

**ECONOMIC PROCESS OPTIMIZATION DEPLOYED BY COMPANIES
WITH COMPLEX ACTIVITY PRODUCTION – TRADE –
SERVICES USING INFORMATICS SYSTEMS
WITH INTEGRATED DATA MINING TECHNIQUES**

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Abstract

There are many economic processes deployed by companies with a complex activity that can be optimized, among the most common being: supply, production/service, distribution, sales, suppliers/customers relationships, inventory management, human resources management, financial management, etc.

After the deployment of business processes related data is obtained. The analysis of the related data must be the starting point in any attempt to optimize the economic processes because this data best reflects the actual situation of the company.

In order to carry out such an analysis, several approaches have emerged to extract knowledge from the data accumulated. The first solution is to use specific software to analyze the available data. Another solution that can be successfully used is the implementation of data mining techniques within the database management software available supposing it is a new generation one.

Key-words: *optimization, informatics system, economic process, data mining, data analysis*

JEL classification: C₆₁

Introduction

This paper addresses the issue of optimizing economic processes within companies with a complex business activity (production, trade, services), especially by using modern computer systems.

It is known that over time the economic processes increased in complexity continuously generating increasing quantities of data stored in large databases and data warehouses, which are a true reflection of the work of a modern company. In this context, it is needed more than ever that the computer systems used to analyze the user's data should integrate data mining techniques, the only practical and efficient way to extract knowledge from data available to substantiate the management decisions.

When it comes to optimizing the business processes of companies there are usually few effective solutions available. Most of the times the information

obtained by interpreting the results of the advanced analysis of the available data must be the starting point of any attempt of optimization. In this context, the knowledge resulted from the use of data mining techniques on data collected previously and stored in databases/data warehouses is important for a company because it best reflects its economic situation at the time of analysis.

In order to be effective, data mining techniques have to be applied on significant volumes of data generated by economic processes within a company, data generated in various types of activities, which are collected over a longer period of time and stored in databases/data warehouses. It is beneficial for all computer systems used by a firm to be interconnected and have access to a common database. This way data mining techniques can be applied more easily, without imposing pre-integration of data from several sources.

In order to use the data a company owns, data analysis techniques can be implemented by adding additional scripts to the applications already used in a company with a complex activity. Data models can be obtained in such way that they can be the base for identifying the underlying problems that a firm faces in its activities and also the proposals for concrete measures to eliminate them as much as possible.

Review of literature on themes

Specialized publications were consulted before writing this paper. These are presented in the references section. Books presenting the general concepts on the subject addressed and up to date articles published in journals some of them being ISI were consulted. Works consulted are considered up to date, most of which being published in the last five years, both domestically and abroad.

1. Opportunities to optimize economic processes undertaken by companies with complex production-trade-services business activity using computer systems that integrate data mining techniques

Typically, any firm that produces goods or services is also required to sell them (trading activities). Within companies with a complex business activity there are typically production activities, related services activities (maintenance, assembly, service, transportation, financing, etc.), and selling activities.

Among the most common economic processes carried out within a company there can be listed a few:

- supply processes;
- production processes/services;
- distribution processes;
- sales processes;
- processes of relations with suppliers/customers;
- inventory management processes;
- human resources management processes;
- financial management processes, etc.

Any of these economic processes may be subject to optimization, and a variety of methods and techniques can be used for this purpose.

Company employees are involved in carrying out economic processes using specialized computer systems for this purpose. Fig. 1 presents various business processes as well as the generic informatics systems that could be used to conduct these processes.

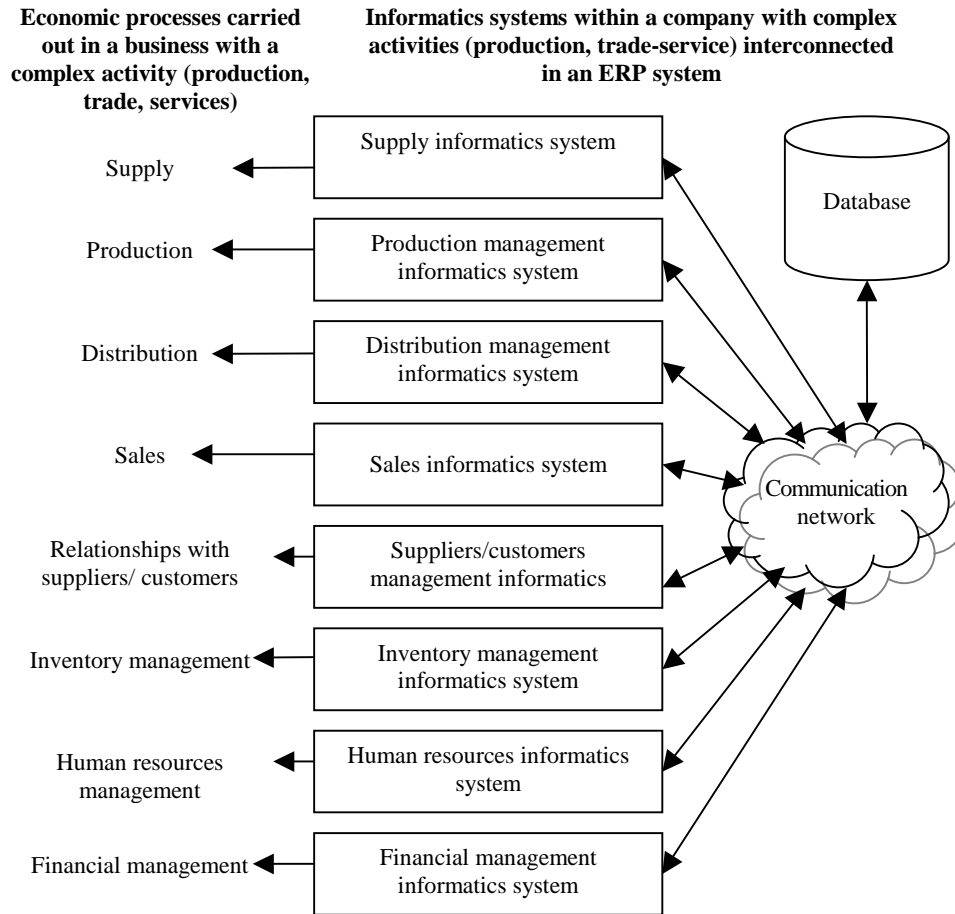


Fig. 1. Economic processes carried out within a firm and their corresponding computer systems

In the most complex situations where a firm is well computerized, we have computer systems involved in all the economic processes performed. It should be noted that not every company has a specialized computer system used for a single economic process as shown in the figure above, the case presented being generic. A computer system in practice can be used in the course of several economic processes, its architecture actually being much more varied.

In the previous figure all systems are represented interconnected through a communications network, all with access to a common database. It is important that the data is stored in the same place to facilitate analysis using advanced data mining techniques.

2. Particularities of the analysis of data generated by business processes carried out by companies with complex production-trade-services activity

We can say that there are some particularities in analyzing data generated by economic processes undertaken by companies with complex activity (production, trade, services). When using multiple unconnected computer systems, each having its own database, it is required that all databases must be integrated into a data warehouse before moving to the analysis stage.

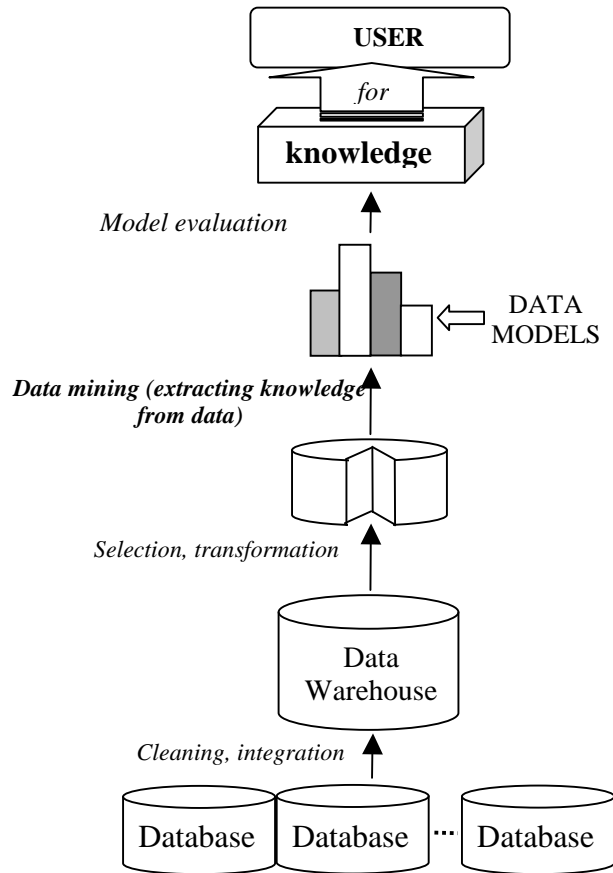


Fig. 2. *Data Mining stages*
Source: [6]

Fig. 2 shows the steps to be taken from collecting the data from a variety of heterogeneous databases to obtaining the knowledge sought. It is apparent that at

first there are several databases, in this case the various databases involved coming from the unconnected systems. There follows a data cleaning step before obtaining a single data warehouse containing all the necessary data analysis. After all data were merged into a data warehouse it is made a selection, a transformation and possibly a reduction of the data available to make it more suitable for analysis. Only after this step we can apply data mining techniques aimed at extracting data models. These models are not knowledge themselves. It is required to give an interpretation to the data models so they can then be used in practice.

Next we are interested in particular about those factors that have to be taken into account when making an integration of multiple heterogeneous databases in a single data warehouse. There have been identified several possible situations where measures should be taken for the initial data not be altered when creating a data warehouse.

We must take into account several aspects:

- Uniformity of data format. Particular attention should be paid to the format in which data are represented. Databases which will form the data warehouse may have different representations, and if the data will not be converted to the same format differences are likely to occur. E.g. calendar date type fields can be represented in many ways. Some may be of type date/time while others only date type, etc.
- Remove unrepresentative data. There may be some out of interest data in terms of analysis that should be removed from the beginning. For example if you want only an analysis of data related to the distribution process, there should be included only the data related to this process.
- Data samples should be representative in terms of quantity and the distribution on the analyzed periods. So if little data is available or they are gathered in certain particular conditions, they are no good for a thorough analysis.
- Fields that represent money must be denominated in the same currency (euro-dollar, etc.). Because in some databases such amounts are represented as numerical values it is possible that at the integration of several databases that relate to different currencies the monetary fields will not be converted at the exchange rates and anomalous data may appear.
- Fields representing physical quantities using different units must be converted in the same unit so not to generate errors.
- When aggregating numerical data should be considered the loss of accuracy, especially for those with more decimal places. The data warehouse normally should represent the resulting numerical data with sufficient accuracy so that data from original database need not be approximated.
- Aggregating data must be made for compatible data in terms of what they represent.
- Data transfer must take into account specific diacritics of various languages. Some words written with or without diacritics may have different meanings.

3. *Computer tools that can be used to optimize the business processes*

Technological advances made it possible for the majority of modern development software to allow definition and implementation of advanced techniques for data analysis (data mining) that can be used to optimize the economic processes within a company. For example, typical databases applications integrate default data analysis by formulating queries that result in the expected response for a typical database, and data warehouse software offer a multidimensional view of data. Developers of databases and data warehouses can integrate into the applications, at user's demand, more complex algorithms for analysis of the available data that leads to determine trends or patterns in data, to discover the characteristics and any trends in the database [6].

Different database management systems can be used in developing database applications that can integrate at user's request, advanced data analysis techniques (data mining) represented as scripts created especially for this purpose. Many database management systems have features and functions that may be used to define appropriate data mining techniques, providing an interactive way of working which facilitates analysis.

Using the features already included in a database management system has the main advantage of increased efficiency because the internal system functions are used and there is no need to convert data into other formats.

There is also the disadvantage that a database management system has not advanced data mining techniques already included and implemented, so it is needed to implement additional algorithms, which requires additional programming and algorithm complexity evaluation skills.

There are many tools offered by most database management systems that can be used for advanced data analysis:

- scripts;
- reports;
- forms;
- queries;
- data restructuring;
- data sort, etc.

Meanwhile, technological developments made possible the creation and distribution of specialized applications with intelligent data analysis techniques (with integrated data mining techniques), some of them being summarized in Table 1.

Main commercially available data mining products [5, page 18]

<i>Data mining products</i>	Main features
SAS Enterprise Miner	<ul style="list-style-type: none"> • comes from statistics; • easy to use graphical interface; • ability to analyze text.
SPSS	<ul style="list-style-type: none"> • comes from statistics; • includes among others, decision tree algorithms (Answer Tree); • allows users data cleansing and transformation.
IBM Intelligent Miner	<ul style="list-style-type: none"> • comes from the databases industry; • provides advanced tools for visualization and data presentation; • compatible with PMML language (Predictive Modeling Markup Language) for exporting the found data models.
Oracle Data Mining (Oracle 10g)	<ul style="list-style-type: none"> • comes from the databases industry; • began with algorithms such as association and naive Bayes (version 9i); for version 10g includes a large variety of algorithms.

Once the company has sufficient data it may use a specialized software application to extract knowledge from data if it has no specialized programmers to implement data mining algorithms within the database management system.

It is preferable for a firm that the analysis of the data it owns will be made by programmers because the resulted applications will meet its exact needs.

Conclusions

To optimize the economic processes taking place in modern companies with complex business activities (production, trade, services), there must be used strong and powerful tools on the one hand, and on the other measures must be taken based on the conclusions drawn from the analysis of the data the company owns.

Optimizing business processes performed by a company must be based on a thorough analysis of the data generated by the processes carried out, using data mining techniques.

For a company wishing to optimize its business processes two possible approaches were identified. The first possibility would be for the company to use data mining techniques implemented with the features of the database management system it uses (assuming it is a new generation database management system that allows such facilities). Another possible approach is to use a specialized product

for data mining. Such products exist on the market and have already proven their efficiency.

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