ERP Systems in Corrugated Packaging Industry

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Abstract – **This article discusses the characteristics of the corrugated packaging industry and on this base, what are the requirements for ERP systems in this industry. An overview and classification of ERP systems in the packaging industry have been made. The author illustrates the typical types of implemented ERP systems in this business with examples and block diagrams. An effective model for the implementation of ERP systems in a corrugated cardboard factory has been proposed.**

Keywords – **Corrugated packaging industry, ERP systems, Model of implementation, Success factors.**

I. Introduction

ERP (Enterprise Resource Planning) systems are software packages that integrate most of the business processes, such as production, sales, supply, finance, human resources, budgeting, and customer service activities [1]. The automation of processes in industrial enterprises is evolving through the building of sustainable IT infrastructure, development and implementation of separate information systems / financial, human resource management, warehousing, production, etc./, to reach the need to implement a unified ERP system. The implementation of ERP systems is defined as a key element of Smart Factory [2], together with the renovation of the production facilities - technologies, machines, and equipment.

ERP systems covered information flows in the enterprise and provides the necessary information to employees and managers to be able to make efficient decisions, make basic business processes more efficient, and help reduce costs and increase revenues in manufacturing organizations. The transition from mass to custom production requires not only automated production lines but also integrated information systems. The production of low-value products in constantly changing volumes, but with specialized customer requirements is very complicated a challenge that can be solved only with the help of modern information technologies.

II. Features of the Corrugated Board Packaging Industry

Corrugated packaging is not often associated with high-tech industry, yet paper boxes are everywhere around as. Corrugated cartons can be customized to carry nearly any item, from food products and pharmaceutical supplies to automotive engines, and is used on an everyday basis in a wide range of industries. They are also sustainable and recyclable solutions that help to reduce the costs of the products. The production is a result of using advanced computer design and manufacturing systems.

In our consumer society, in conditions of oversupply of goods, the choice of a particular product is often due to its packaging. That is why manufacturers are paying more and more attention to the packaging of products. They must be attractive, memorable, unique, and at the same time cheap. The safety of packaging in everyday use and the maximum possibility of repeated recycling for environmental protection is particularly important. Paper and corrugated packaging, made mainly from recycled materials, meet these conditions most fully.

According to statistics, more than 85% of packaging in the world is made from paper. Nowadays, paper for manufacturing the production of corrugated packaging is produced mainly from recycled materials. In addition to the technological qualities of these packages, the possibility of repeated recycling of materials is extremely important - up to 8 times before the cellulose fibers become too short. The amount of wood used worldwide for paper production is about 20% of the total yield. At the same time, it turns out that about 40% of waste is paper and much of it can be recycled and reused. For the European Union [3], statistical data show that about half of paper production is based on recycled paper, with a trend of over 80%. The use of corrugated paper is increasing by 4% per year and is expected to reach 120 million tons this year.

III. Specific Requirements, Review, and Classification of the ERP Systems in Packaging Manufacturing

The implementation of intelligent production management systems is the just possible way for optimal and adaptive business management for this type of manufacturing. Packaging businesses have special requirements when it comes to ordering registration, product configuration, and effective manufacturing and delivery. The main requirements for the selection, planning, and successful implementation of an ERP system in the production of packaging are:

• To be flexible and scalable, this means to consist of a separate independent integrated module. This allows only those modules that correspond to the business processes to be implemented. On the other hand, with the development of the business, newly integrated modules can be easily added if it's necessary.

• To be open, to be easily integrated using standard tools and interfaces to other already implemented systems. In the production of packaging often are used specialized systems for design and printing, quality control, management of the tool warehouse. These systems are not standard modules of ERP systems but must be integrated with the databases of the main ERP systems.

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• In an enterprise to be integrated with existing already implemented corporate systems - financial, BI, CRM, and others. This leads to a significant reduction in implementation costs based on shared experience and the cost of building common ITC infrastructure - equipment, licenses, administration, and maintenance.

• To build high-level secured IT infrastructure not just for the live system but also for testing, upgrades, and maintenance. These requirements ensure the continuous and efficient operation of the system.

• If it's possible, to be cloud-based with a high degree of data and application protection. With the advent of the IoT /Internet of Things/ and Cloud Technologies, the Cloud Computing industry increasingly alters the standard model of ERP systems. E-commerce modules become part of the standard functionalities of ERP systems.

Based on the formulated requirements, different types of solutions for planning and implementation of ERP systems are possible, depending on the internal and external factors in the industry, especially the requirements of the customers and markets. Based on a detailed literature study we will consider the main possible types of ERP systems in packaging industry.

Many software vendors are developing information systems for this business. The different types of ERP systems for this industry can be summarized into three main groups - universal ERP systems /mainly SAP, Oracle/ with customization of some individual modules; specialized integrated systems, containing all necessary modules, including financial and combined systems, that integrate the main business management modules of the ERP system with the modules of specialized packaging production systems.

The literature review showed a clear distinction between these three types of ERP systems worldwide.

A. Universal systems

Universal systems allow fast, secure, and flexible process management in small to medium-sized packaging companies. A typical example of such an implementation of SAP S/4 HANA in a Bulgarian company. This solution was implemented two years ago in Tempodem Ltd. [4], a company specializing in the production of laminated corrugated packaging – Figure 1.

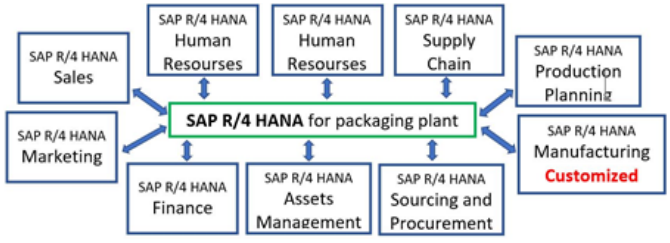

Fig.1. The modular structure of the universal system SAP HANA, implemented in the packaging industry

The company implementer Scalefocus has customized and modified the production module of SAP S/4 HANA to best meet the customer's requirements. The system optimizes production orders based on customer orders by a specially developed algorithm for optimizing the cutting of the semi-finished corrugated cardboard.

B. Specialized ERP

Evolutionarily, the first integrated information systems in production were developed by IT teams of the plants and they were strictly oriented to the specific needs of the concrete company [5]. The main disadvantages of these systems were the difficult and sometimes impossible integration of the various modules and the slow expansion of functionalities. In recent years, many software companies have developed specialized systems for corrugated packaging manufacturers that are designed to solve these issues. They are used benefits of universal systems - modern common databases, cloud computing, integrated security policies.

The implementation of specialized ERP management systems covering all business processes is typical for countries in the Asian region, for example, China: LONGWAY, provided by Dongguan Dragon Computer Engineering Limited [6]; India: ebizframe ERP [7], Finsys ERP [8], Indonesia: CPS/Enterprise Corrugated Carton ERP, [9], where software companies implement their own turnkey solutions. These integrated systems include their own fully functioned production, sales, purchasing, warehouse, sometimes financial, BI, HR functionality. They are designed mainly for small and medium-sized companies that seek to reduce implementation costs while ensuring excellent system functionality.

In recent years, a similar trend has re-emerged in Europe, for example, the software packages of GesPack, France, [10], Volume Software, France, [11], C3 ERP, Germany, [12], Jeeves, Sweden, [13], EFI Corrugated Packaging Suite, UK [14]. What they have in common is good functionality and support at a competitive price.

C. Combined systems

The most widespread worldwide are the combined systems, which add modules, basic production, and logistics to the standard modules /finance, controlling, deliveries, customers, human resources/ of the most common systems, SAP for example. Such are all ERP systems in large multinational companies. The diversity of plants in the Enterprise may use different manufacturing modules with a common financial and controlling module, for example. This is a result of the constant expansion of the business in new regions and the permanent acquisition of new companies with already implemented ERP systems.

A typical example is the integration of the most common universal ERP system SAP with the most popular plant management system for cardboard and corrugated packaging Kiwiplan, [15]. The system is widespread throughout the world and has more than 600 corporate clients with more than 680 covered industries. Kiwiplan is built on a modular principle and is extremely flexible. The main modules of Kiwiplan, Figure 2, are Enterprise Sales Processing /ESP/ - sales management; Roll Stock System /RSS/ - storage of raw materials; Corrugator Scheduling /CSC/ - production planning; Production Control System /PCS/ - production management; Data Warehouse -

warehouse of finished products; Truck Scheduling System /TSS/-expedition management.

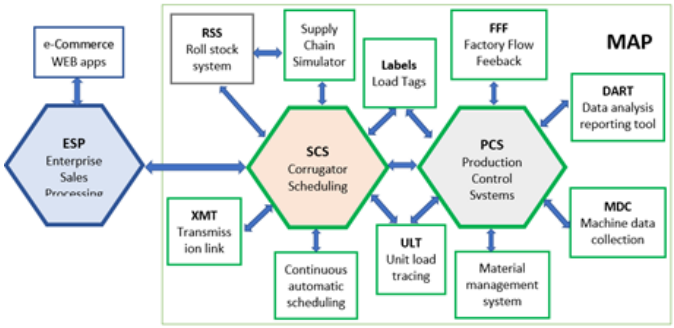

Fig. 2. Structure of the Kiwiplan ERP system

In Figure 3. is presented a structure of the combined system between SAP and Kiwiplan [19]. The ERP system is two-way connected to the control systems of the units of the production – corrugators for corrugated cardboard producing and the converting machines to produce packaging. This means that the control systems of the production aggregates and lines exchange information with the ERP system in real-time. Specialized devices for secure data transfer are used for data exchange. The peculiarities of this implementation are the presence of implemented modules from ERP SAP R3 - FI/finance/, CO /controlling/, MM /material management/.

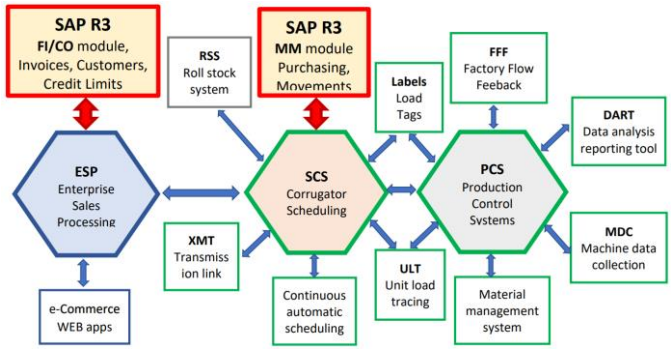

Fig. 3. Example of combined system /SAP R3 & Kiwiplan/

Not all Kiwiplan modules are used in this example of implementation. For example, quality control is performed in other systems due to the specific parameters of the manufactured goods and the requirements of consumers. This also allows for reducing the cost of implementation. The diagram shows the interfaces to the existing SAP modules.

More and more companies offer their own developments for the management of packaging companies based on SAP HANA. VCPowerPack IS Packaging of AICOMP Cloud [17] e one of the many such decisions. Specialized modules have been developed and implemented using the standard distribution package of SAP HANA.

ERP system CC|print and packaging [18], developed by CosmoConsult is an industry solution for printing and packaging companies. The software is built on Microsoft Dynamics 365 for Finance and Operations ERP–specifically tailored for the needs of the printing and packaging industry.

The presented review of corrugated board production management systems does not claim to cover all software vendors of ERP systems, just illustrates the classification made.

IV. Successful Model of Implementation and Success Factors

The planning and implementation of the ERP system in the packaging plant are based on a standard generalized model [19]. This model covers the entire implementation process in four main phases: Preliminary research and analysis; Readiness Phase, Implementation Phase, Go-Live Phase, and Post Go-Live Phase. All four phases have their meaning and specific features.

The phase of preliminary research and analysis. Carefully and precisely planning which business elements will be covered by the system. This requires time and considerable experience. If incorrect decisions are made here under the influence of various factors, this will lead to huge problems and additional costs for subsequent optimization of the implementation.

Preparatory phase. The correct building of the IT infrastructure /hardware, communications, systems, licenses, interfaces / is a result of the preliminary study and determines the scope of the system. The training of key users also predetermines the implementation of the system as deadlines.

Implementation phase. At this time have to be entered in database main the information for the factory – products, designs, machines and parameters, and customers. At this stage, the built infrastructure is "revived". The system is adapted according to the legal requirements of the location of the plant. Specific reports are also being developed, such as those required by public authorities. The training of the users of the system in a test environment begins.

Go-Live Phase – Start of the newly implemented project. All data from the old system /if it's available/ are entered, the available production in the finished products warehouse and semi-production is re-labeled. This stage is extremely important. Incorrect input of prior information can lead to huge losses. The interfaces to the external systems are tested and we move to real work.

In the Post Go-Live stage, errors are cleared, possible problems are eliminated, and fine-tuning is performed.

For a successful project, a strict and clear distribution of responsibilities [20, 21] is needed among all project participants. Each participant in each stage of the project is responsible for the ultimate success and, accordingly, must have sufficient rights and resources to accomplish the specific task. Proper distribution of responsibilities – Figure 4, is perhaps the most important factor for the success of the project.

The following basic steps are required for successful implementation of the ERP:

• Determining a realistic budget. The preliminary study must be carried out as thoroughly and accurately as possible. The widespread practice of starting with partial implementation leads to a significant and unjustified increase in the cost of the project.

• Creation of a capable team of specialists in all departments and at all levels of the hierarchy.

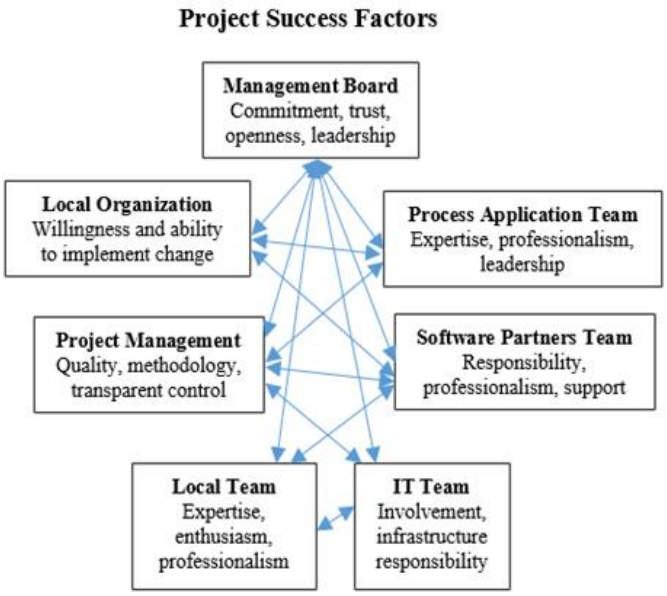

Fig. 4. Distribution of responsibilities on the time of planning and implementation of ERP system

• Determining the right Team Leader. He must have organizational experience and full powers.

• Constant control of the implementation of the stages of preparation and implementation in the prescribed order. The control must be organized in such a way that it does not cause sabotage of the implementation process. It is best to use interactive methods, for example, the presentation of information on a specially designed site or internal portal.

• The main underlying factor is building a reliable IT infrastructure that meets the specific requirements of the system and guarantees security during the transmission and processing of data. Wi-Fi covering the stores and production areas, installation of specialized equipment – MDC /machine data collectors/, forklift terminals, scanners, etc.

• Data protection is an integral part of the system implementation. This is extremely important for cloud-based ERP systems. Mainly are used specialized technologies and devices for data transfer. Very important are recent technologies for the secure storage of information, for example, new database technologies, such as blockchain, are more popular along with crypto cryptocurrency.

V. Conclusion

Finally, the implementation of ERP systems in the packaging industry has no alternative because they allow flexible and efficient business management. This is especially true for medium and large companies. The availability of an information system covering all processes allows for tracking and management of key activities in the company, processing much more information, and facilitating access to quality analysis and reports. This helps managers and operations managers make the right decisions in real-time. The availability of a huge amount of data allows preliminary modeling of processes and forecasting of results.

The review, made in the article of different types of ERP systems intended for the packaging industry allowed to make a classification of the ERP systems and to formulate a generalized common model of the process of implementation of ERP systems in the production of corrugated packaging. Presented in the article example, are sufficiently common and can serve as a model for the implementation of ERP systems in other industries which has the same requirements and market environment, as the packaging industry.

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