

## **EVALUATION OF THE EFFICIENCY OF INTEGRATED ERP SYSTEMS AND BUSINESS INTELLIGENCE TOOLS BASED ON THE DIAGNOSTIC CASES IN THE MSE SECTOR**

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In the paper, an evaluation of the efficiency of the application of ERP class integrated systems and BI tools was carried out, through analysis of two cases micro-and-small enterprises (MSEs). An analysis of the observed successes allowed precise definition of key factors in their successes or failures, in the scope of the efficiency of BI tools application in management. Confirmed rules for guaranteeing of unconditional compatibility of the contents of data warehouses with the transactional databases are, in the opinion of the author, a necessary condition for long-term success with BI application in decisions-making processes. The solutions proposed in the paper for a data processing organisation system were effectively verified over several years' use at the POZKAL printing house in Inowroclaw. Such solutions force compatibility of transactional databases with data warehouse contents, an area often underestimated by the authors of other publications in this area.

Keywords: ERP class integration systems, business intelligence tools, data processing organization, database integration, data warehouse.

### **1. Introduction**

The research implemented over the last five years concerns analysis of the determinants of ERP systems' implementation and Business Intelligence tools in MSEs in the printing and food processing industry. It also justifies the attempt to

make a synthesis of former publications. The research results, which were analyzed in the subsequent publications, also allowed for provision of the diagnoses of the effects of the IT applications in various research facilities that have been evaluated over the last few years.

They also allowed definition of the difficult position based on cause-effect determinants that have been described and confirmed in [11], [12], [13], [14], [15].

Furthermore, the range of research and its evaluation of the success factors in some of the other business organizations surveyed, yielded a synergy that may allow for the occurrence of possible failures in the formulation of diagnostic BI tools and in other facilities.

The first research object was represented by an SME in the printing industry - POZKAL Inowrocław [5, 6]. It provided data led to the effective implementation of an ERP system evaluation, which is related to control processes, as well as a model implementation of BI solutions [1, 2, 3]. It was essential to refine the form of cooperation with the founder of the new implementation system to define another, usually not well précised substantive issue, i.e. the identification of the lack of a coherent and unambiguous code database in the range of terminology and quality of construction and technological parameters, which have caused the frequent occurrence of multiple names for the same processes in the one technological process which was change.

The unique success achieved in the process of ERP system implementation in POZKAL coincided with the application of a corporate process organisation and Activity-based Costing as a more precise method of cost accounting. The successful implementation of these solutions provided a basis for the development of a data warehouse and reporting systems using OLAP technology based on MS SQL Server.

A very good example of the need to have consistent information available on different levels is the process of raw material procurement by a Bydgoszcz-based company processing and selling food products imported from the Far East. Their main customers are large retail networks in Poland and abroad. The materials are procured by purchasing agents who often spend months far from company headquarters, negotiating and preparing long-term supply contracts. The agents must have access to such information as sales plans and the availability of financial resources for the transactions. The results of their work are reviewed and approved by management, in agreement with the financial department. The results are also a source of important information for the marketing, sales and production departments, as they support production planning and assumption of obligations towards suppliers. Another important group using the same information is the logistic department, which has to arrange sea or air freight of the purchased materials to Europe, ensure proper customs clearance and arrange road transport to bring the goods to the company. The deliveries must be coordinated with the

quality control department, whose responsibility is to inspect each batch of materials. If the goods should fail the quality inspection, the purchasing agents, logisticians and the financial department take appropriate steps to obtain another delivery, or to source the missing materials from the local market (European), which often requires approval by the company's top management. Here the success was possible thanks to an efficient implementation of mobile technologies and improvement of the availability of information at various levels of managerial decision-making positions, as described in more detail in Chapters [3] and [6].

## **2. Determination of BI systems' stability at the POZKAL company**

This chapter presents the results of an analysis of success achieved in the area of applications of a data warehouse and OLAP tools in the course of three-year-long utilisation, verified in generated reports and efficiently used in the operational, tactical and strategic levels of management.

Organization of the technological content collections required a 9-month period of technical services and IT planning. As a result, the technological dictionary contains 10 terms instead of the 116 that had been used before. Modification of the structure of the technical collection and order planning processes was executed within the ERP CDN XL system, provided by COMARCH. It was supplemented by additional modules required by POZKAL, such as payroll, warehousing, purchasing and sales supported by CRM system. The presented solutions have ensured efficient implementation of contractor support functions and have provided the opportunity of flexible services with regards to the contractor expectations.

The financial and accounting systems, which provides for the efficient functioning of payments and invoice settlement with modules for fixed assets and controlling in an ABC (Activity-based Costing) version, have provided efficient processing of data in the area of creation and updating of information transaction processes. implementation of an updated version of the ERP system was the basis for the implementation of the Business Intelligence systems. One of the essential objectives for an analytical system's formation was an ABC approach and this objective was achieved.

The reports presented on the following pages illustrate the kind of information which required implementation of activity-based costing. Most of the reports presented here have been based on OLAP cubes – 'Model\_PozkalABC' - which acquires source data from the financial and accounting systems, inventory system and the production control system.

The allocators algorithms have been defined in the platform structure and in the IBIP platform which uses an 'Order Analysis' cube, which was itself rebuilt after 2 years of use.

The first cube was based on studies and assumptions that had been tested with a calculation data sheet, a financial and accounting system. The second cube was constructed on the basis of the first one and was expanded with additional dimensions by the workflow system, OLAP cubes – payments analysis, sales and RCP. The reports acquired from the system contained the costs that are presented with negative values, while revenue is presented with positive values.

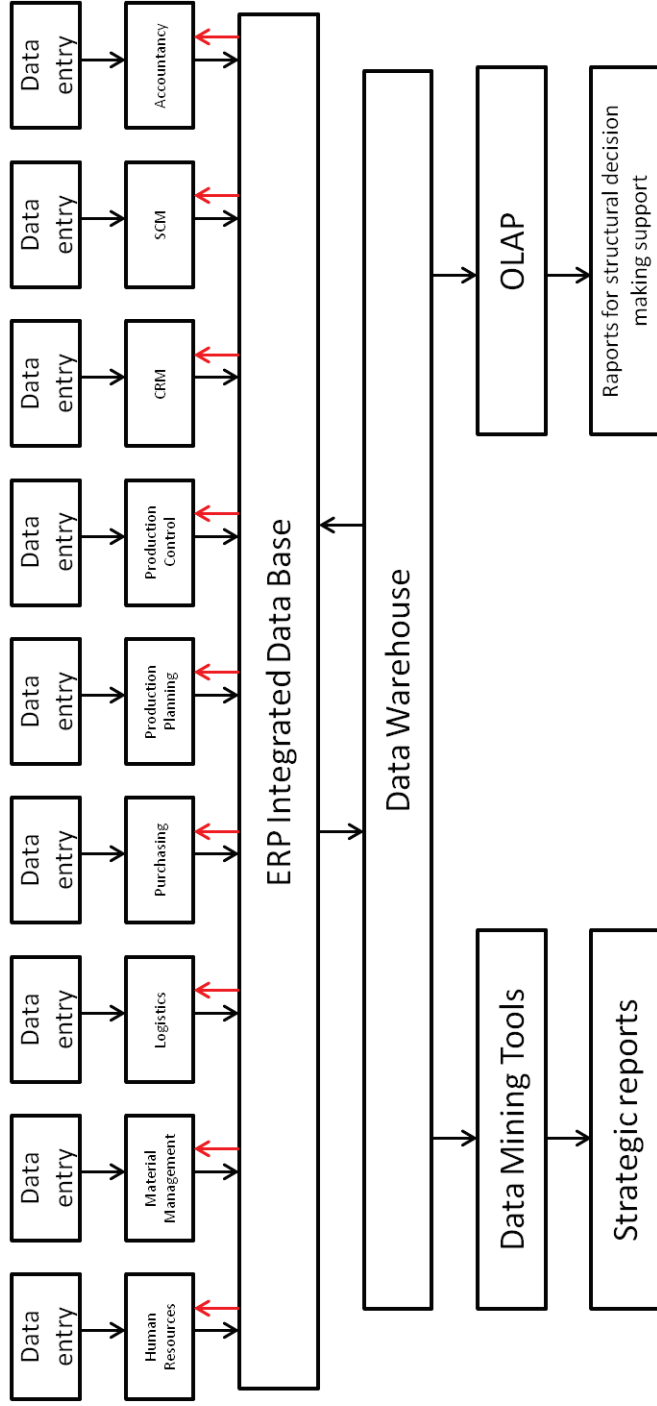
The need for information content synthesis of a series of informational statements in the strategic decision-making process increases the importance of graphical output reports in the synthesis process.

The discussed ERP system solutions offered to the printing sector company did not constitute particularly innovative technologies, although they may still provide a unique standard by the application of specific data processing organization. The use of a controlling application based on the ABC approach can be seen as an exploration of a more effective approach to fixed-assets management. Also, their three years of experience gained in effective exploitation of a data warehouse and OLAP tools for operational, tactical and strategic decision support would even represent great value to any company.

Figure 1 illustrates the most frequently used solutions of data processing organizations, ranging from the formation of source documents, through storing them in a transaction database, to placing them in the data warehouse and generating reports with OLAP tools, by data mining, or graphical output application. Figure 2 presents the solutions implemented at the POZKAL company. There are some significant differences between their processing and the processing of the organization presented in Figure 1.

The differences relate to the extremely important process of updating the data warehouse solutions, which is done at the end of the transaction processing day and provides feedback and records verification in the area of operational information. The registration data which is generated at the beginning of the following day can then provide a basis for later information processing, after acquiring that data from the data warehouse. The processed information can also be a basis for creating source documents and accounting records.

The solution implemented at the POZKAL company seems to be self-evident, but is probably hardly ever applied in practice. This follows from the fact that the data warehouse application for the operational information formation may raise some doubts, both in the management team and in the rest of the staff [7, 8, 9, 10].



**Figure 1.** Typical integrated data processing system

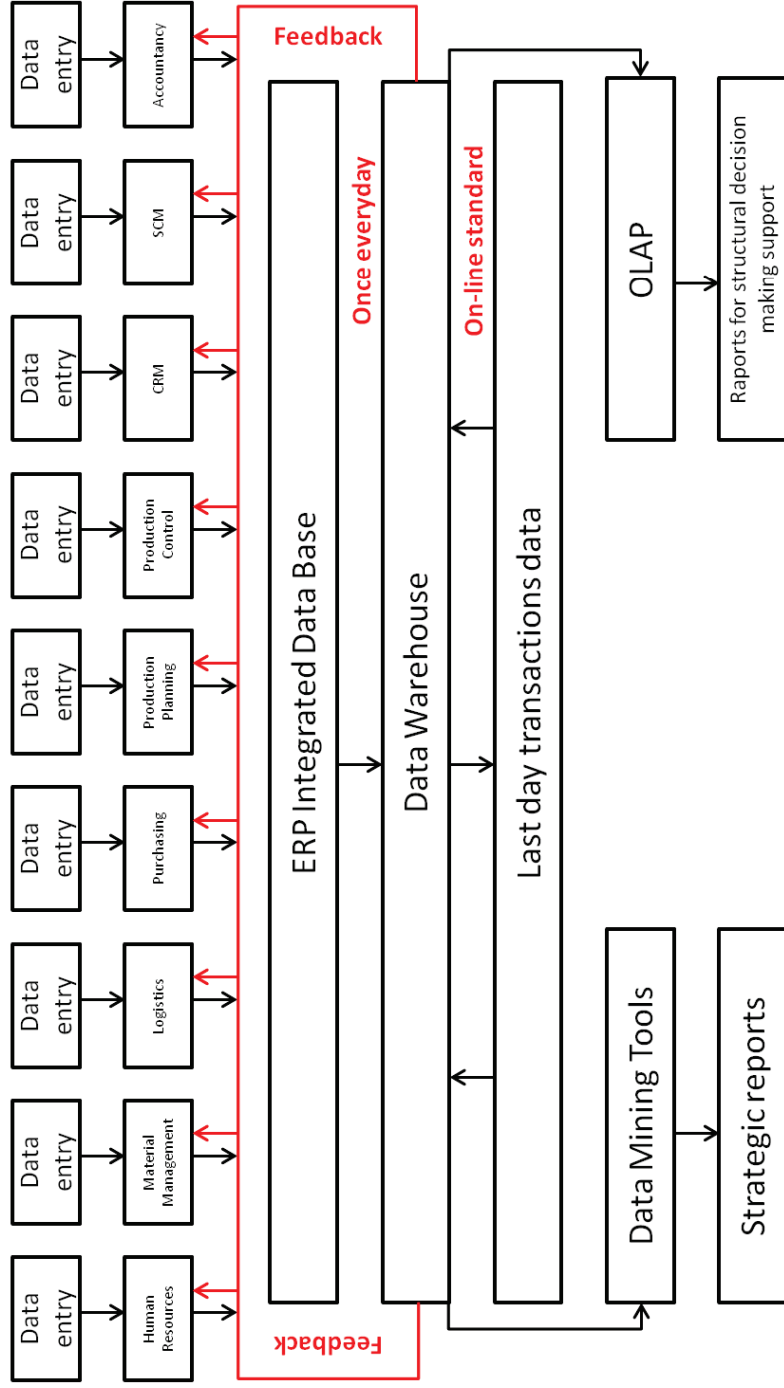


Figure 2. Integrated data processing system with feedback solution

These concerns may be justified because the decision to implement the complex data warehouse update process as a single operation in the organization (Figure 2) was risky and challenging. The application of precise data warehouse and update algorithms that have been tested before implementation and its merging with the last day transactional data analysis could raise the doubts about the precision of these operations.

The results of the three-year application of this solution at the POZKAL company proved to be fully effective from the perspective of long-term implementation. The benefits of these solutions are obvious, because the transaction data records are valid only if they are regularly verified by all data processing functions within the organization.

The conclusions which have been formulated in this chapter can provide a basis for finding an explanation for the weak implementation or even resignation from correctly designed and implemented BI systems within organizations.

### **3. Determinants of the development of mobile technology data warehousing and OLAP system in a commercial and food processing enterprise**

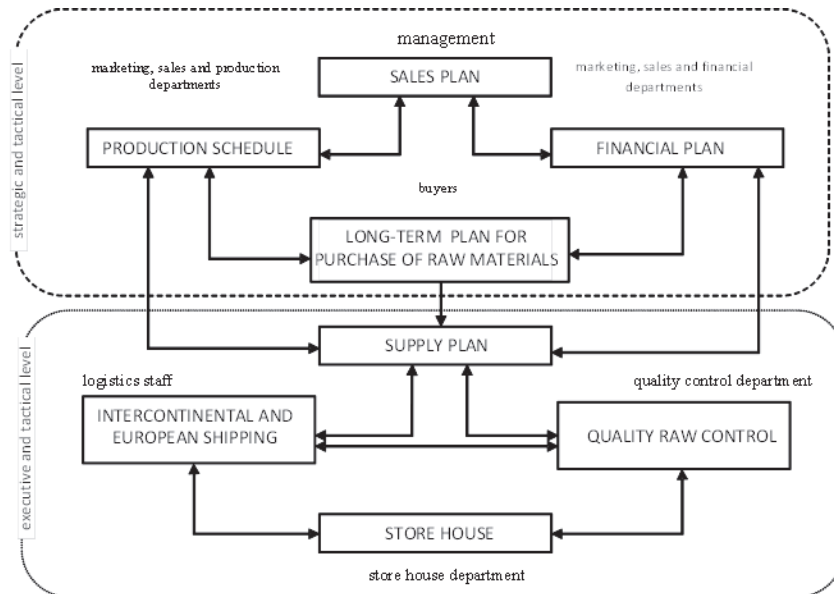
OLAP analysis results are used on various levels in an organisation, for various purposes and by means of various tools, however the important thing is that all the information should be coherent and usable in everyday work, to support all kinds of decisions. This is why a common source of information is indispensable for all applications, or at least an integration of sources to an extent that allows users to obtain consistent information in an efficient and transparent way at all levels of management. Unfortunately, in actual practice individual departments or areas of operations in an organization often use their own databases to support their work, as a result of which they often obtain mutually-inconsistent or sometimes even conflicting information. A situation like this is very undesirable and, if observed, should be eliminated as soon as possible. A very good example of the need to have consistent information available on different levels is the process of raw material procurement by a Bydgoszcz-based company processing and selling food products imported from the Far East [6]. Their main customers are large retail networks in Poland and abroad. The materials are procured by purchasing agents who often spend months far from company headquarters, negotiating and preparing long-term supply contracts. The agents must have access to such information as sales plans and the availability of financial resources for the transactions. The results of their work are reviewed and approved by the management in agreement with the financial department. The results are also a source of important information for the marketing, sales and production departments, as they support production planning and assuming obligations towards suppliers. Another important group using the same information is the logistic department, which has

to arrange sea or air freight of the purchased materials to Europe, ensure proper customs clearance and arrange road transport to bring the goods to the company. The deliveries must be coordinated with the quality control department, whose responsibility is to inspect each batch of materials. If the goods fail the quality inspection, the purchasing agents, logisticians and financial department should take appropriate steps to obtain another delivery or to source the missing material from the local market (European), which often requires approval by the company's top management. At the end of the procurement process is the warehouse, where the goods are stored according to their best-before date and a few other important parameters. The material is then assigned to be released for production. If a batch of materials is rejected by quality control, it is separated from the rest of the stock and undergoes a recall or disposal procedure, as presented in Figure 3.

The simplified presentation of a procurement process described above and illustrated below shows how many different interrelations can exist among the different departments and levels of a business organization in a process which is just one of a number of processes going on in a company. Until an integrated information management system was introduced and a data warehouse was created, the process had given rise to numerous problems and constituted one of the major barriers to development of the company. The main problems included production stoppages resulting from the running out of raw materials, and overstocking, which led to a need to rent external warehouse space. Excessive inventory caused liquidity issues, as the company had to pay for deliveries it did not yet need. Material shortages, on the other hand, prevented the company from fulfilling orders, which resulted in contractual penalties and other charges imposed by customers, suppliers, customs agencies, or forwarding agents. All those issues occurred in spite of functional databases and analytical information available to the responsible departments or employees.

The main cause of the problem was the lack of coherence of the information, which became evident when most of the problems were largely resolved with a uniform, integrated information system based on a central data warehouse, that was introduced and made available to all departments and levels of management. However, its success was not only based on having a uniform source of information, but also in how it disseminated the information. During the implementation process, a lot of emphasis was put on making the information retrieval tools compatible with the needs and capabilities of their users. Therefore, the range of tools included both sophisticated, multidimensional analytical instruments, as well as simple messages and alerts prompting the users to take specific actions. Thanks to the use of modern applications and the Internet, the information is available for employees working at the company headquarters and at its branch offices, as well as for the purchasing agents operating in the Far East.





**Figure 3.** Simplified diagram of the purchasing process in the commercial and food processing company. Source: Own research [3]

#### 4. Conclusion

Synthetic analysis of the operating experience of the ERP system, data warehouse and OLAP tools at the POZKAL company in Inowroclaw have allowed precise definition of two models of system exploitation (Figure 1), with the introduction of a feedback model, ensuring the correctness of the information in the data warehouse, and a model without feedback (Figure 1). The implementation of solutions presented in Model II (Figure 2) allows us to explain the reasons for the abandonment of certain interesting systems which contained BI tools after just a few months of exploitation; because it was not guaranteed that registration records were compatible with the data stored in the data warehouse.

Analysis of the development of ICT (Information and Communication Technology) applications in the discussed example of a commercial and food processing enterprise justifies a statement that reaching an objective of an improved level of customer service requires extension of the range of application of IT systems in MSE s. Implementing integrated systems and CRM systems in enterprises operating globally requires introduction of efficient solutions consisting in proved applications of mobile technologies. For successful global operations it is indispensable for a company to decentralise the processes of decision-making by sales force. This requires implementation of systems allowing automatic control of

inventories and providing quick access to reports presenting actual sales and supplies to enable the sales representative to make the right business decisions, either independently or in consultation with higher-level managers. A solution like this proved to significantly increase the operating efficiency of the enterprise through reduction of redundant stocks and better fulfilment of customer needs [6, 8, 9, 10].

The examples of MSE presented in this paper show that efficient implementation of advanced IT solutions in the form of mobile technologies and OLAP tools has become a source of competitive edge in various industries.

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