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Possibilities of Usage of Strategic Business Intelligence systems Based on Databases in Agile Manufacturing

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Abstract

Organizations must have the ability of responding quickly to predictable and unpredictable changes in the market. Organizations' ability to adapt to the fast changing conditions depending on the differing requirements of the customers, depend to a great extend on their ability to become agile. Since change and ambiguity always exist and always will in future, the necessity of the organizations to understand these changes in environment conditions quickly and to be able to respond gains importance every passing day. This requirement provides the wide spreading of agile manufacturing philosophy in organizations. Organizations, due to agile manufacturing, will be able to have the chance of turning the ambiguities in the environment to possibilities. Today, accessing correct and more detailed information became possible however another problem has arisen. This problem is the management of large numerical data stacks and their becoming meaningful. The work of turning raw data into information or making them meaningful can be made with data warehouse and business intelligence tools (data mining, inquiry-reporting, OLAP). At the stage of quickly accessing and using data which will form the basis of agile manufacturing work, creation of data warehouses and using them by integrating into organization information system will be useful. In this work, information is tried to be provided with the literature scanning about the possibility of usage of data warehouse and data base architecture during agile manufacturing process and with business intelligence tools.

Keywords: Agile Manufacturing Management; Business Intelligence; Data Warehouse; Data Mining; On-Line Analytical Processing (OLAP);

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1. Strategic Business Intelligence and Data Warehouse Architecture

Business intelligence (BI) is the set of techniques and tools for the transformation of raw data into meaningful and useful information for business analysis purposes. BI technologies are capable of handling large amounts of unstructured data to help identify, develop and otherwise create new strategic business opportunities. The goal of BI is to allow for the easy interpretation of these large volumes of data. Identifying new opportunities and implementing an effective strategy based on insights can provide businesses with a competitive market advantage and long-term stability (Rud, 2009). BI technologies provide historical, current and predictive views of business operations. Common functions of business intelligence technologies are reporting, online analytical processing, analytics, data mining, process mining, complex event processing, business performance management, benchmarking, text mining, predictive analytics and prescriptive analytics.

BI applications generally use data collected from a data warehouse or a data warehouse guide. A data warehouse is a copy of the functional data and thereby makes the decision making easier. However, not all data warehouses can be used for business intelligence. Not all business intelligence applications are required for a data warehouse.

Wide definition of business intelligence systems is: Business intelligence is a stack of theories, methodologies, processes, architecture and technologies which change raw data into meaningful and useful information for business purposes (Evelson, 2008). When we use this definition, it covers business intelligence data integration, data quality, data warehouse, high data management, text and content analysis and many others collected in Information Management. From a more narrow point business intelligence is: defined as reporting, analytical and control panel by only pointing to the top level of BI architecture structure. (Evelson, 2010). According to Gartner 2009 Information Management special report estimate, in future BI trends will be (Gartner, 2009): grain calculation, social network, data visualization, mobile BI, estimation analytics, integrated applications, cloud calculation, multi-touch operated. (Campbell, 2009).

When it is considered that data bases are only designed to store information, data produced with computer systems do not have any value on their own. These data produced can only become meaningful when processed with respect to a certain purpose. The work of turning raw data into information or making them meaningful can be made with business intelligence and data warehouse. Design and realization of Data Warehouse Architecture, On-Line Analytical Processing, Data Mining and Decision Support System (DSS) applications have an important influence potentially. Data mining, is all of the informatics technique for extracting information from data bases and use this information for estimating in future (Alpaydın, 1999).   Data mining is a strong data analysis technique which reveals the hidden truth in data warehouse. It provides the analysis of data with various methods, discovery of the relationship in between and observe the process. Data mining brings the load of analysis the users must make to computer environment (NCR,1999). When data warehouse is focused on the large volume data collection and storage, OLAP (Online Analytic Process) tools provide the tool which processes and analyses information. Data warehouse and its components select, extract, load, convert, and clean raw data obtained from organizations or corporations in an easy and effective applicable manner and place them in a structure in OLAP and data mining tools.

There are many definitions in literature for the data warehouse. Some of these definitions are:
•   Data warehouse, is one of the three general types of data warehouses in the business intelligence system which makes the analysis, access to the permanent data belonging the past by the corporations and organizations. Other warehouses are; Data Mart and Operational Data Warehouse (Hahn, Ann Jakson &Kabath 2000).
•   It is a technology which provides the conversion of data located in different places and different sources and their dispersion to the users to be used for decision support purposes (Çarkıt, 1997).
•   Generally, Data Warehouse is a decision support database which support business units or multiple common functions (Craig, Vivona, & Berkovitch, 1999).
•   Data warehouse, is the total of the subject-directed data, integrated, time changing, not variable in decision support process of the management (Şener, 1999 - Cray &Watson, 1998).

•   Data warehouse concept is mostly misunderstood. Data warehouse can be defined as a database which can be read only used in creating a decision support process in reducing the complexity to a minimum. (Reeves, 1996).

•   Data warehouse, is single, complete and continuous information storage obtained from various sources. (Devlin, 1997).

•   Data storages are different from operation systems: 1- They cover a longer time span from movement systems, 2- They contain multi databases and 3- They optimize direct answer to complex questions coming from users or application (Cray & Watson, 1998).

•   Data Warehouse is a set of tools (Microsoft, 1998). It is possible to increase these definitions. However from the point of understanding the subject better and to form an integrity, it will be beneficial to emphasize two of these definitions or similar ones about data warehouse. "Data warehouse" is a tools set. If we can clarify this definition:

1)   Is a tool for users: First and most important of all, it is a tool for the users. Data warehouse provides the possibility of analyzing the data for the researcher, to analyze them by various methods and to make a decision depending on these.

2)   Is the total of decision support and data with analysis purpose: Data warehouse can not reach a decision without people. Data warehouse normally covers the data regarding the total of the organization and these data can be mostly summarized at a certain level for analysis purposes.

3)   Data and Tools: Data warehouse and Data mart are data bases each. Data warehousing, is process covering all tools used in creating data warehouse and these tools are used in accessing information and analyzing it. One of the most important methods of data warehousing is the software used in accessing information. If the users can not use these tools comfortably, then they can not use data warehouse [Microsoft, 1998]. Data warehouse which is an associative database, is designed for enquiries and data analysis rather than movement process (daily, weekly data entrance and exit). Data warehouse can generally be obtained from data warehouse movement data containing past data. but also data can be obtained from outer sources. If we consider the other definition; data warehouse is the total of the following in supporting the decision making process of management; A) Directed to subject, B) Integrated, C) Time variant and D) Not variant.

1.1. Data Warehouse Architecture

Architecture is a required rules and structures stack for a system or product design. (Reeves, 1996). Architecture is developed in order to answer the changing demands of the corporation or organization. Data warehousing is really an architecture. User uses data warehouse architecture in creating data warehouse systems. Data warehouse systems, are not defined by components such as databases, access tools or data itself. Data warehouse is a holistic (apply to the whole) system and consists of processes, products, data, personnel and most important of service (Hackney, 1996).

Figure 1. Data Warehouse Architecture
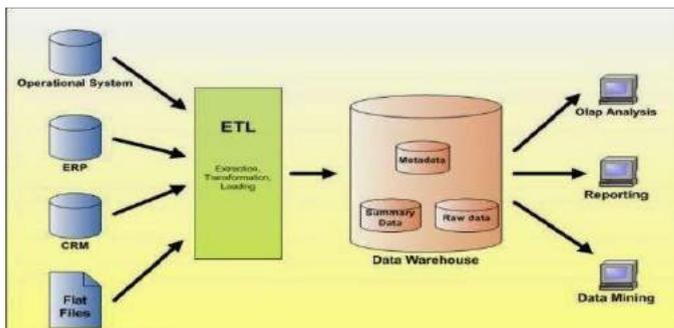
Source: Data warehouse4u.info (2008)

1.2. Data Warehouse Features and Superior Points

Data warehouse, provides some important advantages to its users with its effective decision support solution, in struggling with concept and organization problems. These are: 1-Data warehouse, provides a general setup in order to combine the information stored in heterogeneous work systems (Craig, Vivona & Berkovitch, 1999). Organizations, can analyze and comprehend the relationship between various trade functions deeply such as account and customer services by first joining data in data warehouse. 2-Another important advantage of data warehouse is its optimization of decision support (Craig, Vivona & Berkovitch, 1999). Many data structures of OLTP applications are not designed to cover the high performance decision support requirement. Many database data warehouse design suitable for moving process or a multiple dimension database, can be configured to answer these types of questions in an effective way. 3-Another important feature of data warehouses is its storage feature for historical data (data belonging to the past) (Craig, Vivona & Berkovitch,1999).

## 1.3. Reasons for Organizations Creating a Data Warehouse

Main reason for organizations creating a data warehouse is its providing a strategic advantage regarding the competition between organizations. These advantages can be listed as follows: 1) Access Power of the Organizations and Corporations to their data covering a wide area: Data collected from different departments in many organizations may cause an important difficulty. Different departments of the organization can store data in different ways from main computer database, to work sheets and processor files. Warehouse carries all these data from heterogeneous sources to a central place. 2) Power to Have Continuous Data: Data carrying process is realized continuously from various departments to a central warehouse. When the data from this department are not compared to others, taking decisions becomes harder. In order for the data to be beneficial, data must be internally continuous. Data warehouse, is the best way to provide the continuity between Data Marts and accessing the source. 3) Power to Perform the Analysis in a Fast Manner: When data is continuous in the warehouse and internally, it can be easily requested for analysis purposes. This analysis is realized in general by data mining in re-organizing the data and researching the trends. Data warehouses help the organizations in understanding individual markets better, in examining them and revealing widespread trends (Microsoft, 1998).

2. Agile Manufacturing – Flexible Manufacturing

While reliability and quality is being improved in recent years, at the same time they adopted increasing flexibility in every area as an objective (Vokurka and Fleidner, 1998). Today, it is emphasize that the priority in competition is agility. Agility expresses the ability to manufacture and market to clients high quality products, with shorter supply times and by providing the customers higher value, in different volumes and with low costs (Fliedner and Vokurka, 1997). When considering the definitions in agility concept, it can be indicated that agility is a direct function of the changes occurring within the framework of organizations. The faster a change occurs in the activity conditions of the organizations, the better organizations are agile in order to respond to these changes (Sharifi and Zhang, 2000).

In Yusuf et.al. (1999), stated that agile organizations are organizations which are competitive from time dimension. In Goldman et.al. (1995), gave the description of agility, as the organizations ability to maintain their activities in a profitable manner in a competition environment with customer opportunities changing fast and continuously and therefore very difficult to foresee. With respect to this description, Goldman et. al. (1995) stated that agile manufacturing, 1- Has four strategic dimensions as increasing the value presented to the customer, 2-Cooperation in order to increase the competition power, 3- Organization to overcome the change and ambiguity and 4- Increasing the effect of people and information (Vokurka and Fleidner, 1998; Zhang and Sharifi; 2000).

Agility expresses the ability to respond to changes in a dimension beyond flexibility. Kidd (1995) also stated that the concept of agility contains two basic factors, to respond to changes in a proper way and in proper time, to be able to take advantage of changes and turn them into opportunities (Zhang and Sharifi; 2000). Hooper et.al. (2001) indicated the agile manufacturing structure with respect to literature researches as in Table I.

Figure 2. Agile Manufacturing Structure
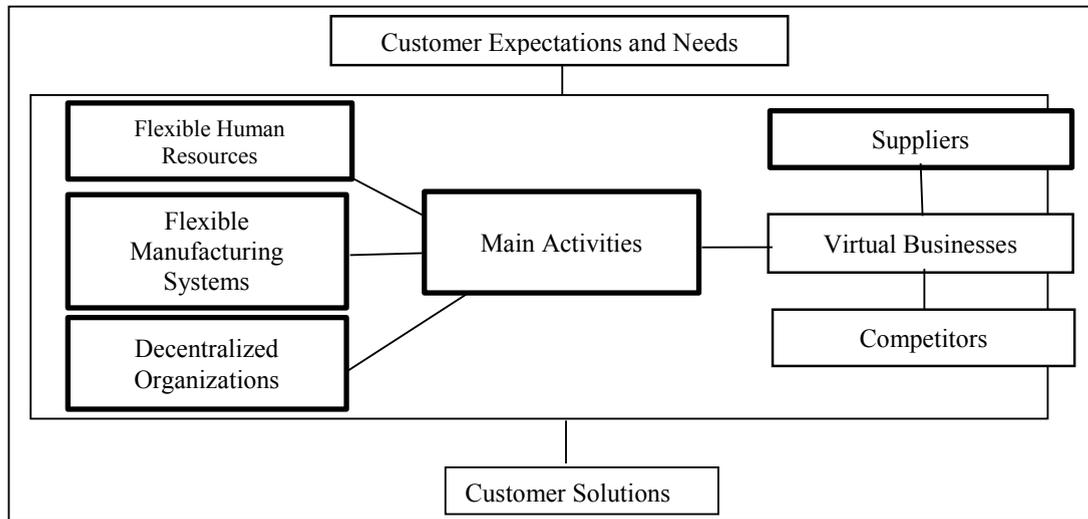
Source: Hooper et.al. (2011)

Agile manufacturing, can be achieved not with differentiation entirely by methods of performing work but with small size continuous changes. Corondo et.al. (2002); with respect to the literature research, indicated the following features of agile manufacturing: 1- Close relationship with suppliers, 2- Integration of enterprises, 3- Fulfillment of operation activities simultaneously, 4- Satisfaction of customer requirements, 5- Fast improvement circles, 6- Innovation dragged by the client, 7- Usage of flexible manufacturing technologies, 8- Learning organizations, 9- Very skilled and flexible labor force.

Flexible manufacturing concept expresses capability of making fast changes in issues such as product volume, product mix, machine scheduling etc.. Agility, also contains being interested in unforeseen changes in market or in customer demands. Therefore, agility concept can be ability to respond in a fast manner to unforeseen market changes different from the concept of flexibility. In the concept of flexibility, while the ability to respond to the changes known with methods previously determined, in the concept of agility there are no standard model and methods which can be followed by all organizations (Vokurka and Fleidner, 1998).

3. Possibilities of Usage of Business Intelligence Systems in Agile Manufacturing Management

Organizations which wish to achieve agile manufacturing effectively, must be able to integrate their marketing and sales activities with their design and production activities in order to obtain products special to the customer and in a way to answer the demand of the customers fully (Hormozi, 2001). In agile manufacturing, customers' participation in the product design process must also be provided. At the design stage of the products, and with respect to the changes in the customers' expectations, making rapid changes in the composition of the products' must also be evaluated (Maskel, 2001). Gunesakaran (1999) also emphasized that hardware and software must be easily adaptable, and production is one of the basic conditions of agility. In successfully applying the agile manufacturing, implementing robots, integrated design with computers, integrated production with computers, electronic data exchange, internet and electronic commerce are critically important.

Assen (2000); stated that organizations to be agile in an effective manner, has a strong relationship with their effective management of their skills based on time. In organizations, information technologies have a very important

role in effective management of abilities based on time. Therefore, technologies such as information technologies, CAD/CAM, robots, visual examination systems are required for agile manufacturing. Flexibility of agile manufacturing systems, is achieved with computer software to a certain extend. System control software must be easily adaptable to new products and these software must be designed to adopt to new conditions in future. Due to internet, text, graphics, sound and visual data sharing between organizations and departments of organizations became easy and accelerated. Additionally, due to internet, although the opportunity of following the changes in the requirements of the customers is provided, following the information regarding which products customers buy and in what amounts they buy, the frequency of their purchases, payment methods they prefer in purchasing the products is also possible. Design requirements are also obtained from information systems belonging to customers. Customers can also quickly access the information regarding the features of a product by opening the internet page of the organization selling that product, and are able to compare the organizations selling the product.

Due to business intelligence systems, orders can be taken over the internet from the customer and production plans are made in a fast manner with respect to the orders and can be delivered to the customers quickly. Therefore, the fact that internet has a very important role in organizations being agile, should not be ignored. The need for computer operators, design, software, system and maintenance engineers increased with agile manufacturing. People who work in the agile manufacturing area, must be people who can achieve many different duties and who can use initiative if necessary, skilled in information technologies and team work, with skills in many different areas compared to people who work in mass production (Gunesakaran,1999). Organizations being agile mean they can access correct information in a fast manner. Power et.al. (2001), in their research, determined that agile organizations also involved the suppliers into the process in increasing customer satisfaction. Traditional supplier selection methods are not adequate in order to be successful in agile manufacturing. In agile organizations, selection of the supply chain members, are not only based on cost and responsiveness, but product and service quality, location of the organization, ability to use information technologies, flexibility level of organization structure and activities also gain importance (Gunesakaran, 1999).

Business intelligence systems can be applied to work purposes in agile manufacturing to increase the following work values :

Scalability: Quality test informing the business leaders about the process leading to work and program objectives consisting of hierarchy of performance measure.
Analytic: Is a system building many processes to decide on the best option and to provide the work information discovery. It generally contains data mining, process mining, statistical analysis, estimate analysis, estimation model, work process modelling, complex event process and point of view analysis.
Reporting/Corporate Reporting: This is the system constructing substructure for strategic reporting on providing strategic management service of business. It is generally used in data visualization, workable information system and in OLAP.
Cooperation/Cooperation Platform: System containing different areas (both in the work and outside) to work together during data sharing and electronic and data exchange.
Information Management: It is a system or program which provide the company's data management together with applications and strategies to define, to create, to show, to distribute, to ease direct adaption and correct work. Information Management, manages training management and regulating adaption.

Business intelligence Systems;

1- Depending on the increasing data volumes of the organizations, provides obtaining more meaningful and reliable results with its detailed analysis feature and reaching information easily when needed for organizations and corporations with its integrated architecture, and which became the indispensable part of decision making processes.

2- Organizations which carry business intelligence to mobile environment with respect to users' requirements and technological developments, can access critical information any time. Accessing all analysis results

developed, reports and dashboards also in mobile environment, provides organizations to make more effective decisions in a shorter time and to be one step ahead of the competitors in strong competition environment.

3- Business intelligence systems which provide gaining a wider point of view to institutions and organizations and providing the means for detailed and strong analysis over large size data, can provide the participation of every employee working in the organization with different business intelligence which can respond to user requirements.

4. Conclusions and Recommendations

The purpose of data warehouse which is defined in the work and the business intelligence systems architecture; is to creatoran integrated decision support architecture against the decision problems seen in organizations, to analyze the existing condition by means of business intelligence and to be able to take healthy, fast and correct decisions with respect to future. In an integrated KDS architecture, benefits provided to the user by data warehouse and and business intelligence tools (OLAP, data mining, enquiry and reporting) are many. The relationship between data warehouse and business intelligence tools can provide important benefits in the production, transportation and sales of products in agile businesses. With an integrated in KDS architecture to be formed in the organization provide the organization the strength to access the data covering a large area, the power to own continuous data and the power to fulfill the analysis in a fast manner and can also provide a strategic advantage regarding competition between organizations. All these advantages depend on the organization's forming a suitable data warehouse for its purposes and capacity inside the organization. Organization, by means of forming one of the various data warehouse architecture, carry the data to a central location by joining them in a common data warehouse coming from heterogeneous sources. Thereby for the first time in the organization, access to all business data regarding the subject is provided and various analysis are done with respect to the purpose.

Agile manufacturing, has very important contributions in turning the ambiguity surrounding the organizations to opportunies. Business intelligence systems turning raw done to meaninful and useful information, is the analysis of business data all across teh organization to understand the existing work performance and reach business decisions based on information. Thereby it is a bridge reaching from raw data to strategic decisions. Agile manufacturing, provides to mechanism to give fast response to changing markets, manufacturing high quality products, reducing supply periods and increase the value presented to the customer. In order to achieve this, important changes must be done in organization culture and work methods. Organizations must be able to benefit from the latest developments in information technology and continuously develop their information technologies. The success in agile manufacturing, depend to a great extend on the ability of the employees and management to respond to changes in a fast and without any mistakes.

Agile manufacturing organizations with business intelligence solutions: Can increase the customer satisfaction with customer support and summary total customer analysis. Can determined the revenue increasing points in the market with income analysis. Can increase profitability with financial and sales analysis. Can take more effective human resources management decisions with human resources and labor strength analysis. Can provide the faster decision making of strategic and administrative decisions with decision support analysis.

Can increase production with product category management and product sales analysis and can follow production parallel to market requirements. Can realize the open points in the market and new business information with estimate analysis from existing data.

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