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Research Article

Evaluation of business intelligence platforms

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Abstract:

Business intelligence platforms are very powerful for decision making and monitoring the organization's performance. It works as a main tool for an organization by improving services, products, operational efficiency, customer relationships and competiveness. In recent time the application of Business Intelligence is developing rapidly. It also provides a sense of competitive superiority to business organizations. Despite the advantages, Business intelligence platforms are crafting problems in decision making and operational management that there are highly diversified interactions through methodologies, processes, technologies and tools within Business Intelligence systems. As a result, to choose a suitable Business Intelligence platform is important and quite difficult to take the competitive advantages for any organization. To address this issue, this paper presents various comparative methods or selecting techniques, as well as Gartner's technology-based functional features analysis or selection criteria that can be used to select and differentiate Business Intelligence Platform for organizations, and identified Microsoft Power BI, Oracle BI, and Tableau as the most effective Business Intelligence Platform.

Keywords: Comparison of Business Intelligence (BI) Platforms, BI Framework, BI Functionalities, AHP Process, Function Point Analysis (FPA), Cosmic Method, Magic Quadrants

Introduction:

Business intelligence (BI) platforms are simply software to achieve new insight that analyze crucial business data for the purpose of improving goods and services, operational effectiveness, competitiveness, and customer connections.

Howard Dresner was created the BI idea and coined the term as Business Intelligence (BI) in 1989, which had more of an organizational management than a technological connotation and it referred to a set of models and techniques that supported decision-making by utilizing data-driven support systems (Rocha et al., 2017)

The concept of BI platforms is related to a set of methodologies, processes, technologies, and tools for the collection, integration, analysis, and presentation of information, which aids in the identification and

development of new business opportunities through the analysis of the interrelationships of facts and data, with the end goal of facilitating decision-making (Leibowitz, 2016).

The overall organizational context necessarily requires careful planning, procedural cohesiveness, and existing resource optimization. These assumptions or decisions also need regular access of authentic and relevant data, as well as the capability of making right decisions that ensure the growth and sustainability of an organization (Rocha et al.,2017).

Business intelligence (BI) technology is used to provide past, present, and predictive views of commercial operations to make the right decisions (Maheshwari, 2014). And this systematic application of technologies creates a BI system that helps an organization to generate business insight and proper decision-making (Moghimi & Zheng, 2009).

At present, it's critical for businesses to save costs, boost returns on investments, and cut the time it takes to deliver goods and services to customers. But Business intelligence (BI) is viewed as a single platform with a wide range of applications that can be utilized to manage services effectively and accomplish organizational objectives (Silver, Pyke, & Thomas, 2016). According to the business needs only a correct choice of BI platform can achieve business gain and success. This paper can help different organizations to select BI platform according their needs.

Methodology

The process of selecting a BI platform is extremely difficult. Although most BI platforms are similar by their usages, they may differ depending on the infrastructure, specificities and functionalities. On the contrary, it is a challenge for organizations to select a BI platform due to the availability of business intelligence tools, support for existing infrastructure, ease of use, scalability, financial commitment, and other parameters. In this review paper different software evaluation methods have gathered from different secondary sources and describe their usages and applications to chose BI platform. By adding five well-known functionalities of modern era named Web Portal, Mobile App, SME, Cloud technology and GIS with Gartner selection criteria, this study has performed an evaluation on popular seven BI platform named IBM Cognos, Power BI, Oracle BI, Qlik, SAS Business Intelligence, Tableau and Domo.

Literature Review:

The implementation and selection of BI system for an organization depends on its specificities or functionalities. It is obvious that, the availability of information regarding the BI platform and their functionality would be clear to the organization for a successful implementation. Only a proper selection of BI platform can result business gain and success, based on the needs of the business. To choose a BI platform different techniques or methods are used, from different angles or views for a specific organization. Gartner's selection criteria are used to measure the complexity of software. Function point metrics is used to measure the weight of software in aspect of examine the simplicity, optimization and the length of codes, written for software. The method named software metric is used to measure the characteristics of software such as portability, reliability and flexibility. To gain competitive advantages through BI platform the magic quadrant is used, when an organization wants to achieve competitive advantages, with its competitors into the marketplace. The AHP model and The COSMIC model are valuable in aspect of measuring software characteristics such as vendor criteria and size of the software sequentially. All these methods along with BI framework are briefly described in the following section.

Business Intelligence Framework:

Companies tailor BI for their specific needs, history, and environment in order to make informed and valued customer-oriented decisions. The traditional approach of BI includes data aggregation, business analytics, and data visualization (Information Resource Management Association, 2012). According to this approach, BI investigates a variety of technological tools, generating reports and forecasts in order to improve decision-making performance. Such tools include Data Warehouse (DW), Geographic Information Systems (GIS), Extract-Transform-and-Load (ETL), Text Mining, On-Line Analytical

Processing (OLAP), Data Mining (DM), Data Visualization, Web Mining, and Web Portals (Ponniah, 2004).

As a result there may be an issue with the integration of commercial enterprises on BI, at the next stage (*Information Resource Management Association*, 2015). According to this viewpoint, BI is a mechanism for bridging the gap between enterprise process management and business strategy. Tools, such as Business Performance Management (BPM), Business Activity Monitoring (BAM), Service-Oriented Architecture (SOA), Automatic Decision Systems (ADS), and dashboards are included in addition to all of the tools in traditional BI (Senthil, 2010).

Adaptive BI is concerned with self-learning adaptive systems that can advise satisfactory actions and analyze previous decisions that allow organizations to improve continuously for decision making. In this manner, artificial intelligence is integrated into BI structures (Rosing, Scheel, &Scheer, 2014). The framework of Business intelligence can be divided into three spheres. First one is data capture or acquisition, second one is data storage and the third one is data access and analysis.

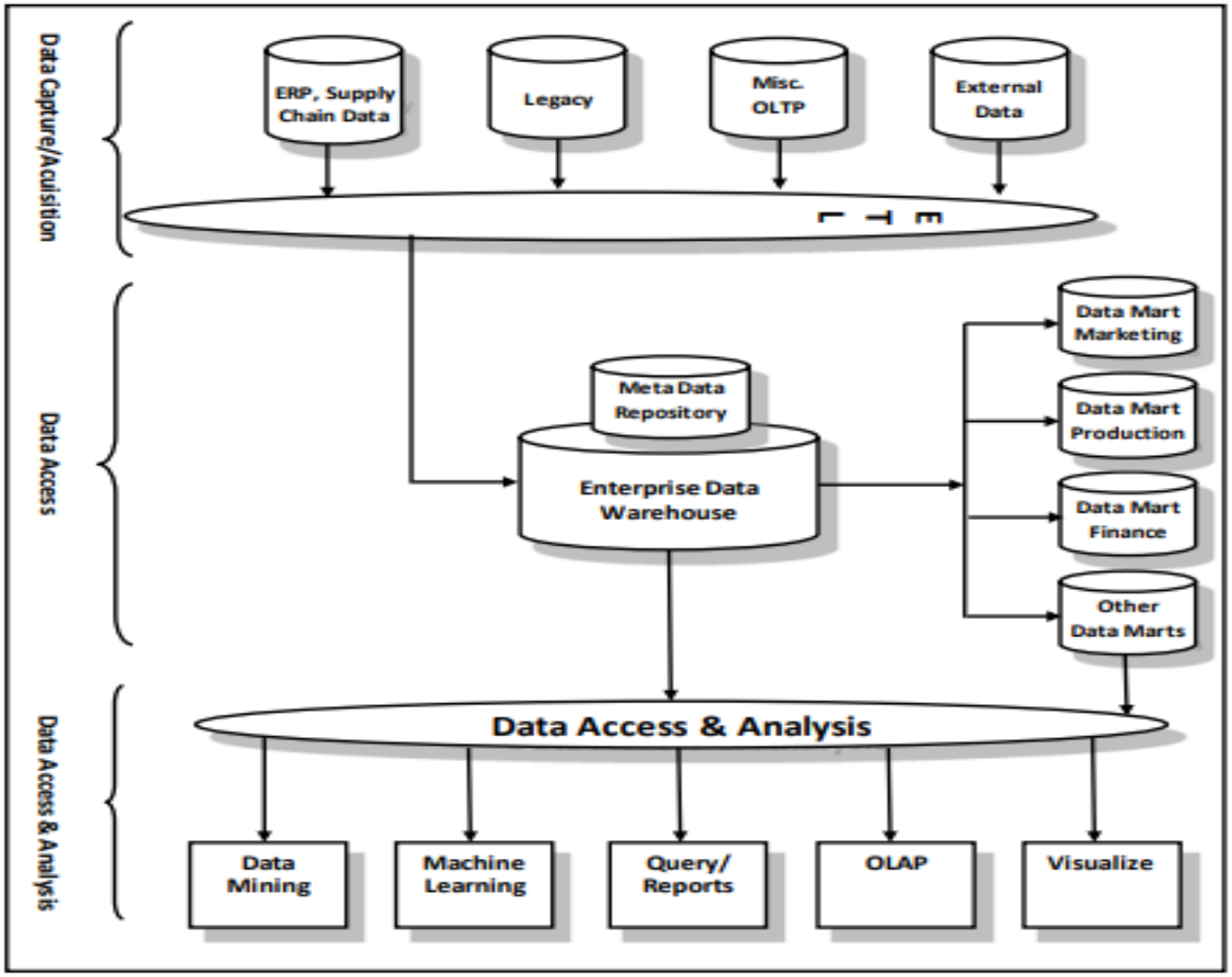

Figure-1: Framework for Business Intelligence (Khan & Quadri, 2012).

a) Data Capture/ Acquisition

The lower back end of data warehouse, known as the acquisition element, has interfaces with operational structures, for the purpose of loading data. An operational database, which can include databases like Oracle, DB2, Informix, SQL Server, SAP R/3, and others, where data is first input or processed using a

daily business approach, that is totally based on an online transaction processing (OLTP) environment. The steps named extraction and purification, transformation, and loading must be completed before loading data from operational database, and external sources into the data warehouse (Ballard et al., 2012).

b) Data Storage: Data is saved in data warehouses or data marts shortly after ETL (extract, transform, and load) for future analysis (Venugopal, 2021).

c) Data access and analysis: The front end is the access component of the BI. It consists of access tools and techniques that give a business person direct, interactive, or batch access to data, while hiding the technical complexity of data retrieval (Marketing & Forum, 2014).

Gartner's Selection Criteria:

The assessment standards used on this paper are described by Gartner, who define twelve abilities divided into 3 primary categories: integration, data delivery, and analysis. The following are the three major areas:

Information Delivery

a) **Reporting:** This capability entails the task of creating and formatting interactive reports by performing on-line analytical queries on both relational and multidimensional data sources, while trying to hide the logical schema of the warehouse. It is also acknowledged that the ability to scheduling and sharing reports with end users is recognized.
b) **Dashboards**: The ability to create, publish, and update a set of meaningful and interactive charts for a web-based application is logically related to the previous one.
c) **Ad hoc queries:** This feature allows users to create their own queries. In this case, users must be familiar with the data warehouse's logical schema as well as the SQL programming language.
d) **Microsoft Office integration:** Many users are accustomed to create their own reports in Microsoft Excel. This capability includes the tasks required for a user to create a report using Excel as an OLAP client and the BI Platform as a middleware.

1) **Integration**
   a) **BI infrastructure**: It included tasks related to the security administration and implementation of practical rules in this capability.
   b) **Metadata management:** The process of creating metadata is the initial and most important step in integrating the BI Platform with the OLAP server.
   c) **Development environment:** A BI platform must include a collection of reusable components that can be plugged into a BI application.
   d) **Workflow and collaboration:** This capability includes all tasks that allow users to share information, communicate publicly, or implement business rules and processes, to generate information through the use of trigger-driven events.
2) **Analysis**
   a) **OLAP:** All tasks that allow users to run traditional OLAP queries (such as drilling) and define their own functions are included in this capability.
   b) **Visualization:** In some cases, users need to visualize a report containing multidimensional data in order to get an optimal view even on a two-dimensional screen; for example, this effect can be obtained by defining the tools with graphical presentations.
   c) **Predictive modeling and data mining:** Tasks in this capability allow users to manage a predictive modeling environment.
   d) **Score carding:** This capability refers to the tasks that must be completed in order to create strategy maps that align key performance metrics with the achievement of strategic goals.

Software metric:

Software metric is a measurable or countable way of measuring of a software process. (Lammel, 2018). The software measurement process is defined and

governed by ISO standards (S, E, & Joshi, 2020). It is a well-known expert in the field of software engineering (Bott, Coleman, Eaton, & Rowland, 2014). The following principles can be used to recognize the software measurement process (Chidamber & Kemmerer, 2018).

Formulation: The creation of software measures and metrics are appropriate for recognizing the software under consideration.

Collection: The process of gathering data required to generate the calculated metrics.

Analysis: Metric computation and application of mathematical tools.

Interpretation: Metric evaluation provides insight into the quality of the representation.

Feedback: Recommendation based on product metrics will be translated and sent to the software development team. Software metrics are classified into three types (Nicolette, 2015):

Product Metric: Product metrics are used to assess the current state of a product, track risks, and identify potential problem areas. The two most important product matrix characteristics are software size and complexity, as well as software quality and dependability.

Process metrics: Process metrics are concerned with the long-term process of the team or organization.

Project matrix: The project matrix describes the characteristics of the project as well as the execution process. Counting software developers and patterns of staffing throughout the software life cycle, the project matrix was divided into these criteria based on cost and timetable.

Analytical Hierarchical Process:

The Analytic Hierarchy Process (AHP) is a mathematical and psychological technique used to organize and analyze complex decisions (Felice, Petrillo, &Saaty, 2016). Thomas L. Saaty invented it in the 1970s, and it has been delicate since then (Ramk, 2020).

The analytic hierarchy approach (AHP) is concerned with cost scaling, sensitivity analysis, and compatibility and incompatibility. AHP model can solve qualitative and quantitative aspects of a complex problem by decomposing the problem into specific hierarchies.

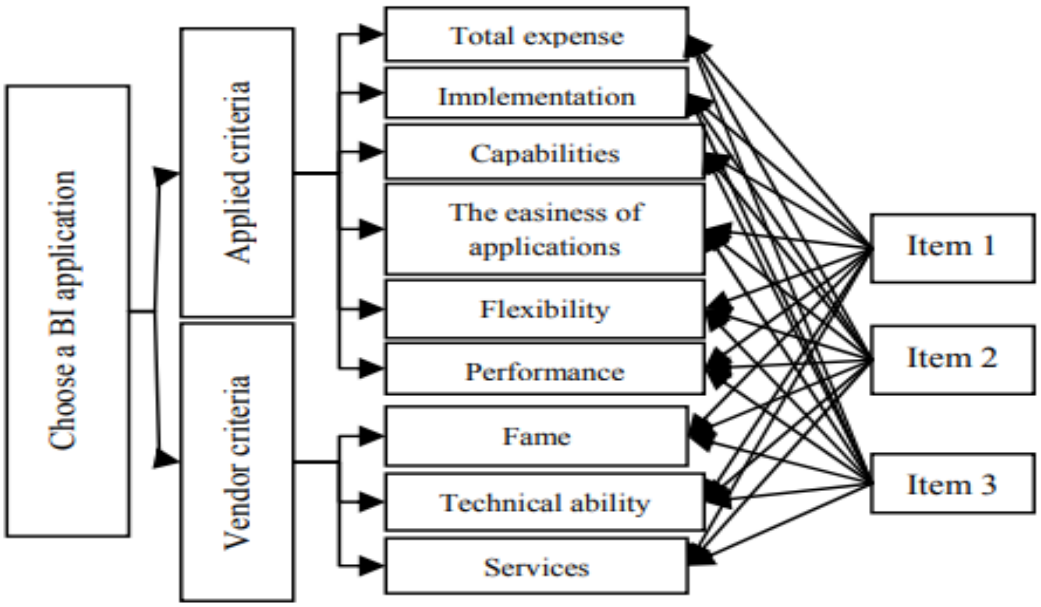

Figure-2: The Final AHP Process (Moghimi& Zheng, 2009)

The final AHP method divides the factors into two parts to define the appropriate Business Intelligence named applied criteria and Vendors criteria. Total expense, implementation, capabilities, the ease of

application flexibility and performance were named as applied criteria, and fame, technical ability, and services were named as vendor criteria.

Function Point Analysis:

Allan Albrecht of IBM created the estimating principle known as "function point counting" in 1979. As a part of this approach, Albrecht discovered that software may be scaled by scrutinizing external transactions (McDermid, 2013). IBM added application complexity, assessment, system characteristic and categorization to this methodology in 1984. The function point counting methodology has been improved by automated analysis tools to offer a reliable, repeatable type of code examination (Council, 1995).

Functional point measures the accurate weight of the software Because it enables organizations to analyze the useable weight of software program delivered at any step of the development life cycle without understanding the capabilities of the program (Beck & Andres, 2004). The following elements are taken into account during the calculation (Saxena, 2021):

I. **External Inputs (EI):** Data can flow into the program from outside the boundary according to the transaction function identified as external input (EI).
II. **External Outputs (EO):** Data can "leave" the system that used the transaction function known as External Output (EO).
III. **Internal Logical Files (ILF):** Internal Logical Files (ILFs) are collections of data or control information that are logically related and only exist within the limits of an application.
IV. **External Interfaces Files (EIF):** A user-identifiable collection of logically connected data or control information called an External Interface File (EIF) is used by an application just for reference.
V. **External Inquiries (EQ):** Data retrieval is the result of the transaction function known as External Inquiry (EQ), which has both input and output components.

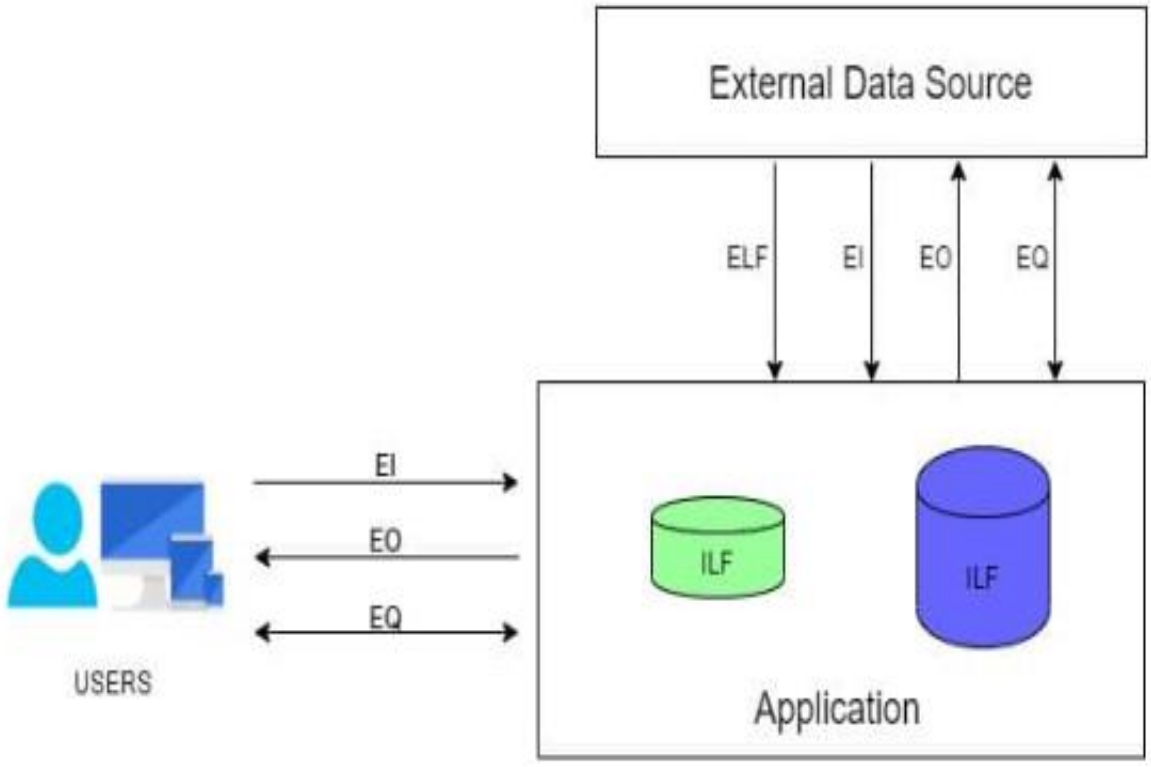

Figure-3: Function Point Analysis (Heilig, Lalla, E &Voß, 2017)

The Calculation of Function Point:

Mathematically, AFP= UFP*CAF Where, AFP means Adjustment Function point and UFP means Unadjusted Function Point and CAF determined Complexity Adjustment Factor. To calculate Function Point Analysis, we do consider the following steps:

Step-1: UFP= Σd_i. Where, d_i represent the values of Factors multiplied by the Complexity Level.

Step-2: CAF = 0.65 + (0.01 *f_i), where, f_i is the total complexity adjustment values those can be calculated based on the degree of influences ranges from 0 to 5.The responses achieved from 14 selected questions determined the total value of f_i.

Step-3: AFP= UFP*CAF

The Predefined questions that are used to perform step-2 are given below in a table:

Adjustment Parameter	Description/Questions
Data Communications	How many channels of communication are available to aid in the exchange of information with the application or system?
Distributed Data Processing	What occurs when processing and data functions are distributed?
Performance	Was the user seeking for throughput or reaction time?
Heavily Used Configuration	How well the hardware platform currently used for running the application?
Transaction Rate	How frequently, on a daily, weekly, monthly, or other basis, are transactions carried out?
On-Line Data Entry	What percentage of data is input online?
End-user Efficiency	Was the end user considered during the application's development?
Online Update	In how many ILFs does an online transaction result in an update?
Complex Processing	Is the application heavily logical or mathematically processed?
Reusability	Was the program designed to fulfill the needs of a single user or multiple users?
Installation Ease	How challenging are conversion and installation?
Operational Ease	How efficient and/or automated are startup, backup, and recovery procedures?
Multiple Sites	Was the program particularly created and supported to be installed in several locations for various organizations?
Facilitate Change	Was the intention behind the application's conception, development, and maintenance to encourage mental flexibility?

Table-1: Predefined question of Adjustment Factor

COSMIC Method:

The Common Software Measurement International Consortium (COSMIC) examined current functional size methods, including IFPUG Function Points (FPs), in order to develop a length metric based on "fundamental principles" applicable to a much broader range of application domains (Dumke & Abran, 2016).

This process defines a set of data movements that may include one or more of the group's attributes. The procedure will be followed when the software fulfilled all requirements to react to with the event (Morris, 2013). Calculating the length of software with

COSMIC Function Points (CFPs) requires three phases: measurement strategy, measurement, and mapping. The overall activity of the Cosmic FP software model is divided into four types: entry, exit, read, and write.

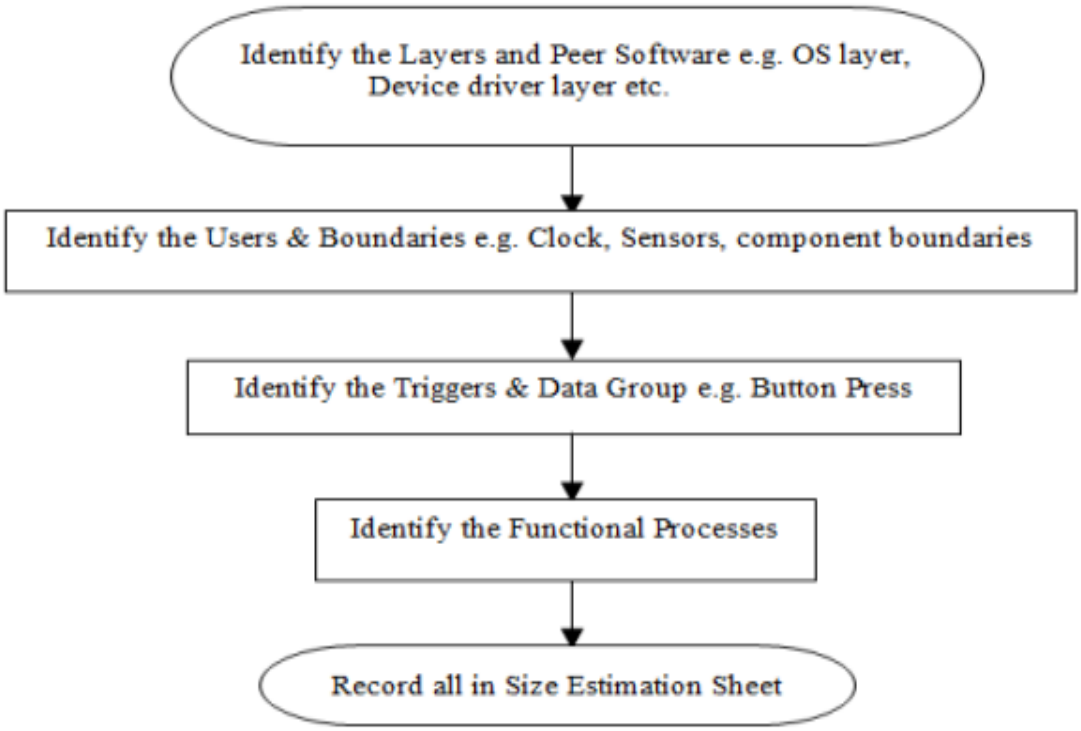

Figure-4: The Mapping Phase (**Kumar, G., & Bhatia, P. K. 2015).**

The measurer's strategy outlines the purpose, scope, and stage of granularity of the measurement and the significant customers of the software program. The mapping segment is entirely based on information provided by useful consumer requirements. During the measurement phase, a set of functional processes is established. Each of these procedures contains a unique set of data movements or manipulations. Mathematically:

Size (Change (Functional Processes)) = sum (size (added data movements)) + sum (size (modified data movements)) + sum (size (deleted data movements)).

Magic Quadrant:

The outcome of market research is a Gartner Magic Quadrant, which gives you a comprehensive understanding of the relative positions of the market's competitors. In the 1990s, Gartner published their first Magic Quadrant. The analysis is carried out entirely on the basis of two criteria: vision and ability to execute. Based on this, groups are classified as niche players, visionaries, challengers, or leaders (Sharda, Delen, & Turban, 2020). The magic quadrants use a two-dimensional matrix to display a company's strengths and differences. The magic quadrant diagram divides competing organizations into four distinct quadrants based solely on their completeness of vision and ability to execute (Pollock & Williams, 2016).The magic quadrants use a two-dimensional matrix to display a company's strengths and differences. The magic quadrant diagram divides competing organizations into four distinct quadrants based solely on their completeness of vision and ability to execute (Pollock & Williams, 2016).

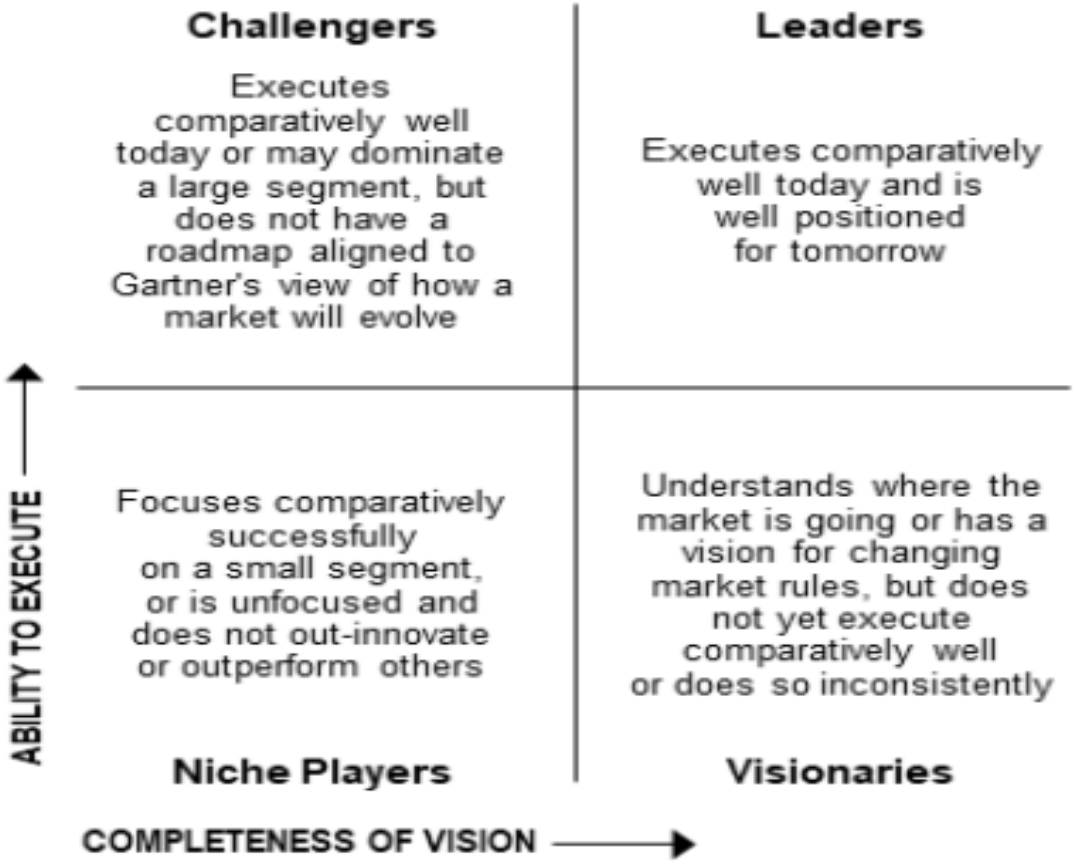

Figure-4: Magic Quadrant (Rumanian, 2013).

Leaders: Leaders are providers who excel in all criteria. Leaders are typically providers with a large client base who have established businesses.

Visionaries: Visionaries see where the market is heading or have a vision for changing market rules, but they don't carry it out properly. They Are aware of market trends and may be innovative, but may be unable to put their visions into action.

Niche players: Niche players efficiently focus on a small section or are unfocused and do not invent or outperform than competitors. Niche players' scores low for both imaginative and prescient completeness and ability to execute.

Challengers: Although challengers are currently performing well or can dominate a large segment, they lack market perception. Have the ability to execute but may be lacking in vision.

Result and Discussion

A comparative table of capabilities or functionalities has been drawn below based on the technical specifications available in the current marketplace and previously referred criteria by Gartner. According to the table, all of the platforms are very similar in terms of the previous criterion used by Gartner. However, there are some minor differences that distinguish the Business Intelligence Platforms today.

Function/Criteria	IBM Cognos	Power BI	Oracle BI	Qlik	SAS Business Intelligence	Tableau	Domo
Reports	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Dashboards	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Ad-hoc Queries	Yes	Yes	Yes	Yes	Yes	Yes	**No**
Microsoft Office Integration	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Mobile BI	Yes	Yes	Yes	Yes	Yes	Yes	Yes
OLAP	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Interactive Visualization	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Predictive Modeling/Data Mining	Yes	Yes	Yes	**No**	Yes	Yes	Yes
KPIs	Yes	Yes	Yes	Yes	**No**	Yes	Yes
Collaborative Technologies	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Cloud	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Web Portal	Yes	Yes	Yes	Yes	Yes	Yes	Yes
SME	Yes	Yes	Yes	Yes	Yes	Yes	Yes
GIS	**No**	Yes	Yes	Yes	Yes	Yes	**No**
Development Environment	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Score carding	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Metadata Management	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Table-2: Comparison of BI Platforms

From the above comparison this paper has found the GIS (Geographic Information System) feature is not supported by IBM Cognos and Domo. Data mining functionality is absent in Qlik. KPIs and ad-hoc query functionality is not supported by SAS Business Intelligence and Domo. Power BI, Oracle BI, and Tableau demonstrated the best functional capability in this comparison.

Conclusion:

For a specific organization, BI platform Selection and Its implementation is a critical and complex matter. Any organization must consider its organizational capabilities, vendor capabilities, and BI platform capabilities. It's a team work that includes financial strength, human or material resources, Vision of the executives to grow, AS-IS (Present processes and work flow), TO-BE (Processes and workflow will be implemented), planning, scheduling, testing, training, monitoring and maintenance. As a result, financial strength of the organization, BI platform capabilities, vendor experiences and services are factors for successful BI platform selection and implementation that can create business growth and new business opportunities.

The purpose of this paper was to conduct a capability or functionality based analysis of seven BI platforms named IBM Cognos, Power BI, Oracle BI, Qlik, SAS Business Intelligence, Tableau and Domo. And it is obvious that the selection of the best BI platform will be an integration of all necessary tools that allows optimized process learning and operational

management with user friendliness in a unique environment. Form this comparison among the seven BI Platforms this paper has conclude that the most effective BI platforms with modern technologies are "Microsoft power BI", "Oracle BI" and "Tableau ". We hope this paper will help and contribute for the organization which is going to select and implement a BI platform in their organization for future business growth and decision making.

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