

THE CONCEPT OF USE OF ENTERPRISE RESOURCE PLANNING SYSTEM IN THE PROCESS OF REALIZATION OF THE PRODUCTION ORDER

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Summary: This article describes the most common databases of Enterprise Resources System. Also a process of realization of the production order was described and the attempt to connect processes with the databases was taken. Additionally the life cycle of production order was taken into account as a part of a production process. The basic premise of the study is the thesis that the ERP system is essential to the smooth functioning of the enterprise and manage its resources. Also the attempt to identify the most important databases of participating in this process was taken.

Keywords: ERP system, ERP databases, order realization, life cycle of production order.

1. Introduction

Manufacturing companies are complex organizations, focusing on many processes. For managing them all some additional managerial support is required. Not only manufacturing process is a complicated, but also fitting production capacity to particular orders, the calculation of the number of necessary materials, loads of workstations, as well as other requirements of supply chain management. Also the vastness of the management of all resources (tangible and intangible) in the enterprise is a challenge for managers. The variety of company's resources can be divided into four basic types: human resources, financial resources, tangible resources (visible and quantifiable) and information resources [1].

All those requirements can be met by Enterprise Resource Planning systems (ERP systems), whose foundations were created in the early 1950's, and at the moment are increasingly being developed to meet all the assumptions and expectations of the global market [2]. Currently fast-growing number of companies delivering goods and services force companies to find a way to be more competitive in the market. Initially ERP systems were very simple, but the technology caused that they are not only a tool but also a key element of competitive strategy [3]. It can therefore be concluded that ERP systems are becoming an indispensable tool in any organization focused on the existence and survival on the market. ERP systems are generally targeted for all types of businesses operating in the current economic environment, regardless of whether the main area of economic activity is the production, trade, or services [4]. The main objective of the following article is to create the concept of use of elements of ERP system based on an analysis of the production process. The research was conducted in company that produces custom welded components for the automotive industry.

2. Analysis of enterprise resource planning system

The first step of analysis is to define a sub-systems that will ensure full and correct functioning of the system [5]. In this step four subsystems, that are corresponding to the four major companies' resources, were identified. These are: the production subsystem, which mainly corresponds to the tangible resources, human resources subsystem, which as the name suggests, corresponds to human resources, and two financial subsystems - sales and accounting subsystems, which corresponds to financial resources (Fig. 1). Previously information resources were described as one of the major resources, but they cannot relate to a specific subsystem, due to the fact that information resources are present in all four described subsystems. It can therefore be concluded that information resources are precisely the factor that ensures integration of all subsystems through the transfer of data between elements of enterprise resource planning system.

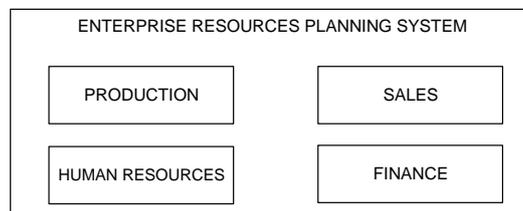


Fig. 1. General scheme of enterprise resource planning system [own elaboration]

The next step in the analysis of the order realization process based on resource planning system is to identify the databases present in the subsystems which are necessary to ensure the circulation of information for the data processing system [5]. Because of the variety of ERP systems, and hence the variety of databases in different ERP systems, this article focuses on the primary databases used by most of the ERP systems.

The first subsystem to be analyzed (due to the fact that it is connected with the most important operation in analyzed company - manufacturing operation) is the production subsystem that contains all necessary data used in the production process. The databases of this subsystem include (Fig. 2):

- Item master – also known as the index of the material. This database contains all the details of the material, i.e. a description of the material, its unique code or storage place. Also the production workstations and routes are defined. This database is a kind of foundation for the remaining bases of the production subsystem.
- BOM (Bill of Materials) - describes the structure of the product, number of parts, the duration of each manufacturing process and workstations which are used for machining. With this database it is possible to plan material requirements and the calculation of the cost of the product. Additionally, it is used as the basis for determining the technological route.
- Routing file - describes the production process by the sequence of all operations and workstations and with successive stages of production and their machining times (and setup time as well). It enables work scheduling and it is the basis for determining the production plan.
- Materials - in that database can be found information on the quantity of materials / supplies available in warehouse and the quantities which have been ordered by the

customer and intended for consumption during the production process. This database is used in the calculation of material requirements plan.

- Production plan - contains data such as order size, capacity, batch size, production schedules, planned downtime. In this base it is possible to carry out the main production scheduling and material requirements planning.
- Factory Equipment - describes the machines, production and assembly lines, operators, etc. This database is used to create a description of the operation in routing technology.
- Orders - contains data such as customer name, order size (number of units per batch, batch number), date of contract and payment, scheduled date of shipping. The information in this database are the starting point of the whole process of production.

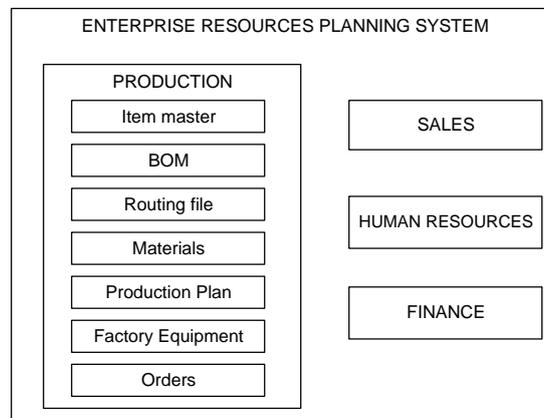


Fig. 2. Scheme of enterprise resource planning system - production subsystem [own elaboration]

In sales subsystem some databases were distinguished that are compulsory to be found in the whole system, in order to develop business contacts and to create production orders. They are the following sets of information (Fig. 3):

- Customers - this database contains basic contact information and facts about existing contacts. Another information that can be found in this database are: contact person of the company, the currency in which financial transactions are carried out.
- Orders - This database has already been described in the production subsystem. It is also worth mentioning that these orders involve not only customers but also vendors.
- Contracts - describes the business relationships with customers who often made the same order. This database serves as the basis for the implementation of regular orders.
- Delivery - this database contains the size and time of delivery and inventory of materials delivered. This information includes not only the transport of manufactured goods shipped to the client, but also material orders the company need in the production process. With the database delivery schedules are created.
- Delivery Schedule - information from this database allows to plan when to order

the materials from suppliers, as well as when the goods should leave the factory to reach the customer in scheduled time.

- Offers - contain data on orders, which are not yet approved by clients. There are also information about the product, its specification, production, and the offered price. This database is used to create specific contracts to be approved by the client.
- Goods returns - otherwise determined by the complaint database. The database contains the information about the reason of the return and the number of missing ordered materials. The information in this database are compiled from data on orders and deliveries in order to check whether the size of the order is the same as the size of delivery.

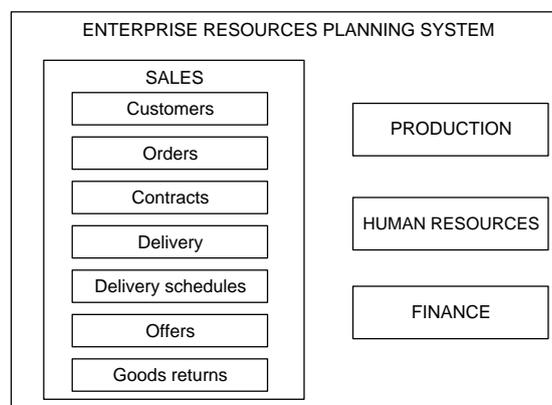


Fig. 3. Scheme of enterprise resource planning system - sales subsystem [own elaboration]

Financial subsystem is used for all accounting. This subsystem should include such databases as (Fig. 4):

- Accounting - This database allows to record electronic invoices and payment settlement on the basis of the data contained in customer and orders databases. This database serves as an electronic financial transaction services. The information contained in it are used in other bases of financial subsystem.
- Taxes - in the database calculations are carried out on the basis of staff billing and accounting. This database also allows the calculation of the tax on sold goods.
- Budget - this database contains information on the size of capital for use in a given period, as well as information regarding the use of financial resources.
- Balance sheet - based on data from the entire system, the ERP system is able to calculate the company's balance sheet. Mainly databases from financial and sales subsystems are used, but there are also important data in the production subsystem (calculation of the material resources).
- Reports - thanks to this database it is possible to evaluate the effectiveness of the company by analyzing all the data contained in the system, such as assessment of the realization of orders. System based on accounting data from the can perform calculations of costs and revenue and various types of financial analysis.

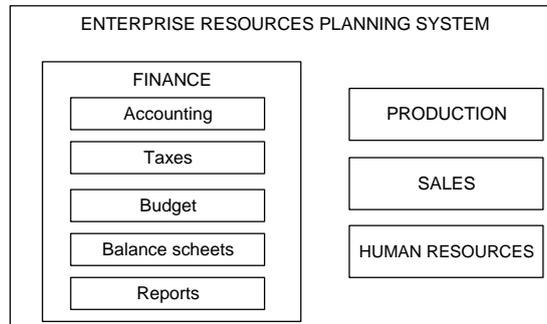


Fig. 4. Scheme of enterprise resource planning system - finance subsystem
[own elaboration]

The last of the analyzed sub-subsystem is Human Resources sub-system. It provides a smaller amount of databases, but they are equally important for the entire company, and without them the analyzed company would not be able to fully function properly because employees are one of basic resources, and thanks to them all the processes are performed in the company. The bases of human resource subsystem are (Fig. 5):

- Employees - This database brings information on all employees, their working time and the capabilities and system authorization. This database is the basis for production planning, "filling" production lines and determining the production capacity. In addition, it serves to calculate the remuneration.
- Wages - creates information about the wages on the basis of career structures for different groups of employees. Also information about bonuses or pay rise can be found. This database is the basis for settlements in the sales subsystem.
- Social issues - the database is used to monitor the costs of benefits and the degree of utilization of budgets. It contains also information about base salary and wages, which the system calculates for appropriate amount of social benefits.
- Staff billing - is used to control operating times, calculation of indirect costs of production and accounting staff of the delegation. The database uses the data entered into the database of employees and workstation operators. Based on this information system is able to calculate the actual time the employee's work and its cost.

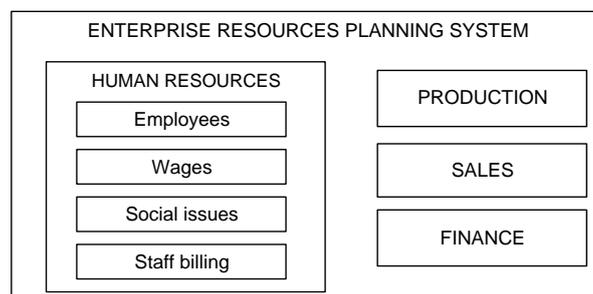


Fig. 5. Scheme of enterprise resource planning system - production subsystem
[own elaboration]

Preliminary analysis of enterprise resource planning system shows that the database used by the subsystems are linked together, and without the existence of one base the other one could not fully functional. Only a combination of databases from all subsystems gives a full range of information that should be included in the ERP system to enable interactions between subsystems. It should be also mentioned that there are also other databases used in the process of customer orders, although they could be classified as elements of other, larger databases. These items will be marked in schemes with a star (*).

3. Scheme of customer's order realization

The next step in the process of analyzing the realization of customer's order based on Enterprise Resources Planning system is to determine the course of the implementation of the customer's order for a specified good. The simplest, a very general way to present this process is to divide it into three stages - "Order", "Production" and "Delivery" (Fig. 6). Initially it was assumed that the individual stages will correspond to specific subsystems of ERP system. For stage "Order" assumed mainly the use of elements of the sales subsystem, for the stage "Production" the components of the production subsystem, while for the final stage of "Delivery" - the use of financial subsystem components. The fourth of the defined subsystems - a subsystem of human resources, cannot be specifically assigned to one of the stages, because employees (not only production, but also administrative) are involved in all three stages of realization of customer's order.

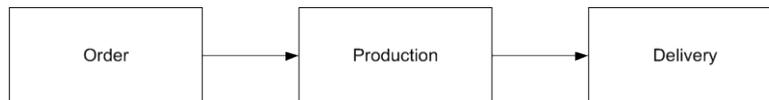


Fig. 6. General scheme of orders realization [own elaboration]

Another element of the process analysis is to determine which of the previously described basic databases are used in each of three stages. This analysis aims to prove the correctness of assumptions relating to the use of a given stage of elements mainly from one of the determined subsystem.

At the "Order" stage, which consist in receiving an order from a customer for a particular good, as expected, were identified mainly databases from sales subsystem: offers, customers, contracts, orders and delivery schedules, as well as previously not mentioned forecasts (Fig. 7).

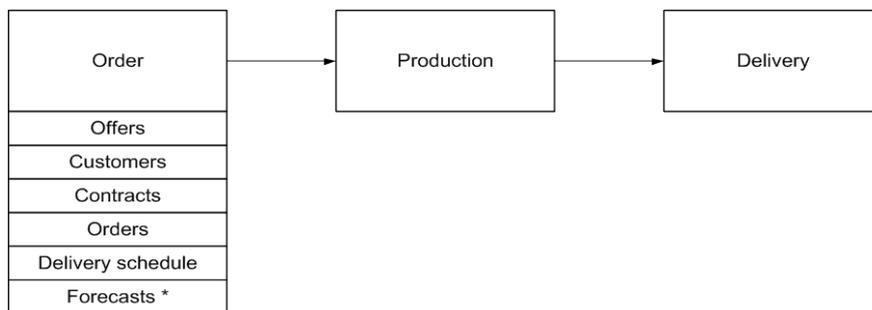


Fig. 7. Scheme of orders realization - the databases of "Order" phase [own elaboration]

Due to the fact that the process of "Production" is the basic process to be executed in analyzed enterprise, it was decided to look at it closer. For a deeper analysis of the "Production" the scheme of life cycle of production order was used [6]. This cycle consists of three main stages - the development of a production order, production planning and production monitoring (Fig. 8).

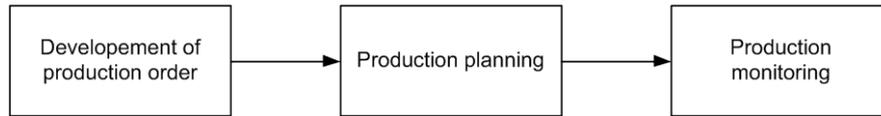


Fig. 8. General scheme of life cycle of production order [own elaboration, [6]]

The basic processes performed during the development of production order stage includes: registration of a production order, process of completing order's data and verification and validation standards. During registration the order has been identified using databases with sales subsystem, such as: contract, customers and deliveries. In the process of filling order's data is used item master, routing file, BOM and materials, belonging to the subsystem of the production and delivery schedules and supply base, belonging to the sales subsystem, and a common database - orders. The process of verification and approval standards is supported primarily by the information contained in the item master, factory equipment, and delivery schedules. (Fig. 9).

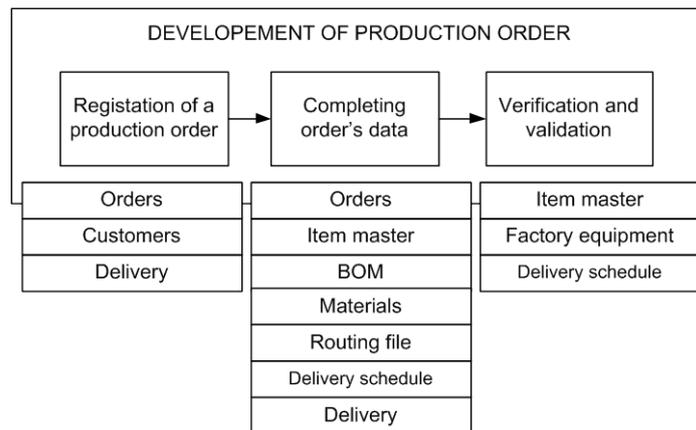


Fig. 9. General scheme of life cycle of production order – Development of production order [own elaboration, [6]]

To processes implemented during the production planning stage can be included: preliminary scheduling, checking schedules and approving newly created schedule. To create the preliminary schedule it is necessary current information contained in the database of orders, delivery schedule, routing, and information on the number of shifts and planned shutdowns (these items could be classified as factory equipment database). All these data are then transmitted to the basic production plan under which the schedule checking is performed, consisting in the verification of data received from data contained in the delivery schedule, routing, and equipment of the factory (the calculation of production capacity). The final element of the production planning is to approve the schedules previously created database delivery schedule and production plan. (Fig. 10).

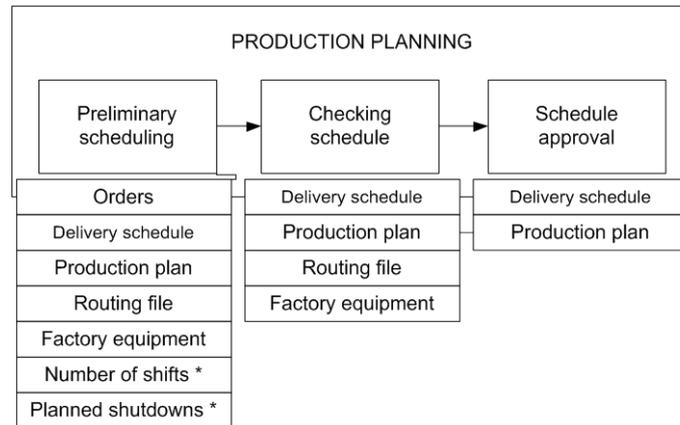


Fig. 10. General scheme of life cycle of production order – production planning [own elaboration, [6]]

The final stage of the life cycle of production order is to monitor production. Its main element is a production process that uses a previously created production plan, updated database of contract and materials (previously automatically calculated in Material Requirement Planning), and the data contained in routing technology based in BOM' and employees data with information of production workers and their availability schedule. In the case of deficiencies in materials supply the delivery base is used, focusing on the information on orders from vendors and financial database containing billing information.

During the manufacturing process it is carried out the production progress reporting, so it can be known exactly where, how and by whom the process is realized. For this stage orders, plan production and routing file are used. The final element is finishing order, which is also a consequence of the manufacturing process. It uses order and delivery schedule databases. (Fig. 11).

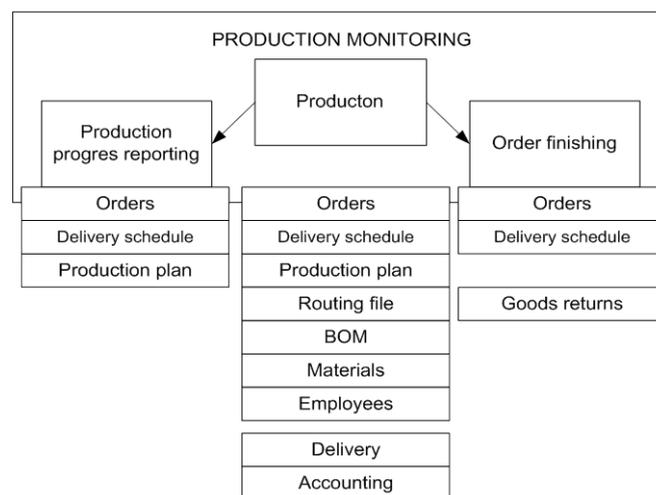


Fig. 11. General scheme of life cycle of production order – production monitoring [own elaboration, [6]]

Taking into account stages of "production order life cycle," that can be considered as a detailed map of the "Production", an extended scheme of orders realization was created.

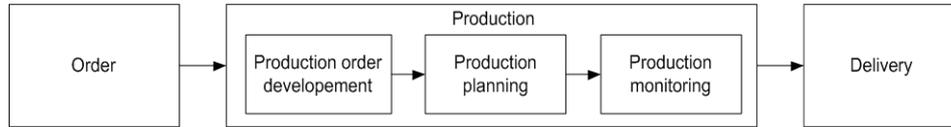


Fig. 12. Extended scheme of orders realization was created [own elaboration]

At the stage of "Delivery" the database of orders, customers, supplies, accounting, taxes, and in case of need - the return of goods were identified. The first three bases allows to review the correctness of the post-delivery, but they are only informative. More important are two next bases that manage financial issues, due to the fact that these are key elements of the finalization of the order. (Fig. 13).

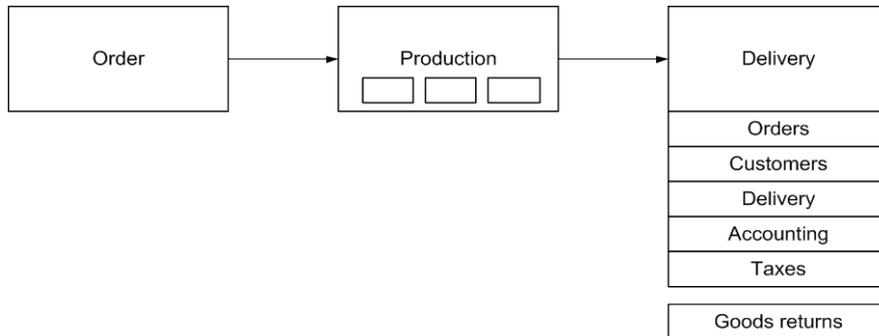


Fig. 13. Scheme of orders realization - the databases of "Order" phase [own elaboration]

4. Resources in the realization of the customer's order

As part of this analysis also a matrix of used databases for each of the stages of the contract was constructed. On the basis of previous assumptions about the representation of the distinguished Enterprise Resources Planning subsystems can be concluded that this matrix is a representation of the resources used in the analyzed enterprise.

The use of relevant databases indicated in the matrix corresponds to each determined main process (Tab. 1). The matrix also includes indirect use of databases, which combine with other databases used in the process, such as wages or staff billing, associated with the human resources subsystem, directly used in the monitoring process of production.

It should be noted that the order database appears in every stage, so it can be concluded that the data contained there is the basic information for the whole process. This database can be considered as a base that is not only integrating the stages of the contract, but also all the other databases used in this the process. For this reason it is important that inputted data are filled carefully and precisely, because the absence or distortion of certain information would cause the appearance of errors and defects, which would entail financial implications for example in the case of inadequate production of the contract.

Equally important base is the delivery schedule, because the data contained there apply to all stages of the order. Respect of the deadlines set by the analyzed company is associated not only with the timely delivery of goods to the recipient, but also with the

costs associated with the detention of excess materials in warehouses, or other costs arising from the shutdowns of production. Thus, it is important that the information contained in this database is accurate and available at all stages of the order realization especially during the life cycle of a production order.

Tab. 1. Matrix of used databases in main processes

	Order	Production			Delivery
		Development	Planning	Monitoring	
DATABASES	Item master		✓		
	Routing file		✓		✓
	BOM		✓	✓	✓
	Materials		✓		✓
	Production plan			✓	✓
	Factory equipment		✓	✓	
	Orders	✓	✓	✓	✓
	Customers	✓	✓		✓
	Contracts	✓			
	Delivery		✓		✓
	Offers	✓			
	Delivery schedule	✓	✓	✓	✓
	Goods returns				✓
	Employees			✓	✓
	Wages			✓	✓
	Social issues			✓	✓
	Staff billing			✓	✓
	Accounting				✓
	Taxes				✓
	Budget				✓
Balance sheets				✓	
Reports				✓	

5. Conclusions

Matrix analysis shows that during process of accepting an order from the customer the most frequently used information are the ones in the databases of the sales subsystem. In production process in general are used databases qualified to the production subsystem, but in various stages of the life cycle of a production order is supported by the data information from the sales subsystem (during the stage of development orders and monitoring), human resources (in the planning stage - when determining the capacity and production during the monitoring phase). The implementation process of delivery is based mainly on the use of database form sales and financial subsystems. Subsystem of human resources was not

assigned to a specific process, since the human factor is involved in every stage, but it was considered that it is of utmost importance in the production process, because the process depends largely on the company's employees.

These subsystems correspond to three of the four major company's resource human resources (human resources subsystem), tangible resources (subsystem of production) and financial resources (financial and sales subsystems). Fourth resource (information resources) are not attributable to any specific subsystem, because the information in the ERP system are the database itself.

Based on analysis of the use of sub-databases in various stages of the contract realization, it can be concluded that the initial assumption regarding the use of each resource in each of main stages mainly form one of determined subsystem, has been confirmed. There is therefore a basis to conclude that authors correctly identified subsystems of Enterprise Resources Planning system and resources used by them.

The components of ERP system are an essential element of the order realization process. Without them, this process would be much more difficult to plan and synchronize with customer's schedule, and thus, would extend the delivery time, with the result that the company could become less competitive in the eyes of not satisfied customers. The intelligent use of enterprise resource planning system and the careful processing of the information contained in it can bring many benefits for enterprises (not only the analyzed one, but in general).

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