed by filling missing values into right format. This processed data is then loaded in a suitable data warehouse by RDBMS.
2. Reporting tools

a. Production Registering Tools-they generate operational reports in batch mode on voluminous data. For example- salary slips.

b. Desktop Report Writers- helpful in designing queries and reports on small data.

c. Managed Query Tools- they are used for reporting on complex data using Graphical SQL [26]

Thus it removes stress from user's mind about data storage, location, consistency etc.

3. Modeling Techniques-methods and process of model conceptualization and designing for DW [2].

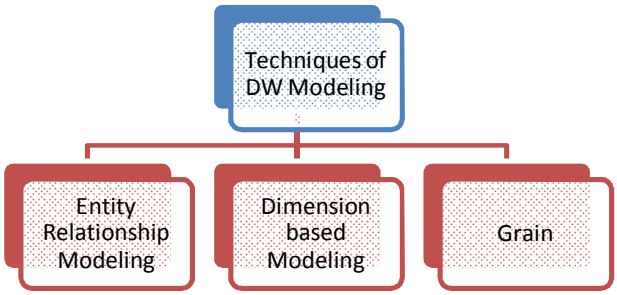

Figure 3. Techniques of Data Warehouse Modeling

Data Warehouse Design can be of-

- ER Modeling focusing on entities, their attributes and relationship between them
- Dimensional modeling which fetches data using star schema, central fact table and dimension tables. It is a powerful data model that uses measures and facts to make decisions and to represent business and user's requirements.
- Grain type having highest level of detail using drill-down analysis.

DW is also called as Online Analytical Processing (OLAP) because unlike Online Transaction Processing (OLTP) system which serves as daily operational information system, DW helps managers, analysts, decision makers and knowledge workers in data analysis. The data mart or data warehouse stores data as star schemas of DIMENSION and FACT Tables which is a modern approach than traditional ER Diagrams. Thus managers now make sure that all processes are highly effectual making optimum use of monetary, personnel and material resources by checking their Key Performance Indicators (KPIs) and score cards [11]. This has led to evolvement of new category of Business Intelligence called **Business Performance Management** (BPM) that integrates DW, OLAP tools, specialized ETL, data integration systems, real time mining and streaming systems. [10, 22].

Key Features of Business Performance Management (BPM) systems in contrast to normal Data Warehouse (DW)

- Information used is usually more exhaustive and comprehensive.
- Users are generally decision makers who use BPM related to their specific tasks.
- Reports, automated alerts and dashboards carrying relevant indicators and general modes of user interface in BPM
- BPM systems operate in right time than in real time so as to provide correct information at correct time to the correct person for correct decisions. [7, 8].

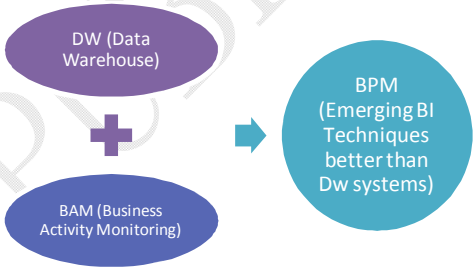

Figure 4. Framework of Business Performance Management System

Business Activity Monitoring (BAM) consists of following components-

- RTI- Right Time Integration
- DDS- Dynamic Data Store
- KPI- Key Performance Indicators
- Mining Tools
- Rule Engine

OLAP

Online Analytical & Processing are end users activities performed on online systems. It is precise, unrestricted query generation through SQL, statistics, Decision Support System applications, ad hoc reports, data models and visualization summaries. It uses specialized class of DSS/BI/BA tools and front end access systems or interface of database, data access and visual information.

IV. Data Mining (DM)

It is a blend of machine-learning, statistical, mathematical, and intelligent agents that organize and employ information and knowledge from databases in a mechanized manner [15]. It uses simple, intermediate and complex models for pattern matching and following features and technologies-

- Neural computing
- Statistical techniques, tests and analysis
- Intelligent agents
- Decision trees
- Case enabled reasoning
- Genetic algorithms

For Text Mining following tools and techniques are used-

- Determine relationships
- Searching and analyzing hidden content
- Themes based grouping

To find patterns in data For Knowledge Discovery, data mining is used through following methods-

- Conversion to universal format
- Identification of data
- Algorithms application
- Preprocessing
- Assessment and Estimation

Data mining application has various classes of problems as

- Regression
- Categorization / Classification
- Sequencing
- Clustering
- Relationship /Association
- Forecasting

V. BUSINESS INTELLIGENCE (BI)

Business Intelligence (BI) is the process of altering raw and discrete data into summarized and meaningful information for extracting useful knowledge from it [14]. Such systems combine day to day operational data with critical tools of analytics to present competitive and complex interpretations to managers and decision makers [23]. BI improves the timeliness, quality, robustness and reliability of inputs for decision process; understand the technologies, operational capabilities, future market scope, the rules and regulations in the concerned domain of the firm, competitor's strategy and working pattern, and the outcome or after effect of these actions.

The demand for BI application and its tools is ever growing even when demand for most of the IT products is soft [21,28]. It has replaced traditional Information systems like Decision Support Systems (DSS), Management Information Systems (MIS) and Executive Information Systems (EIS) [25]. BI tools combine data collection, storage, analysis and manage internal, external and competitive intelligence. It thus provides right and correct information at all times for effective and quick decision making.

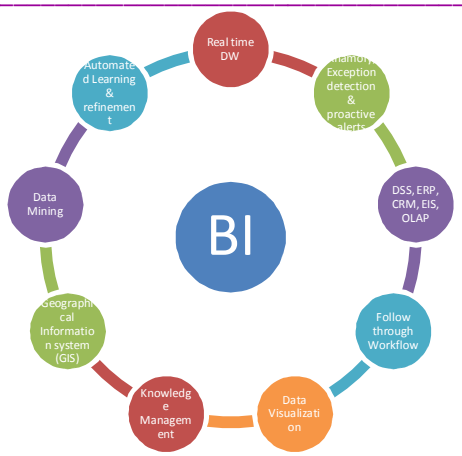

Figure 5. Essential Components of BI [17]

BI FRAMEWORK

BI has inputs of both structured and unstructured type that are used by analysts to take effective decisions [17-19] so, majority use semi-structured data. For example- emails, chats, memos, reports, spreadsheet files, web pages etc. [3].

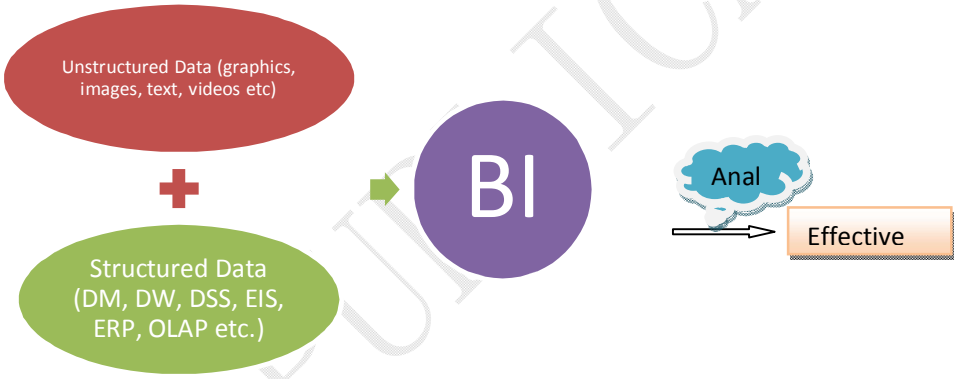

Figure 6. Proposed BI Framework

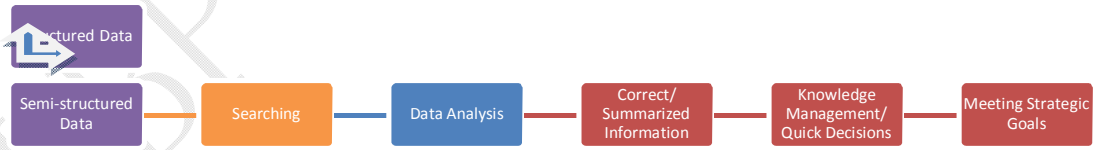

Figure 7. Enhanced BI Framework

Structured Data – DW, OLAP, DM, ERP, ETL tools
Semi Structured data- less complicated analytic tools

There are yet many challenges for the above BI Framework as to how to cater for masses or broader segemnt of population for problems related to data security, user friendly interface on web browsers and bulk reporting. Thus organizations are now expanding BI to all staff and managerial levels. Even the

Investment done for BI installations and its return can be sbstantiable due to its high up-front costs, hardware and softawre costs, skilled IT personnel costs etc.

BI enables rapid and smarter decisions than its competitors by providing competitive intelligence and balanced score card through quick information congregation, analysis and decision making support for strategic achievements of goals. It helps in monitoring product profitability, estimating production costs and expenses, channel analysis, customer and market analysis, forecasting and planning, sophisticated self-service reports, real time view and informed decisions.

VI. ROLE OF BUSINESS INTELLIGENCE AND ANALYTICS (BI & A)

Business intelligence is a process of acquirement of information for reporting and decision-making processes. It provides solution for modeling in business analytics and for applying models and techniques on data to predict patterns and trends in data mining. BI and Analytics together are referred to as equipments, structure, procedures, tactics, applications and practices that examine complex company statistics to enable better understanding of operations, customer and market for quick and effective delivery of decisions. [5]. It includes industry oriented practices and techniques that can be applied to e-governance, e-commerce, e-business, competitive intelligence, market intelligence, security, healthcare, customer intelligence etc. Business Analytics was introduced in late 2000s for representing key analytical components in BI [6] which is now studied in context of Big Data in order to analyze and visualize immense data store ranging from terabytes to exabytes. BI & A closely relies on various data compilation, mining and investigation technologies [4, 26-27] for deployment of business analytic applications for real-time queries and investigation, decision-making and data warehouse updates on regular basis or recurrent basis. Updates can be done even when queries are active but, not possible always. Infact BI & A is majorly used through web as -

- **Web analytics-** it is the application of business mining and analytical tools on Web sites
- **Web intelligence-** it is the application of business analytics techniques to Web sites

BI & A is thus an amalgamation of data marts, ETL, OLAP, BPM using score cards and visual reports / dashboards, statistical tests and interpretations, data mining, associative analysis, data fragmentation, clustering, regression analysis, classification, anomaly detection and predictive modeling [20].

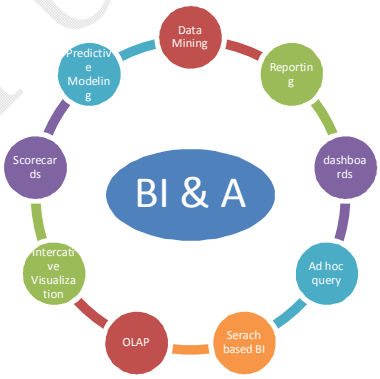

Figure 8. Essential Capabilities for Business Intelligence & Analytics

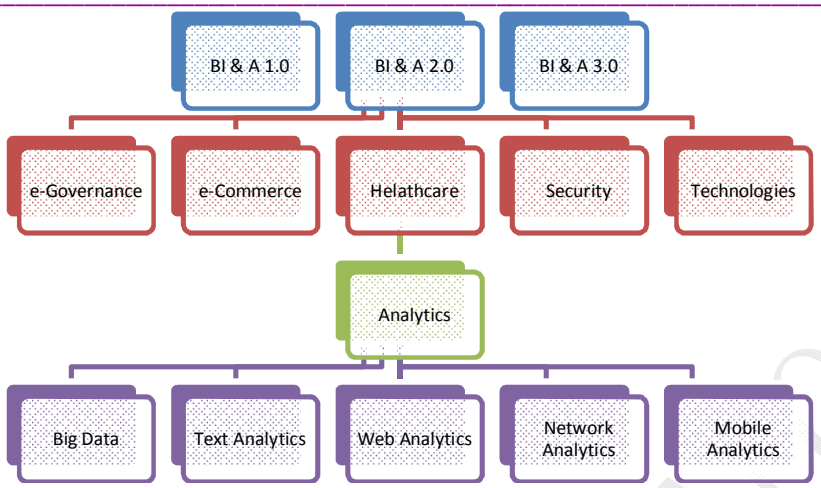

Figure 9. Proposed BI & A Framework

BI & A 1.0- RDBMS, ETL, OLAP, Data Mining etc.
BI & A 2.0- Predictive Modeling, ad-hoc query, visualization etc.
BI & A 3.0-Column-based and in-memory DBMS, real time decisions stc.

Analytics on Big Data - Hadoop, MapReduce
Text Mining & Analytics-MapReduce, Cloud services, Hadoop
Web Analytics-Cloud, representation State Transfer (REST), Really Simple Syndication (RSS), JavaScript Object Notation (JSON), Asynchronous JavaScript & XML (AJAX) etc.
Network Analytics- Exponential Random Graph Models (ERGM)
Mobile Analytics- Mobile sensing Apps, mobile social modernization, mobile health, mobile learning, mobile social networking, crowd sourcing, mobile visualization etc.

VII. CONCLUSION

Business Intelligence & Analytics aids an organization to achieve many strategic objectives and goals as CRM, Corporate Performance Management, Reporting, OLAP etc. Lot of research and development is yet required to cater to semi-structured data [12-13]. This paper developed a BI framework as to how to integrate structured and semi-structured data for better analytics and also proposed how Business Performance Management (BPM) helps in inter-departmental and inter-divisional sharing of information. Though with this, the initiative and creativity of individuals in small/ medium companies can be overlooked for strategic decisions as IT provides open-platform tools for all such tasks as a better substitute. This paper attempted to find how BI & A technologies, Data Mining and Data Warehousing can better help decision makers to use different Information Systems and reach to effective, timely and correct conclusions.

REFERENCES

Alter S.L, "Decision Support Systems: Current Practices and Continuing Challenges", *Reading MA: Addison-Wesley pp. 130, 1980*.

Ballard Chuck, et al, "Data Modeling Techniques for Data Warehousing", IBM International Technical Support Organization; Pgs 36-37, 1998.

Blumberg, R. and S. Atre (2003) "The Problem with Unstructured Data", DM Review, http://dmreview.com/master.cfm?NavID=55&EdID=6287 (current Sept. 12, 2003).

Chaudhuri, S., Dayal, U., and Narasayya, V. ,"An Overview of Business Intelligence Technology," Communications of the ACM (54:8), pp. 88-98, 2011.

Chen. H, Chiang. R, Storey. V, "Business Intelligence and Analytics: From Big data to Big Impact", MIS Quarterly Vol 36 No. 4, pp. 1165-1188, December 2012

Davenport, T. H. , "Competing on Analytics," *Harvard Business Review* (84:1), p. 98-107, 2006.

Dresner, H. Business Activity Monitoring: BAM Architecture. *Gartner Symposium ITXPO* (Cannes, France, 2003.

Dresner, H., and Buytendjik, F. Business Intelligence and Data Warehousing Scenario: Key Trends and Evolving Markets. Gartner Symposium ITXPO (Cannes, France, 2003.

Gupta, V and Singh, J., "A Review of Data Warehousing and Business Intelligenec in different perspective", International Journal of Computer Science and Information Technologies, Vol. 5 (6) , 8263-8268, 2014.

Istante Software. Istante: Product Overview. http://www.istantesoftware.com

Kaplan, R.S., and Norton, D.P. The Balanced Scorecard – Measures that Drive Performance. Harvard Business Review 70,1, 1992.

Kontzer, T. , "Companies are choking on information employees create. And a spate of vendor mergers has yet to deliver tools to deal with the problem." InformationWeek, http://www.informationweek.com/story/ showArticle.jhtml?articleID=17301874. Current Jan. 19, 2004.

MacIntyre, B. (2004). "Information Technology Challenges Keep Rising." The Business Journal of Portland, Jan. 23, 2004. http://portland.bizjournals. com/portland/stories/2004/02/23/focus8.html

Golfarelli, M., Rizzi, S. and Cella, I., "Beyond Data Warehousing: What's Next in Business Intelligence?", DOLAP'04, November 12–13, Washington, DC, USA, 2004.

Han, J and Kamber , M, "Data Mining: Concepts and Techniques", San Francisco: Morgan Kaufmann , 2001.

Inmon W.H., "Building the Data Warehouse", A Wiley QED publication, John Wiley and Sons, Inc., New York 123-133, 1993.

Langseth, J. and Vivatrat, N., "Why Proactive Business Intelligence is a Hallmark of the Real-Time Enterprise: Outward Bound", Intelligent Enterprise, (5)18,pp. 34-41, 2003.

Moss, L.T. ,"Nontechnical Infrastructure of BI Applications", *DM Review*, (13)1, pp. 42-45, 2003.

Moss, L.T. and S. Atre, "Business Intelligence Roadmap: The Complete Project Lifecycle for Decision-Support Applications", Boston, MA: Addison-Wesley, 2003.

Rudin, K. and D. Cressy, "Will the Real Analytic Application Please Stand Up?" *DM Review*, (13)3, pp. 30-34, 2003.

Sallam, R. L., Richardson, J., Hagerty, J., and Hostmann, B., "Magic Quadrant for Business Intelligence Platforms," Gartner Group, Stamford, CT, 2011.

Soejarto, A., "Tough Times Call for Business Intelligence Services, an Indisputable Area of Growth", http://vb.channelsupersearch. com/news/var/40682.asp or www.VarBusiness.com, current May 5, 2003.

Sonnen, D., and Morris, H. BusinessFactor: Event-Driven Business Performance Manager. TIBCO White Paper, 2004.

Negash, S., "Business Intelligence", Communications of the Association for Information Systems (Volume13) 177-195, 2004.

Thomsen, E. ,"BI's Promised Land", Intelligent Enterprise, (6)4, pp. 21-25, 2003.

Turban, E., Sharda, R., Aronson, J. E., and King, D. , "*Business Intelligence: A Managerial Approach"*, Boston: Pearson Prentice Hall, 2008.

Turban, Aronson, and Liang, ", Decision Support Systems and Intelligent Systems", 7th Edition, Prentice Hall, 2005.

Watson, H. J., and Wixom, B. H. , "The Current State of Business Intelligence," *IEEE Computer* (40:9), pp. 96-99, 2007.

Whiting, R. ,"Look Within—Business-Intelligence Tools have a New Mission: Evaluating All Aspects of a Company's Business", *InformationWeek*, pp. 32, Jan. 13, 2003.

Palak Vaish
Research Scholar , Mewar University, Chittorgarh, Rajasthan, India.