

## A Framework for Embracing Business Intelligence and E-Government Integration for Effective Decision-making

**Dalia A. Magdi**

Vice Dean of the Canadian International College, Cairo, Egypt  
Associate Professor, Computer and Information System Department,  
School of Computer Sciences, Sadat Academy for Management Sciences, Egypt  
daliomagdi@gmail.com

إطار عمل لتبني ذكاء الأعمال بالتكامل مع الحكومة  
الإلكترونية من أجل اتخاذ قرارات فعّالة

**داليا أحمد مجدي**

وكيل المعهد الكندي العالي للحاسب الآلي، القاهرة، مصر  
أستاذ مساعد بقسم نظم المعلومات والحاسب الآلي، كلية علوم الحاسب الآلي،  
أكاديمية السادات للعلوم الإدارية، مصر  
daliomagdi@gmail.com

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## Abstract

As government services are often always monopolistic, it is critical to maximize accessibility. Adopting business intelligence (BI) technology is crucial due to the complexity of making quick and accurate decisions. Technology breakthroughs, big data, and the accessibility of open source information have all contributed to the explosive growth of the business intelligence (BI) market during the past ten years.

This study seeks to establish a bridge between BI and e-government in order to pave the way for an integrated framework that would improve public administrative decision-making. The main issues with integrating BI into e-government are examined in the study, as well as the types of e-government research that are required to enable the integration in practice.

The research methodology is conceptual. Firstly, the fundamental BI ideas and experiences from the business world are reviewed. Secondly, BI research traces in e-government are examined. Thirdly, a scenario of administrative BI application is developed to identify integration challenges. Finally, the building blocks and connectors for the integration of BI and e-government are suggested and pointing to future research.

**Keywords:** Business intelligence, e-government, data warehouse

## المستخلص

نظرًا لأن الخدمات الحكومية غالبًا ما تكون احتكارية، فمن الأهمية بمكان زيادة إمكانية الوصول إلى الحد الأقصى من الجودة بها، ويُعدُّ اعتماد تقنية ذكاء الأعمال (BI) أمرًا بالغ الأهمية؛ نظرًا لتعقُّد عملية اتخاذ قرار سريع ودقيق، وقد أسهمت الاختراقات التكنولوجية، والبيانات الضخمة، وإمكانية الوصول إلى المعلومات مفتوحة المصدر في النمو الهائل لسوق ذكاء الأعمال (BI) خلال السنوات العشر الماضية.

هذا، وتسعى الدراسة إلى إقامة جسور بين ذكاء الأعمال والحكومة الإلكترونية؛ من أجل فتح الطريق لإطار عمل متكامل من شأنه تحسين عملية اتخاذ القرار الإداري العام، ويتم فحص القضايا الرئيسية المتعلقة بدمج ذكاء الأعمال في الحكومة الإلكترونية في الدراسة، بالإضافة إلى أنواع أبحاث الحكومة الإلكترونية المطلوبة؛ بهدف التمكن من تعزيز تكاملها في الممارسة العملية.

واعتمدت منهجية الدراسة على عدة محاور، أولاً: القيام بمراجعة الأفكار والخبرات الأساسية لذكاء الأعمال (BI)، ثانيًا: البحث عن آثار أبحاث ذكاء الأعمال في الحكومة الإلكترونية، ثالثًا: القيام بتطوير سيناريو لتطبيق BI الإداري؛ لتحديد تحديات التكامل، وأخيرًا: اقتراح اللبنات الأساسية والموصّلات؛ لتكامل ذكاء الأعمال مع الحكومة الإلكترونية، مع الإشارة إلى الأبحاث المستقبلية.

**الكلمات الدالة:** ذكاء الأعمال، الحكومة الإلكترونية، مستودع البيانات.

## 1. Introduction

To acquire an analytical insight on organizational possibilities and problems, managers clearly require reliable and timely data on their organization. Managers have realized the need of preserving high-quality data in their databases, as well as the need to integrate and use such data to improve the quality of their decision-making (Chaudhuri et al., 2011). Business intelligence (BI) solutions are designed for this purpose, allowing users to make fact-based, conclusive, and actionable decisions by combining data from diverse sources (Loshin, 2012). Managers may make more accurate, relevant, timely, and intelligent decisions with the help of business intelligence solutions, resulting in enhanced productivity and profitability (Lackman et al., 2000). To support decision-making, business intelligence combines business processes with IT systems like data warehouses, data marts, data mining, query/reporting tools, and visualization. The use of business information effectively can provide a number of benefits to a company, including boosting the quality of strategic and operational decision-making. Relevant and timely intelligence allows for more systematic and accurate analysis, as well as faster decision-making processes (Khan & Quadri, 2012).

Business intelligence (BI) has been increasingly important in many firms' operational and strategic decision-making in recent years, particularly as they aim to leverage the massive volumes of data they hold and/or operate (Chaudhuri et al., 2011). The Gartner Group created the phrase "business intelligence" in the mid-1990s. Tools, technologies, databases (DBs), applications, and techniques all fall under the BI umbrella. The main goal of BI is to provide real-time data access and manipulation. Decision makers can gain useful insights from BI by examining historical and present data. This allows them to make more educated judgments (Baars & Kemper, 2008). The BI process is primarily a transformational one: data is transformed into information, which is subsequently transformed into decisions. Business intelligence is not a ready-to-use product. It is a goal reached, when various information consumers within an organization are able to harness huge amounts of data collected and created, in order to improve company performance. There are four major components of BI (Alter, 2003):

- *Data warehouse (DW)*: a data warehouse is an archival data storage used to help decision-making. To make reporting and analysis easier, DW offers the ability to combine data from several sources.
- *Business analytics (BA)*: business analytics is a set of tools and strategies for analyzing and manipulating data in a data warehouse. Many data mining techniques are included; such as association rules, cluster analysis, decision trees, and genetic algorithms.
- *Business Performance Management (BPM)*: this component is based on the Balanced Scorecard Concept (BSC). By integrating objectives with important measures, BSC provides a framework for establishing, executing, and managing strategy.
- *User interface*: a digital dashboard of key performance indicators (KPI) across multiple functional areas that are compared to industry benchmarks.

Government databases are now receiving enormous gigabytes, necessitating analysis and strategic use of these data for decision-making and strategic goals. Although IT has been used to enhance data analysis and decision-making, implementing BI with all of its components in administration is still in its infancy. Neither research nor practice has developed a mature approach to maximizing BI's potential in administration (Baars & Kemper, 2011).

The research methodology is conceptual. Firstly, it examines basic business intelligence (BI) concepts and examples from the business world. Secondly, it searches for BI research traces in e-government. Thirdly, it creates a scenario of a managerial BI implementation to define integration challenges. Finally, it implies the foundations and connectors for the integration of BI and e-government and points to further study.

This paper intends to connect business intelligence with e-government in order to pave the way for an integrated framework that will bring value to public-sector decision-making.

## **2. E-Government**

Information and communications technology (ICT) play an active and substantial role in the governance processes known as e-governance (Middleton, 2007). E-governance is the use of information and communication technologies to improve the transparency, accountability, efficiency, and interoperability of informational and transactional exchanges within and between government agencies, as well as between citizens and businesses. It also aims to give citizens greater access to and control over their own information.

E-government solutions are designed to aid in the transformation of government organizations into enterprise infrastructure-based end-to-end digital governments that build services around the preferences of citizens, increase accessibility, promote social inclusion, provide information responsibly, utilize resources efficiently, cut spending, offer online services, and involve citizens in the political process (Layen & Lee, 2001).

There are various potentials for economic and human growth provided by information and communication technology (ICT) and its uses. National governments are engaged in designing and deploying ICT and e-government applications to assist development within the context of the Egypt's Vision 2030, in collaboration with other stakeholders at the national, regional, and international levels. The problem of policy formation and ICT program monitoring is embedded in both approaches.

A set of goals for the advancement of the information society was defined by Egypt's Vision 2030. It contained the goal of establishing websites and email addresses for all municipal and federal government offices as well as connecting all of them (Khan & Quadri, 2012).

Governments are working harder than ever to reduce operating expenses, while enhancing service delivery to both staff and citizens. Giving self-service process enhancements through online web-based applications is becoming more and more of a focus. Government, citizens, and businesses/interest groups can be identified as the three main target groups in e-governance concepts (Andersen & Henriksen, 2006). The internal objectives are focused on the government itself, whereas the external strategic objectives are focused on citizens, corporations, and interest groups. Government to Government (G2G), Government to Citizens (G2C), Government to Business (G2B), and Citizen to Government (C2G) are the four main elements of e-governance.

By facilitating a better access to governmental services, e-government has the potential to accelerate the social and economic growth of nations. Examples range from easier access to information about services offered to full online processing of permit, certificate, and payment requests, among other things. Efficient usage of e-government can also enhance connections among government agencies and the efficacy and efficiency of the public sector (Heeks, 2006). Examples include the use of networks and computers to increase the personal productivity of government employees, as well as adjustments to more effective business procedures. Such procedures are linked to a shift to the provision of government services online. Rethinking e-government policies and programs in this context is necessary in order to take advantage of these capacities.

Different nations are at different phases of e-government development. The use of ICT to enhance public sector performance and service delivery is somewhat advanced in developed economies.

### **3. E-Government in Egypt**

In this framework, the government has attempted to advance and build the communications and information technology infrastructure. Additionally, it has addressed enhancing digital services across all ministries and government organizations and increasing the effectiveness of governmental services by giving government organizations better working conditions and required assistance (Layne & Lee, 2001).

Additionally, the government has made considerable progress toward becoming a digital economy.

This was consistent with its courageous efforts to quicken the pace of growth and raise the standard of living for its people by building infrastructure and investing in human resources. The strategic goals of Egypt's digital transformation are mostly on enhancing citizens' experience with services through digitizing them. In order to enhance operations at the State's administrative apparatus and guarantee efficiency and effectiveness, they also rely on connecting governmental digital systems (UN E-government Survey, 2008). Another strategic goal is to encourage electronic governance and the values of accountability, openness and monitoring throughout all government entities.

E-government offers a powerful incentive to advance in the twenty-first century with better more economical government services and a more robust citizen-government connection. The e-government program in Egypt is a component of the 2030 Vision plan, which was introduced in February 2016. The program's goal is to increase government efficiency by providing citizens and investors from all societal segments with higher-quality services in a way that is simple, fast, accurate, and efficient, creating a new class of government worker and improving government performance. Such an objective necessitates cross-administration coordination, which might be challenging at times. The digital transformation of the Egyptian government is proceeding increasingly in the last few years. It is crucial to address one of the system's main problems: the division of data administration, data interoperability, and decision making. Some ministries were among the first to implement the change, while others are still getting used (Al-Omari & Al-Omari, 2006).

For Egyptian government agencies using big data platforms, the quality of information is a challenging issue, because it influences an organization's performance. The type and volume of data it manages, the interactions between these data, and their dynamic nature all contribute to the evolving of E-government's complexity. Strategic decision-making in the Egyptian government requires the use of multiple sources of information that involve all ministries. Finding reliable solutions between data collection and data management is more difficult than ever. Due to the difficulties in linking the government information system as a whole, a quick access to crucial data is needed in an interoperable fashion. The best answer appears to be to use a business intelligence strategy to create a data integration architecture for e-governance.

## 4. Business Intelligence in Governmental Sector

The Egyptian government faces numerous operational obstacles due to numerous and demanding constituencies, as well as rigorous budget and performance targets and reporting requirements. In order to improve (data-driven) decision-making, monitor operations closely, and maintain information security, government agencies require information management solutions.

The absence of visibility into the public sector's most important operational processes is evident. Spreadsheets should no longer be the principal analytical tool used by public sector entities. Spreadsheets are unquestionably valuable as a general business tool, but businesses are increasingly looking for alternatives to statistical tools and methodologies in favor of adaptable solutions that will give users across the organization access to tactical and strategic business information, regardless of their technical proficiency (Jiang & Tao, 2018).

Governments all over the world must take advantage of their massive data stores and ride the open data wave to use this data to the country's advantage. Data is a precious thing and will live longer than the technologies themselves. Data have a crucial function in contemporary culture, and easy access to data has developed into a profitable and in-demand service. In fact, once the crucial breakthrough with regard to data collecting for development has been completed, business intelligence application should be the following step to systematically investigate data (Guo et al., 2018).

Governmental organizations that provide services have access to large amounts of important data that can be used for the development's advantage. The exposition of fundraising innovation and inspiration contends that data collection is useless, unless it is properly used, at which time it is priceless. Due to the fragmentation and disjointedness of current storage methods, current processes for obtaining internal data are incredibly laborious from a human capital perspective. This often results in incorrect data being provided, which ultimately has a negative impact on future planning from a service delivery perspective (Capgemini, 2006). The advantages include increasing efficiency by digitizing data collection and sharing processes to enable more insightful reporting and analysis.

Business intelligence and knowledge management have an obviously significant association. Knowledge management refers to the capacity to choose the appropriate data at the appropriate moment from the appropriate sources in order to gain insightful knowledge and guarantee the maximization of advantages for a business. By enabling efficient knowledge management to occur, which enhances the use of evidence-based policy decision making, business intelligence implicitly represents a lucrative opportunity for every firm (World Bank, 2011).

Business intelligence can be used in an organization in a variety of ways in order to improve management processes, adjusting processes to improve efficiency and cost reduction, improve operational processes, and relationship management.

Business intelligence is a topic that is still developing in local government and needs specific attention. In order to enhance decision-making, the Egyptian government should investigate the value and function of business intelligence in its context. The implementation of smart and innovative solutions and products is envisioned in the Smart City and Vision 2030 strategies; however, this can only be done if decision-makers, including those in administrative and political management, have access to pertinent and intelligent data to enable them to make informed decisions. The ability of decision makers to communicate and evaluate data effectively will lead to improved service delivery because information is offered in almost real-time.

## **5. Business Intelligence and E-governance Relationship**

Business intelligence is a broad area of software and hardware for gathering, storing, processing, and making data accessible to decision-makers. Decision support systems, query and reporting, On Line Analytical Process (OLAP), statistical analysis, forecasting, and data mining are typical BI applications (a technology to extract unknown and hidden patterns and knowledge from within the data) (Baheer et al., 2020). Therefore, in the G2G and G2C environment, business intelligence is highly suited for e-governance applications. The de facto prerequisite for successful implementation of a BI system is a strong and trustworthy data warehouse (Mahmoud et al., 2019).

A data warehouse is a cross-enterprise, subject-oriented, integrated, time-variant, non-volatile collection of data. Application of BI technologies to assess and support strategic business choices is not possible unless there is a repository of reliable data across the organization value chain. Currently, the most challenging and resource-intensive stage of BI development and deployment is data integrity, which is lacking in the majority of organizations.

Potential advantages of BI for better e-governance include not having to deal with disparate and isolated systems, reducing reliance on IT staff, obtaining comprehensive information that is simple to understand without the use of complex tools, and performing extensive analysis on stored data to respond to in-depth queries. This helps decision makers in developing more sensible strategies and directives for facilitating citizen participation. According to the concept of e-governance, business intelligence tools that assist policy makers in drawing important conclusions from data constitute a crucial part of every e-government endeavor.



This is a brief summary of the BI system's advantages. The BI technologies lean more toward G2G than other kinds from a layperson's perspective. With the aid of thorough multidimensional evaluations of all the pertinent data, all government plans and choices can be reached. In actuality, it benefits the populace more than the state. The government may provide the public with a brief and comprehensive profile of each person, and they can access this information online and utilize it wherever they choose.

Governments from all around the world have recognized, and still do, the importance of information. It is unnecessary to overstate the importance of information to the health of a government, an organization and an economy. According to the government, information has the power to influence success or failure, efficiency and effectiveness, innovation, and economic prospects, depending on how it is managed (Oumkaltoum et al., 2019). Information is viewed as a valuable resource and the foundation of an accountable and transparent administration in the context of e-government and in general terms. Since transparency and accountability are essential components of modern governments and democracies, information has thus become a pillar of good governance and government.

Putting it in writing that data and information must be managed strategically, in a coordinated and uniform manner across government, in order to achieve the potential benefit. This comment specifically addresses the idea of knowledge, which is thought to be essential for a government to reach its full potential. Governments are therefore challenged to ensure that they give information the attention it merits in order to improve their effectiveness and efficiency toward the realization of their full capabilities, which is a step in the right direction toward the fulfilment of the two main tenets of good governance; namely accountability and transparency (Idowu et al., 2018).

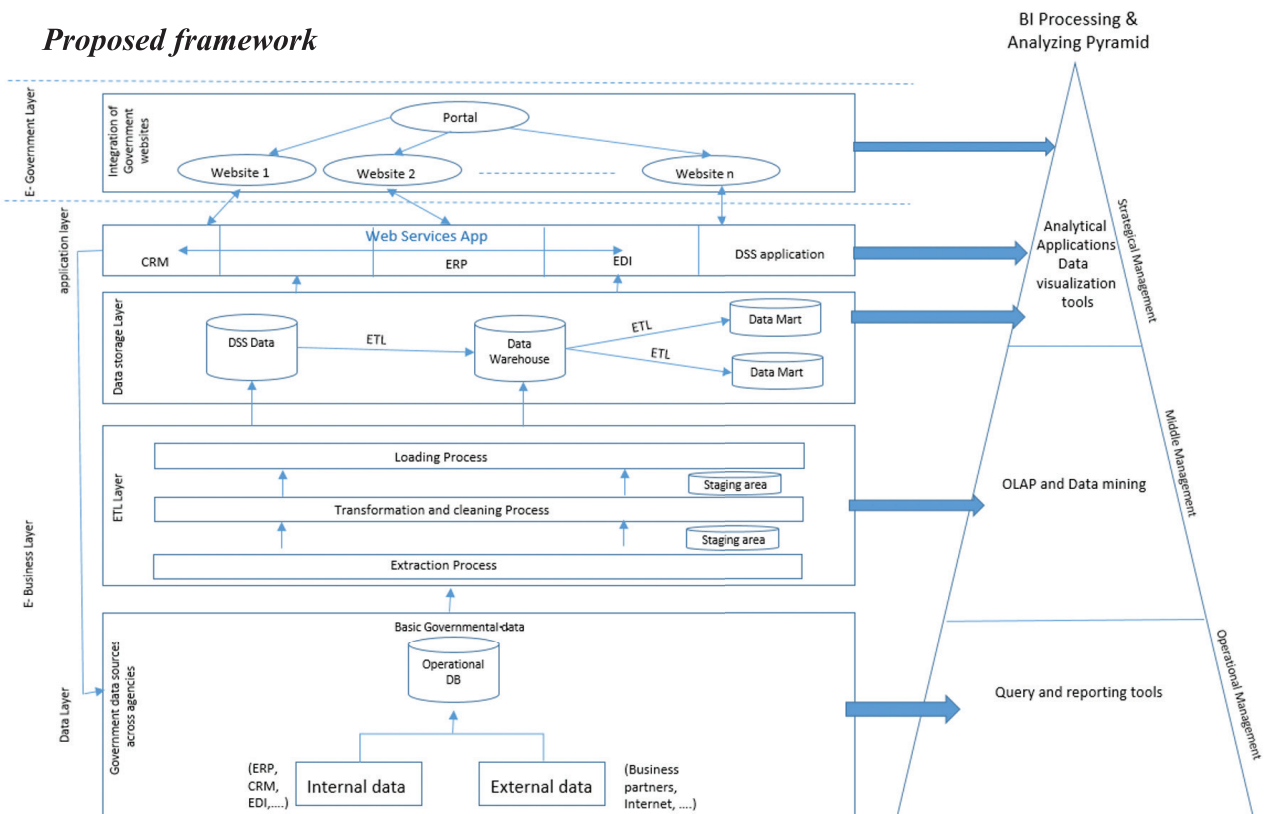
Although the Egyptian government has embraced the idea of e-government, it appears that this endeavor lacks a reliable information structure. The full benefits of e-government may not only be postponed but also not fully realized, if there is no intelligent information framework. This is to support the Egyptian government's e-government agenda.

## 6. Proposed Framework

The process of meeting information needs for decision-making is complicated and is compounded by several exploitable activities. Our task is to put forth a framework to direct the growth of intelligent data-based e-government activities. Providing business intelligence enhances managers' decision-making by providing the tactical and strategic data they require for comprehending, controlling, and coordinating organizational activities. The proposed framework procedure is based on the capacity to recognize and gather relevant material to analyze and extract pertinent information from that information to aid in decision-making. We might claim that obtaining data is the most difficult component of business intelligence (BI), and it can take up to 80% of the time and effort to generate. Organizations' attention is focused on getting data in and out, which involves business users and applications gaining access to data from the data warehouse to do enterprise reporting, OLAP, querying, and predictive analytics.

In this study, a framework for BI architecture is proposed, it takes into account the system's information flow as well as the value and quality of the data. The proposed framework is composed of data source, ETL (Extract-Transform-Load), data warehouse, end user, and metadata layers. Each layer is described in the following paragraphs.

Figure 1



Source: Proposed by the author

## ***6.1 Government Data Sources Layer***

According to the literature review, information sources for business intelligence can come from internal data or external data. In order to make efficient and timely decisions today, many application areas need to employ both structured as well as unstructured and semi-structured data. Data are the lifeblood of the digital world, and governments have a tone of it. As such, they provide a huge hidden source of value for both the public and commercial sectors. When used properly and with consideration for the ever-increasing demands for data protection and privacy, data can streamline the provision of public services, lower fraud and human error, and spark significant operational efficiencies (Barakat & El beqqali, 2020).

In spite of these potential advantages, governments all around the world are still mostly unable to seize the chance. The main factor is that information is frequently scattered over a patchwork of registers (datasets utilized by government organizations for a particular purpose) that are frequently controlled in organizational silos. Data are frequently kept in un-processable formats or locations where digital access is not available. As a result, data are not readily available when needed, digital government development is stymied, and citizens are not given much information about the data the government collects on them or how it uses them.

Only a small number of nations have made substantial progress in resolving these issues. The experiences of these nations may offer other governments useful direction, as they weigh their alternatives. These experiences also suggest actions that governments may take to unleash the value that is already at their doorstep.

Organizations must identify their data sources with clarity. In order to handle specific business problems and requirements, it can be helpful to know where the necessary data can be accessed. This can result in substantial time savings and faster information delivery. The information can also be applied to make data replication, data cleaning, and data extraction easier. This is due to the fact that, despite the abundance of available data sources, some of them may be difficult to acquire, untrustworthy, or irrelevant to the needs of the business at hand. Inconsistent data, difficulty locating root causes, and challenges with data isolation can all be avoided with proper data source identification.

Internal data sources, such as Customer Relationship Management and Enterprise Resource Planning systems, information about corporate activities is also considered among the sources of internal data (i.e. customers, products, and sales data). Because they execute a huge number of transactions in real time and update data as needed, these operational systems are also known as online transaction processing systems. Only recent data that are used to support ongoing company operations are contained in the operational systems of the organization.

Data sources that come from outside of an organization are referred to as external sources. This kind of information can be gathered from outside sources like: clients, suppliers of syndicate data, the internet, authorities, and market research firms. These facts frequently concern the market, competitors, surroundings (such as consumer economic and demographic information), and technology.

## ***6.2 ETL (Extract-Transform-Load) Layer***

Extraction, transformation, and loading are the three key activities that this layer concentrates on. Extraction is the procedure for locating and gathering pertinent data from various sources. The data gathered from internal and external sources are frequently disjointed, lacking in detail, and possibly duplicated. In order to choose the facts that are important for assisting organizational decision-making, the extraction process is required.

Prior to being transformed and cleaned, the extracted data are then transported to a short-term storage location called the data staging area. This is done to avoid having to extract data repeatedly in the event that an issue arises. The data will then undergo the processes of transformation and cleaning.

Data transformation is the process of turning data into standardized formats for reporting and analysis using a set of business rules. To maintain consistency across an organization, the data transformation process also involves establishing data definitions and defining business logic for data mapping. In terms of data cleaning, it is the procedure of locating and fixing data problems in accordance with pre-established rules. The extracted data is sent back to the data source for repair if an error is discovered. Data are stored in the staging area, once they have been converted and cleaned. In the event that the loading operations fail or end, this can avoid the need to modify the data again.

The final step in the ETL process is loading. The target repository is loaded with the data from the staging area.

## ***6.3 Data Storage Layer***

### **6.3.1 Data Warehouse**

An integrated collection of historical and summarized data from internal and external data sources is called a data warehouse (DW). With the aid of ETL procedures, data warehouses are used to standardize the outcomes for all systems that can be searched as well as to collect diverse types of data in one place. DW gathers pertinent data into a repository, organizes and verifies them, in order to support decision-making goals. Users need knowledge of the data warehousing system and its contents in order to comprehend and locate data in the warehouse.

The format, encoding/decoding algorithms, domain restrictions, and descriptions of the data are all included in this so-called metadata, or data about data, information. It also incorporates organizational changes, business rules and assumptions, business definitions, data quality alerts, and other items of business importance. Business users may better grasp what is accessible, how to get it, what it means, which data to use, when to use it, with the aid of metadata. The data warehouse can be seen simply using metadata browsers.

### **6.3.2 Data Mart**

Small data warehouses called data marts or localized data warehouses. Particular departments or divisions to support their own decision-making processes often develop them. For instance, a data mart can be developed for particular goods or tasks, such as client management, marketing, finance, among others.

### **6.3.3 Decision Support System (DSS) Data**

It includes executive information systems (EIS), geographic information systems, data warehousing and analysis systems, and file drawer and management reporting systems (GIS). Data-Driven DSS place a strong emphasis on the use of massive databases of structured data, particularly time series of internal corporate data and occasionally external data, for access and modification.

## ***6.4 Processing & Analysis Phase***

The knowledge management and BI tools' essential features are integrated during this phase. It facilitates the thorough study and sharing of business data, information, and knowledge. First, filtered and organized knowledge is taken from cleaned data warehouses.

This stage is crucial, since it is where sorting, filtering, advanced search, and query creation all take place. This phase involves extracting information and processing it, while going through many stages in accordance with user needs. In order to extract useful data/knowledge from data warehouse, BI technologies like OLAP, data mining, and other query reporting applications are connected with Knowledge Management (KM) processes like knowledge discovery and KM technologies like text mining. The process of knowledge discovery includes data mining as a phase. The actual process of looking for interesting patterns is called data mining. Choosing the right data mining algorithm—such as neural networks, linear or logistic regression, association rules, etc.—for the task is crucial at this point (Shehzad & Khan, 2013).

It is necessary to save the information/knowledge that was extracted using BI tools for usage in the future and dissemination within the company. Most KM systems that are used to store this information and knowledge include knowledge repositories, which are often regarded as essential parts of these systems. They aim at recording both tacit and explicit information and are collections of both internal and external knowledge. With the use of OLAP, data mining, and other reporting technologies, explicit knowledge is produced. To make generated knowledge accessible effectively and efficiently, it must be filtered, arranged, and stored in a central knowledge repository. The tacit knowledge of human specialists can be directly gathered by KM systems.

## **7. Conclusion**

Although the idea of BI was only developed a few decades ago, it is now a key issue for businesses of all sizes to assess, whether they should invest in this system or not, in order to serve the demands and wants of their customers. Today, BI determines the true commercial value of data assets and significantly improves the ability to spot and seize business opportunities.

Here, a BI framework for e-government is described. There are already many active e-governance apps. The opportune time has come to include BI into e-governance and strengthen the system even more. The BI system may initially be created across one or two sectors as a proof of concept in order to incorporate it and apply this. Once the intended outcomes are obtained, additional government departments might adopt the same strategy. A knowledge base for the full e-government environment can be developed, once the entire system is ready for usage at the national level.

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