BUSINESS INTELLIGENCE AS SUPPORT TO KNOWLEDGE MANAGEMENT

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Abstract: Knowledge management is becoming an increasingly important business resource not only in the development and innovation process, but also in securing an organization's competitiveness and survival in the environment. In view of the fact that there is no full consent as regards adopting a universal definition, knowledge management can be regarded as a concept encompassing methods of simplifying, enhancing, sharing, distributing and creating knowledge within an organization. The dominant approach of contemporary business operations is based on business intelligence, which, including Data Warehouse as its integral part, represents a highly significant component in knowledge management. As the application of information technologies provides the key support in conducting all business activities, from operative to highly complex ones, this article considers the significance and functional application of Data Warehouses in the knowledge management system.

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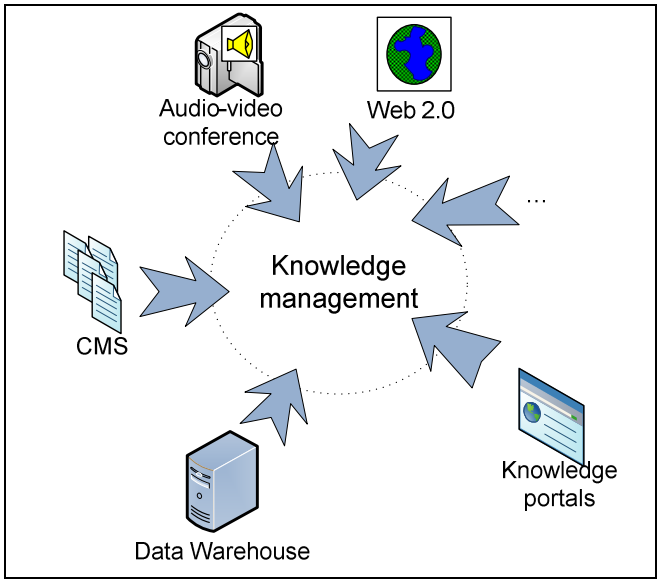
Introduction

As the contemporary interdisciplinary concept of business operations, knowledge economy encompasses knowledge management as one if segments, and determines it as an important set of processes to be managed by the organisation. Despite the fact that it denotes a highly significant resource, the phrase "knowledge management" does not have a unanimously and unequivocally adopted definition, for its determination depends on the perspective from which it is viewed and defined. Out of a considerable number of definitions in literature, we shall mention only some, as the closest to information technologies and business intelligence, such as "the cycle of creation, integration and dissemination" (Fischer and Ostwald, 2001). Knowledge management can be defined as a method for achieving goals in an organisation by gathering, creating, systematising and sharing information (Đurković, Trninić, Vuković, and Raković, 2010). Knowledge management is a dimension focussed on systematic and innovative methods, procedures and tools for managing the creation, acquisition, exchange, protection, sharing and exploitation of knowledge, intellectual capital and intangible assets (Gottschalk, 2005).

FIGURE 1. KNOWLEDGE MANAGEMENT COMPONENTS



Source: Đurković, Trninić, Vuković, and Raković, 2010.

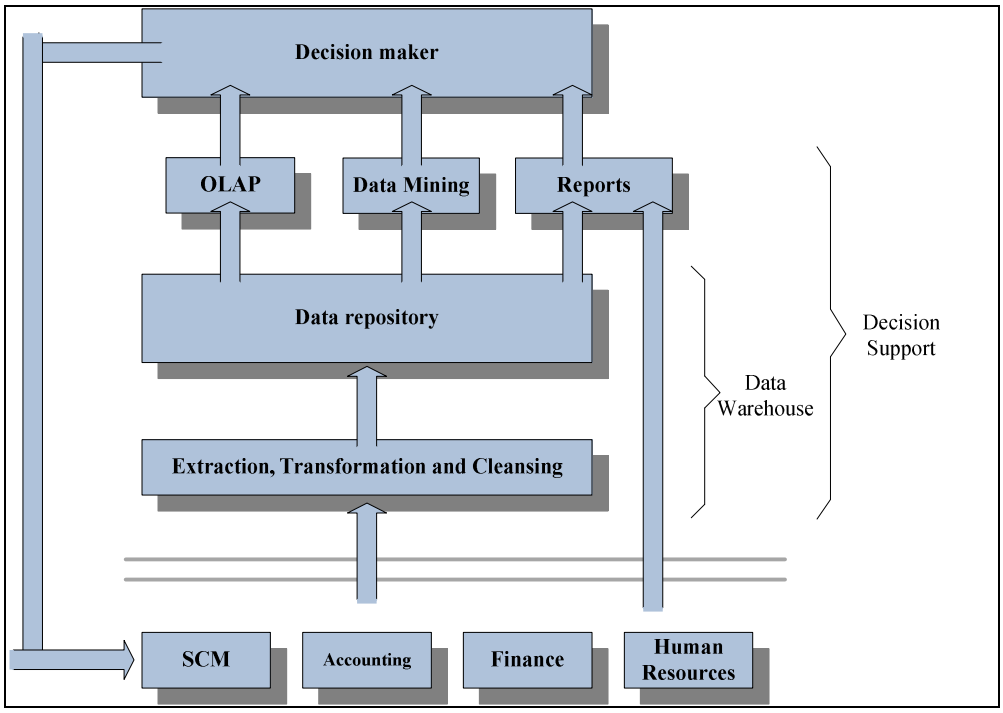
The key factor of implementing knowledge as an organisation's resource is reflected through its ability to maintain market competitiveness. Integrated activities within the knowledge management process point to the significance and function of a specific form of knowledge - organisational knowledge. Most frequently, organisational knowledge refers to "the sum of human resources, intellectual property, infrastructural and market resources of an organisation". From this point of view, it is very important for the organisation to manage the existing knowledge, and continuously create and encourage knowledge creation and distribution within the organisation. This is one of the reasons why knowledge management cannot be separated as an independent concept, for it depends on a large number of mutually dependent and conditioned components within the organisation. Knowledge management components are numerous, and the most significant ones include (Figure 1): knowledge portals, CMS, audio-video conference, Web 2.0 and Data Warehouse.

Out of the above listed set of components, we shall single out Data Warehouse as a constituent of business intelligence, which is a reason for focussing our attention on business intelligence and its importance in knowledge management within an organisation.

Business intelligence

For over ten years, corporate environment has involved the application of information technologies and business intelligence as a standard option, as it is apparent from their imposing growth and development. Obviously, the increasingly intensive development and application of business intelligence and information technologies have considerably facilitated data generation, gathering, transfer and storage. Storing large amount of data containing a multitude of valuable information required for and relevant to forecasting, decision-making and managing is undoubtedly essential, which is also reflected through the intensive development of tools supporting their management.

FIGURE 2. BUSINESS INTELLIGENCE LOOP



Source: Giovinazzo, 2000, p.2.

From the aspect of analysis in this article, it is necessary to point to the difference between operational and analytical data processing. Whereas operational data processing refers to a company's day-to-day operations, analytical (or DSS) data processing is conducted in order to provide information necessary for analysing a problem or a given situation. The principal resource for decision support systems (DSS) is the analytical database, filled from a large number of various operational systems - Data Warehouses - whose primary functions include maintaining operation processes and regulations of the entire organisation (Balaban and Ristić, 2006).

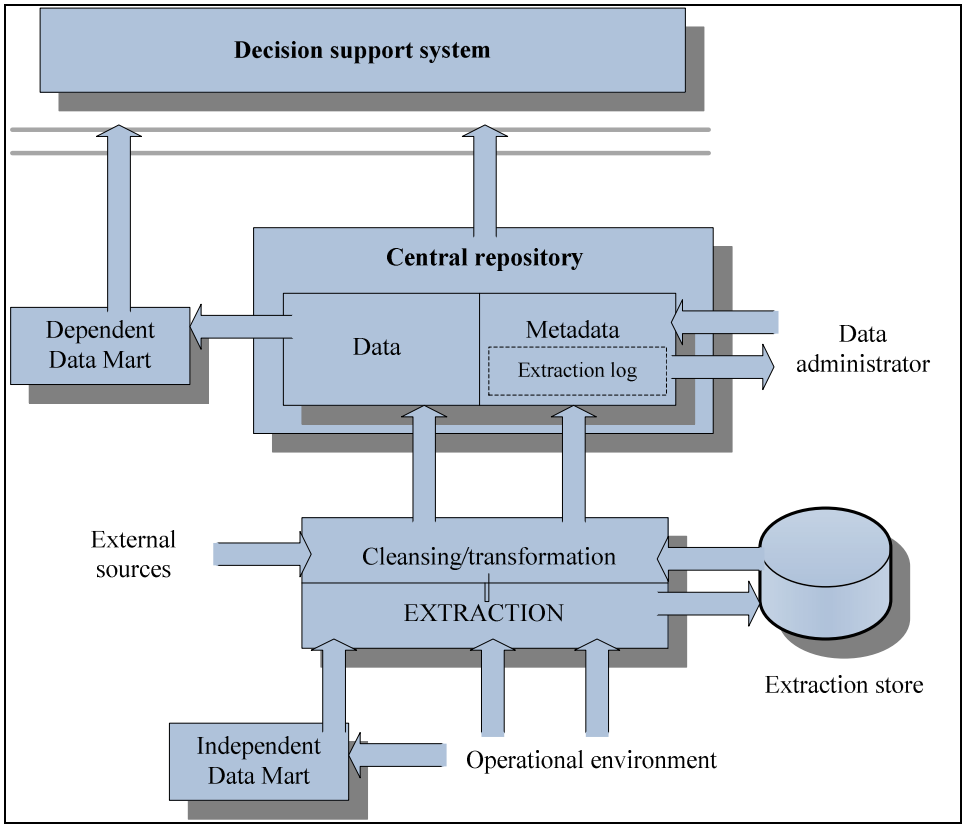
Data Warehouse is a segment of the business intelligence (BI) infrastructure, and despite being the principal basis for DSSs, it does not feature as an independent concept. Giovinazzo (2000) represents the business intelligence structure as a loop (Figure 2) including the Data Warehouse (or smaller Data Warehouse segments referred to as Data Marts), on-line analytical processing (OLAP) and Data Mining.

Data on stakeholders and data on the organisation itself enter the business intelligence loop through the operative environment. Before commencing data storage in the Data Warehouse, these need to be transformed so as to meet the defined norms related to data quality and format. Only when the data have been extracted, transformed and refined, they are stored in the central data repository. By default, this central data repository can be a multidimensional or relational database. Due to the huge amount of data and the need for fast response to queries, Data Warehouse database is mostly designed as a multidimensional database.

The next step in the business intelligence loop is the decision support system (DSS). Decision support is provided by way of quite simple reports, down to executing complex and manifold requests through OLAP and Data Mining. A significant convenience is that decision support can also be achieved directly from the operative environment. Naturally, information obtained by the DSS is easy to return to the operative environment.

The picture below shows the core components of the data warehouse as the central data repository (Figure 3). In the knowledge management process, a data warehouse is what can serve as a significant basis for knowledge management within the organisation itself.

FIGURE 3. DATA WAREHOUSE STRUCTURE



Source: Giovinazzo, 2000, p.9.

In the usual functional structure, the centralised data repository (Data Warehouse) is located outside operational environment, but receives data both from the operational environment and from other sources outside the enterprise. Data Warehouse represents the central repository, primarily used for extracting information that can be relevant as the basis for the business decision-making process. Data Warehouse, of course, should by no means be identified with a much simpler process such as data archiving.

The essence of Data Warehouse is best presented by explaining the constituent components and the components that it interacts with (Giovinazzo, 2000). Operational environment involves managing day-to-day activities, and contains raw data whose function is to describe the organisation's current state. Extraction is focussed on the task of repairing and/or receiving data from the operational environment. By way of extraction, data are transferred into the extraction store, where they are kept pending their transformation and cleansing. Transformation is the process of converting data into a consistent format. Cleansing is a process by which errors are removed from the data. The extraction log keeps the record of all the data related to extraction. It is a segment of metadata, and helps the data administrator to verify the quality of data integrated in the Data Warehouse. External sources are data sources outside the organisation, and in most cases they are reports from various institutes, institutions, market research etc. The Central Repository is the

basis of the Data Warehouse architecture and comprises data and metadata related to the Data Warehouse. Metadata are data on data, i.e. metadata describe what kinds of data are stored, where they are stored, as well as operating rules, and, if required, other relevant features. The data administrator is in charge of the quality of data located in the Data Warehouse. Some of the data administrator's tasks include reviewing the transaction log, where he examines whether there have been any changes in the metadata, whether there are any inaccurate data, etc. (Giovinazzo, 2000).

Data Warehouse as support to knowledge management

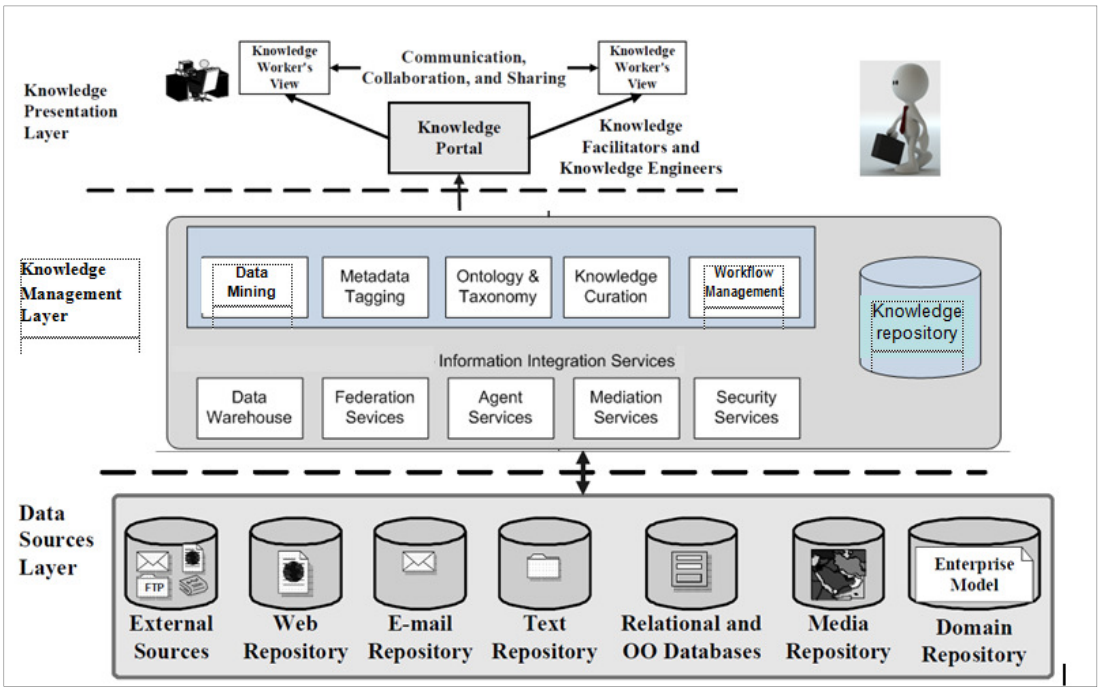
Data stared in the Data Warehouse database may serve as one of the main components in the knowledge management system. Erdmann cites two ways of obtaining knowledge from the Data Warehouse database:

1. Various reports can be produced with OLAP technologies. With OLAP tools, analysts can form various queries. Results obtained by given queries can be the starting point for subsequent queries. Erdmann refers to this approach to searching as analyst's "wondering" through information in search for information to be subsequently presented to the organisation's management. Naturally, the process of interpreting the obtained data requires adequate knowledge, and thus formed information becomes new knowledge or augmentation of the existing knowledge, if they result in certain decisions or actions.
2. Knowledge acquisition through discovering knowledge by way of various algorithms. Such a procedure, in most cases, includes mathematical methods that the unknown knowledge can be detected with.

As it has already been noted, a Data Warehouse comprises data from various heterogeneous sources. For high-quality knowledge management architecture, Kerschberg proposes meeting the following requirements:

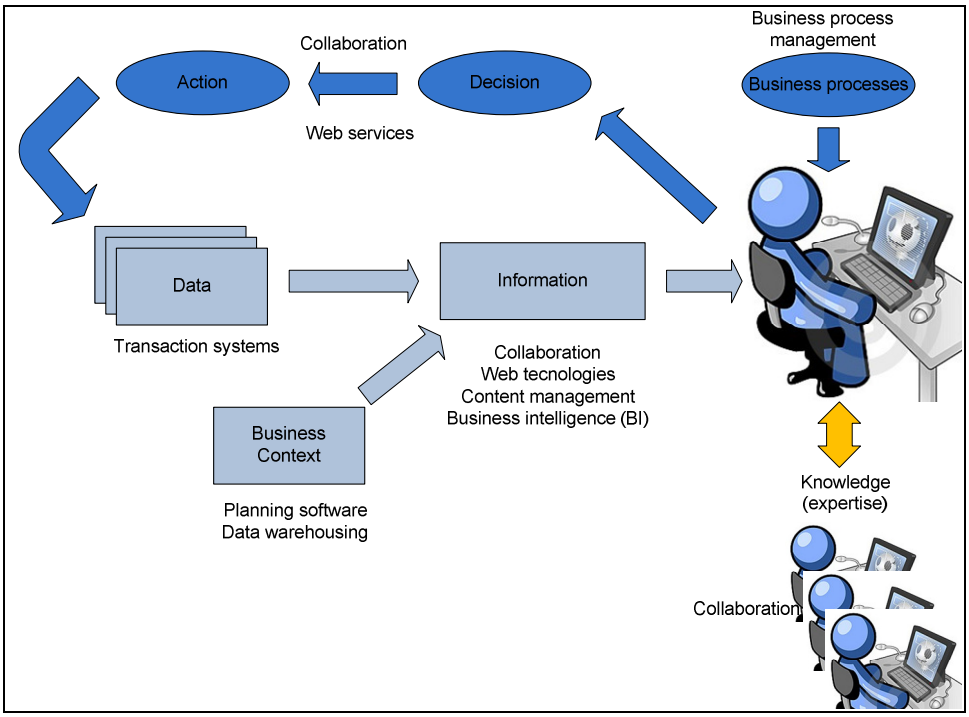
- access to external and internal information sources;
- existence of a repository that contains explicit knowledge;
- existence of processes and tools that support knowledge acquisition, cleansing, indexing, storage, repairing and presentation;
- existence of mechanisms for cooperative knowledge sharing among employees;
- existence of organisational structure and incentives to enable sharing knowledge and forming a life-long learning organisation; and
- information technology support for the entire architecture.

FIGURE 4. CONCEPTUAL MODEL FOR KNOWLEDGE MANAGEMENT SYSTEM



Source: adapted from Kerschberg.

FIGURE 5. KNOWLEDGE MANAGEMENT TECHNOLOGIES



Source: White, 2005.

Kerschberg presents a conceptual model for knowledge management systems composed of three layers (Figure 4). The first layer is marked as Knowledge Presentation, the second - Knowledge Management, and the third one is referred to as Data Sources layer. The Presentation layer enables the workers to communicate, collaborate and share knowledge. They obtain information through a defined Knowledge Portal, which can be customised for every employee. The Knowledge Management layer consists of a Knowledge Repository, a process used for acquiring, cleansing, distributing and representing knowledge and data integration services (Kerschberg).

Kerschberg represents the Data Warehouse within the Data Knowledge Management (Figure4), in the segment he refers to as Knowledge Integration Services. Together with other services, notably Data Mining, Knowledge Integration Services form a knowledge repository which becomes available to employees in the enterprise through various knowledge portals.

White (2005) argues that the development of information technologies has significantly contributed to the fact that knowledge management, through knowledge management systems, has become a significant resource of any organisation, and business intelligence has acquired a highly important role in knowledge management projects. Business intelligence applications provide the analysis of business information, producing information that enables users to enhance and optimise business operations. Information used in the decision-making support domain can be obtained directly from the transaction system (Figure 5), or, more frequently, information is obtained by processing data from the Data Warehouse database. The Data Warehouse data repository is managed by the database management system, using languages such as SQL (Structured Query Language) for data access and manipulation White (2005).

In his works, White (White, 2005) states that business intelligence plays a central role in knowledge management (Figure 5). The same author also places knowledge management in the context of business process enhancement as well. For the traditional business intelligence system to support knowledge management, what is essential is their integrated functioning with business process management software, planning and collaboration software, portals, content management systems and other systems with similar purpose, thereby enabling provision of timely information for individual management levels.

As one of the shortcomings of Data Warehouse databases, many authors mention the existence of unnecessary, redundant, inaccurate or incomplete data, and sometimes even incorrect data. Albescu, Pugna, and Paraschiv (2008) claim, however, that despite these shortcomings, it must be borne in mind that each piece of data, similar to chips in a jigsaw puzzle, may be helpful, if they are integrated so as to get the complete picture. Even if it is established that some of the data are missing, this can often result in the idea of what the picture actually represents. These authors refer to this procedure as knowledge creation. Further on, Alabescu et al. (2008) write of two approaches to knowledge creation:

1. Data ⇨ Information ⇨ Knowledge - represents a process of creating and adding value to data

sustained by information technologies. Business intelligence technologies play a key role in this context. OLAP and Data Mining techniques are used for retreiving information from Data Warehouse database whose interpretation may become augmentation of the existing as well as newly created knowledge.

2. Integration - represents interaction or communication of implicit or tacit knowledge (expertise) and explicit knowledge (documents, databases, Data Warehouse).

Successful knowledge management requires integration of databases, information systems and knowledge-based systems, where Data Warehouse features as the integrating component of these three elements (Erdmann). Knowledge retrieved by way of OLAP, Data Mining and other techniques can be very useful if applied appropriately (Đurković, Trninić, Vuković, and Raković, 2010).

Conclusion

In view of the fact that knowledge undoubtedly represents one of the strategic resources of any organisation, organisations increasingly tend to highlight mastering this resource and building an appropriate knowledge management concept. Development and successful implementation of knowledge management concept have been made into a rational solution by the intensive development of information technologies. Technologies such as business intelligence, knowledge portals, audio and video conference, as well as content management systems facilitate the development and successful implementation of knowledge management within an organisation to a great extent.

As one of the knowledge components, Data Warehouse has a significant role in the implementation and realisation of knowledge management within an organisation. As a repository of data from different heterogeneous sources, Data Warehouse technology represents an important basis for creating information that can subsequently used for knowledge acquisition. Implementation and dissemination of knowledge management throughout an organisation requires high-quality networking of Data Warehouse with other knowledge management components, as this is the only way to achieve synergetic effects.

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