

PROGRAM FOR MONITORING PRODUCTION

Borislav Drakul

University of East Sarajevo, Faculty of Business Economics Bijeljina, Bosnia and Herzegovina
borodr@gmail.com

Srdan Damjanović

University of East Sarajevo, Faculty of Business Economics Bijeljina, Bosnia and Herzegovina
srdjan.damjanovic@fpe.unssa.rs.ba

Predrag Katanić

University of East Sarajevo, Faculty of Business Economics Bijeljina, Bosnia and Herzegovina
predrag@telrad.biz

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Abstract: *In this paper, a program is presented that provides for automatic monitoring of production processes. The program is designed to be used in companies that deal with a wide variety of production activities. This program has several menus: production order, delivery note, receipt, consumption of materials, realization of production, inventory, write-offs, leveling, components, an account review, a business overview and a card of goods.*

We plan to make this production management program part of a single ERP (Enterprise Resource Planning) program, which we have been developing for several years now. This integral program, apart from the production process, should include modules for: employees, business clients, general information about the firm, services provided by the company, products that the company produces, products that the company supplies, sells and services, relationships with existing banks, bookkeeping entries and outgoing faxes and financial operations.

The production process of any product requires the generation, monitoring, and storage of a large amount of documents. This paper will be about a program that seeks to automate these processes. The program is intended primarily to address the needs of manufacturing companies, but can also be applied to assist services companies as well. The program monitors every product, through the

raw materials needed for production, as well as monitoring the technology used in the production of each product. In order for the program to be operational, it is necessary to first enter data into a relational database. To store the data, a PostgreSQL relational database is used with 13 interconnected tables. The complete program is written in the Java programming environment.

Keywords: *program, production, product, account, tracking*

1. INTRODUCTION

Companies today operate in dynamic and turbulent conditions that are constantly changing. This imposes the need for continuous improvement of their business models, in order to increase their competitiveness in the local and global environment.

Therefore, it is necessary to identify on time all the requests of customers or service users of the company in order to be able to offer quality and cheaper products or services in a short period of time. But all this should be done with minimal operating costs. In order to achieve these mutually opposite goals, it is necessary to integrate all business processes in the enterprise and optimize all available resources.

The need to make decisions that are critical to business operations in the shortest time possible, based on a large number of information, has

created a necessity for information systems that provide a quick and efficient way to the management of the company with a picture of the state of affairs of the company as a whole. Amongst organizational units within the company, a better and faster flow of information is required, in order to make decisions more efficiently regarding systems of procurement, inventory management, accounting, resource management, and for the needs of production, sales and distribution of goods and services to be addressed more efficiently. The ability to provide the right information, at the right time and in the right place, bestows great advantages in a complex business practice.

Enterprise Resource Planning (ERP) is the name for a software solution that integrates all the processes of an organization into a single system. The basic idea is that, by its application it ensures that the planning of all activities is carried out appropriately and efficient functioning of individual functional areas is ensured, as well as the entirety of the business system⁴. ERP refers to a comprehensive view of the business of the company and all its interrelated components. ERP represents a software infrastructure that, on the one hand, connects all internal parts of the company, and on the other hand supports external business processes of the company.

In order to achieve all the stated goals, the ERP system usually consists of several software modules, serving the various functions of the enterprise, employing a common database. One of the reasons why the ERP system is packaged into modules is price, which is not insignificant. It is precisely because of price that some companies buy individual ERP system modules based on budget availability for these types of investment.

Today in the world there are a large number of ERP software vendors, with very different modules and prices. For most of these software packages, menus are made in English. We have come up with the idea to create ERP software where the entire menu interface will be in Serbian.

Not only will it be written in Serbian, but we have already planned that this software package reflect the business environments in which the companies in Republika Srpska and Bosnia & Herzegovina do business. Thus, we wanted to reduce the resistance of end-users, which always arises when introducing new programs into the functioning of the business. Without involvement of employees and their support in the implementation of new programs in the company's operations, such

projects have been ill fated from the beginning. This stems from it being hard for employees to get rid of old habits and acquire new ones.

The ERP system we develop consists of several modules that include: production, employees, business clients, general information about the company, services provided by the company, products manufactured by the company, products that the company purchases, sales of products and services, relations with a bank, book entry and outgoing invoices and financial operations. In this paper, attention will be paid only to the module that supports the production process within the company.

2. Production monitoring program module

When production is discussed within the company, it is a big mistake to think of it only in terms of people directly working on production machines. Manufacturing is a very complex process in which employees in different departments of the company have access to the same information, which is constantly varying with current modifications.

When a department completes its part of the job, all relevant information is transmitted to the other departments that are in the processing chain. It is necessary to grant authorized access to the information system, so that employees can access the information they are intended to have. In this way, at any moment it can be determined at what stage the job is currently in and what are the next steps to be taken. The main goal is to do the job quickly and efficiently, with as few mistakes as possible. Errors cannot be completely avoided, it is therefore important to easily trace errors and who is responsible for their occurrence. It is necessary to prevent the transfer of responsibility for mistakes to non-culpable individuals. At each stage of the process, you must know the first name, last name and precise time of each event. In other words, who has completed what and what the specific responsibility entailed.

In regards to production, we can say that it is one of the most important parts of every company, because without production there is no new value added from which salaries could be disbursed to employees, but also investments instituted, such as ones in information systems. This is also the main reason why when purchasing an ERP program, companies usually opt for the purchase of a module that supports the production process. In this paper we present our program, which provides for automatic monitoring of the production process.

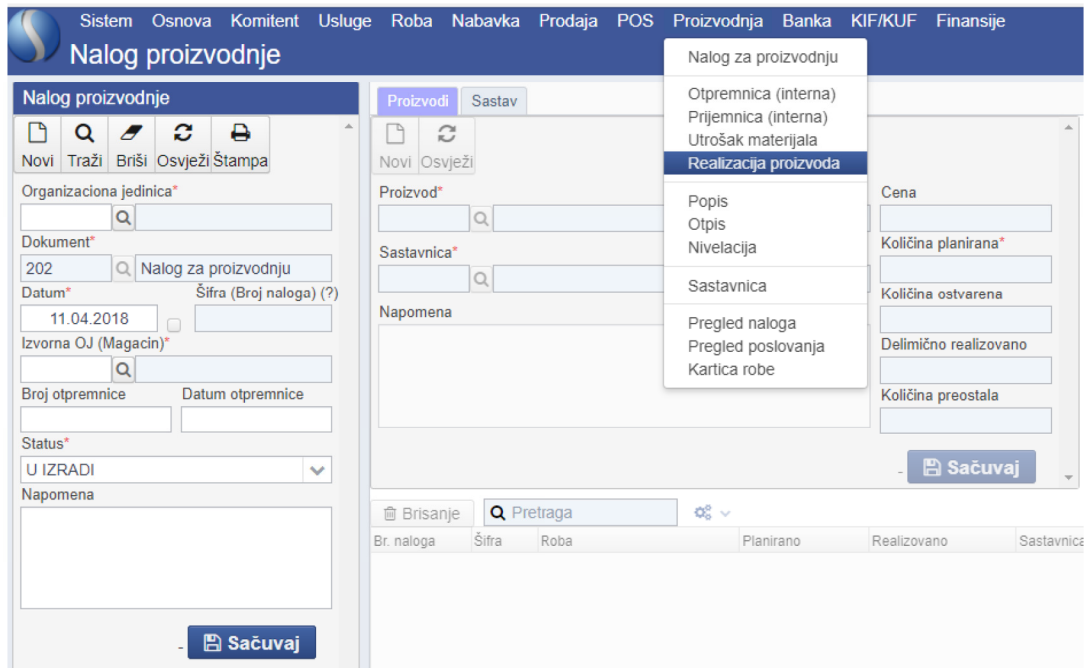
The program is structured so that it can be used in varied companies that deal with different

⁴Stankić R., Kršmanović B., „Upravljački informacijski sistemi“, str. 297.

production activities. The production module is supported through the 'Production' menu. These menu items are: production order, dispatch note, receipt, material consumption, production realization, inventory, write-off, leveling,

component, account overview, business overview and card of products used in production monitoring. Figure 1 shows the main menu of our ERP program and it is also visible under the option-tracking menu for production.

Figure1.ERP program main menu



The production module is a program designed primarily for the needs of both manufacturing companies and companies that deal with product servicing. The program monitors every product, from the raw materials needed for production to the technology needed for making each product. The goal is to more effectively control the inventory of products in the warehouse, both raw materials and finished products.

Minimizing the costs of keeping stock of raw materials in the warehouse reduces the amount of committed financial resources of the company, which can be redirected to some other purposes. Moreover, excessive stocks of finished products in a warehouse due to them being less well sold also represents stranded financial assets, for whom we do not know, when and if their value will be recovered.

In this paper we will briefly show how the issuance of a work order in the production process works with the help of our program. Figure 2 shows the layout of the program when a production order is made for two products. It is in

regards to the production of two products, which have their own unique codes 39 and 740.

Through these codes each product is stored and monitored in the database. From the figure we notice that an intention exists to produce one unit of product under the code 39, and two units of product under the code 740. By clicking the **Sačuvaj**

Production Order button, the planned production amounts of the two products mentioned is saved. When entering the product to be produced, the components with which the product is produced must be selected.

One product can have several components used in its production and the product itself can be a component of another product (when configured as a semi-finished product).

Based on the components stored in the warehouse, a delivery note of the raw materials is prepared, which are required for the production of the planned quantities of products in the order, Figure 3.

Figure 2. Making a production order

Br. naloga	Šifra	Roba	Planirano	Realizovano	Sastavnica	Napomena
740		PLATFORMSKA VAGA DMV-IV 1200x1000 mm	2,00		740-6	TEST
39		VAGA ZA SILOS 30t	1,00		39-4	

Figure 3. The composition of intermediate goods for the two products

Šifra	Naziv	JM	Cena	Količina	Iznos
142	SQB-500kg MJERNA ČELIJA	kom	37,17	8,00	297,38
688	SQB-A51 MJERNA ČELIJA	kom	83,85	6,00	503,07
318	LIM CRNI TVL 15X1500X6000	kg	1,35	30,00	40,50
100164	NAVRTKA M10	kom	0,06	40,00	2,40
100194	KABAL LIYCY 5 x 0.25	m	1,05	30,00	31,50
100163	MAŠINSKI VIJAK KV8.8 10X70	kom	0,23	4,00	0,92
2	JXH-4C SABIRNA KUTIJA KELI	kom	24,20	2,00	48,40
100189	MATICA M10	kom	0,10	30,00	3,00
100188	MASINSKI SARAF 10X70	kom	0,39	8,00	3,12
100084	LIM CRNI TVL 12X1500X6000	kg	1,33	20,00	26,60

As part of the preproduction materials list from Figure 3, which is automatically generated, there is a list of all parts that are necessary for the production of the pre-selected products.

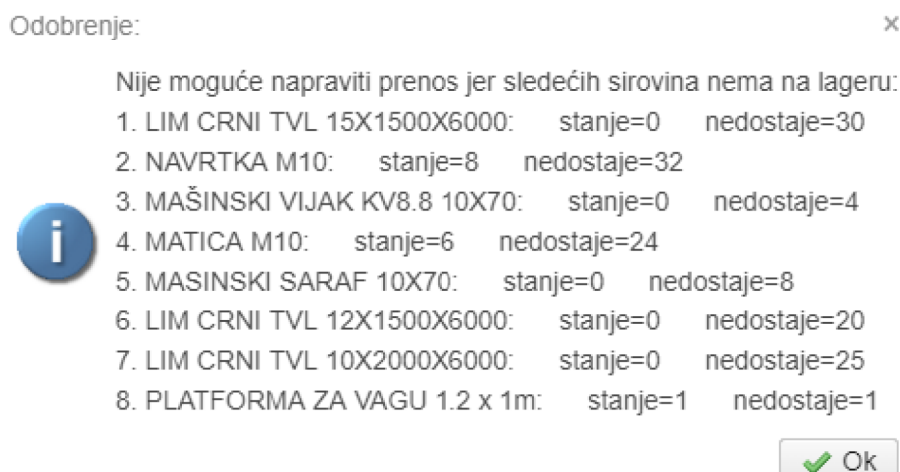
This component shows the part code, the part name, the unit of measure, the amount required for the production of the selected products and ultimately, the monetary value for each individual component as well as the complete product.

If we were to initiate the production according to the allocated components, we would begin this process in the menu **Realizacija proizvoda**.

When this form is initiated in the database, it is checked that the warehouse has all the parts in sufficient quantities necessary for production. If there are no parts in the warehouse, then the message will appear as in Figure 4.

The inquirer is informed of the condition of the currently available parts and those for which extra quantities should be ordered for, as well as the respective monetary amounts.

Figure 4. Missing parts for the production process



The program also monitors the further course of production, when sufficient quantity of raw materials is available in the original warehouse. The material that is transferred to production is monitored by the "transferring" document, where the synchronized real-time production is monitored by the quantity of the produced product. During the process of production of additional products, inventories of raw materials in the warehouse are reduced and the inventories of finished products are increased. The program also provides a reversible process (for products for which this process is possible - disassembly).

In order to show all the forms and options available to the agent when using this program, we would need a lot more space than currently allotted in such a work. But, we hope that at least we have shown how this completely homegrown software solution for monitoring the production process would look like. The main advantage of such homemade software is that it can easily adapt to the needs of each individual production enterprise. This primarily refers to some specificity each firm has, both in terms of the number and complexity of the parts used in the process of producing one or more products. Another advantage this program has is its price, which is considerably lower than the price such programs command that originate from abroad.

he program was created as a Web application according to the latest standards in the creation of information systems. The complete program is based on open source solutions, which means that the user has no obligations and costs in terms of additional licensing. In addition to the high performance, the Java programming language offers the ability to run client applications on virtually all operating systems (Windows, Linux...), and also the server part (application server and database) supports work on all leading platforms. It is also interesting to note that the

United Nations recommended that its members use open source software, especially in the fields of health, education and international trade.

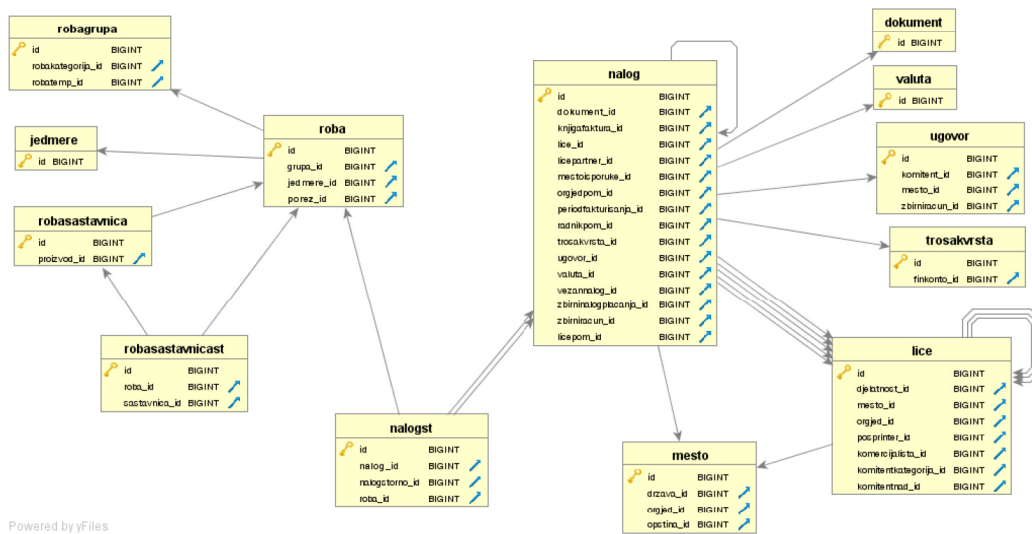
3. Database

In order for the program to work, it is necessary to first enter data into a relational database. To save data, a PostgreSQL relational database is used with 13 interconnected tables. Figure 5 shows the diagram of the relational database, which is used in the production-tracking module. A complete database that supports the entire ERP system contains much more tables and links between these tables.

PostgreSQL is an object-relational database management system (ORDBMS), based on POSTGRES version 4.2 developed at University of California, Berkeley Department of Computer Science. POSTGRES was a pioneer in some concepts, which became available in commercial databases only much later. PostgreSQL is an open source version of the original Berkley Code. It supports a large number of SQL standards and provides many modern features: complex queries, external keys, triggers, views, and transaction integrity.

PostgreSQL can be freely used, modified and distributed by any user for any use, whether it's private, commercial or academic. The POSTGRES project was run by Professor Michael Stonbraker and the implementation started in 1986. The first demo version became operational in 1987. Andrew Ju and Jolie Chen used POSTGRES to implement a SQL language interpreter in 1994. Under the new name, Postgres95 was released on the web as an open-source version of the original POSTGRES Berkley Code. The new name of PostgreSQL was selected in 1996 and indicates the connection between the original POSTGRES and the ability to use SQL.

Figure 5. Relational database schema



PostgreSQL manages the database access permissions using the concept of access rights (Eng. Roles). The right approach can be organized around individual users of the database or groups of users. Logins can be organized around the owners of the database objects (tables, queries, reports), and privileges can be assigned to these objects for other access permissions. It is even possible to assign membership to other entities by allowing others access to the privileges that they have.

For everything that contains critical data, backups should be made regularly including for the PostgreSQL database. There are three fundamentally different approaches for backing up the PostgreSQL database: SQL dump, the Back-up file system level, and On-line backup. Each of these three approaches has its strengths and weaknesses.

The idea of the SQL dump method is to generate a text file with SQL commands so that after introduction to the server, it recreates the database, as it was when SQL Dump was executed. PostgreSQL for this purpose is provided by the utility `pg_dump`, which writes the result to the standard output file. PostgreSQL is a client application, which means that backing up can be done from any computer that has access to the database.

An alternative strategy for backing up is the direct copying of files that PostgreSQL uses to store data in a database. There are two limiting factors that make this method impractical or at least worse than the SQL dump method. The first server must be extinguished in order to obtain a backup. Moreover, it is impossible to backup only certain specific parts of the database.

Online backup is perhaps the best method of making a backup. All the time, PostgreSQL maintains write ahead log (WAL). Log describes any changes over the database and is primarily for security reasons. If a system crash occurs, the database can be raised-up again by "repeating" the event. It is possible to combine backup file system level and backup of WAL files.

The PostgreSQL database, although not the fastest, is characterized by many testers as the most advanced database. It is inspired by the Oracle database and from the very beginning it supported transactions, triggers, and referential integrity. Recommendations for its use are more in the direction of proven quality and robustness than performance itself. PostgreSQL users include, among others, UNICEF, Cisco and the American Chemical Society.

CONCLUSION

In this paper, we have briefly described the program that we constructed, which enables complete monitoring of the entire production process.

The program has been designed to be easily adapted to various production activities of varied companies. This program has several main menus and each of them has several sub-menus, which allow tracking of various processes during production.

We plan to make this production management program part of a single ERP (Enterprise Resource Planning) program, which we have been developing for several years now. This integrated program, apart from the production process,

should include modules for: employees, business clients, general information about the firm, services provided by the company, products that the company produces, products and services it sells, deals with banks, book entry and outgoing invoices and financial operations.

We believe that this program can be very competitive in the software market that deals with tracking the entirety of the production process.

One of the main advantages of this software is that it is based on open source solutions, which means that the user has no obligations and costs in terms of additional licensing. In this area, this is very important because many companies do not have now licenses for the operating system and application programs they use, which can be a major obstacle for future development.

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SUMMARY

Companies today operate in dynamic and turbulent conditions that are constantly changing. This imposes the need for continuous improvement of their business models, in order to increase their competitiveness in the local and global environment. Therefore, it is necessary to identify on time all the requests of customers or service users of the company in order to be able to offer quality and cheaper products or services in a short period of time. But all this should be done with minimal operating costs. The ability to provide the right information, at the right time and in the right place, bestows great advantages in a complex business practice. Enterprise Resource Planning (ERP) is the name for a software solution that integrates all the processes of an organization into a single system. The basic idea is that, by its application it ensures that the planning of all activities is carried out appropriately and efficient functioning of individual functional areas is ensured, as well as the entirety of the business system.

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The complete program is written in the Java programming environment. In order for the program to be operational, it is necessary to first enter data into a relational database. To store the data, a PostgreSQL relational database is used with 13 interconnected tables. This program and database is based on open source solutions. Therefore the user has no obligations and costs in terms of additional licensing.