Information System of Automated Assembly Line on RDBS Oracle base

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***Abstract*— Paper deals with the implementation of an information system for the automated production line. Definition of a complex methodology for design and implementation is described, followed by the structure of the information system, which is depicted using different diagrams, forming a comprehensive design of an information system. Paper also contains a description of the automated production line (flexible assembly company), used software and description of IS modules and their functionality. Verification of the IS functionality is taking place in the last part of the paper.**

***Keywords*— Information system, Flexible assembly company, RDBS Oracle, C#, SQL**

I. INTRODUCTION

Information system (IS) can be considered as an integrated set of components designed for capturing, storing and processing data, or for providing information to its users. Companies introduce the IS for managing information, communication with the customers or suppliers and for enhancing competitiveness on the market. IS is composed from following parts:

- software (applications),
- hardware (computers, servers and other devices),
- databases or other data storages,
- human resources.

IS implemented for production line increase mainly a production efficiency (it is monitoring production from creating an order to an expedition of final product). They are able to monitor activities such as stock control, calculation of an order price, expedition of final products etc.

II. FLEXIBLE ASSEMBLY COMPANY

This fully-automated production line model is located in Department of Cybernetics and Artificial Intelligence at Technical University in Košice (Fig. 1).

Fig. 1: Flexible Assembly Company

Flexible Assembly Company (FAC) is composed from five posts and conveyor that is responsible for moving the pallets between posts. At every post, particular part of final product construction is being realized. Product is composed from four different parts:

- base,
- bearing (large, small),
- shaft (blue, green),
- cover (metallic, nonmetallic).

The role of FAC is to assemble the product according to an order, which has been sent to PLC from IS. In case of shortage of space in entrance or output warehouse, a production is not launched. There are 24 positions available in the output warehouse. Main process controlled by the created IS is described on Fig. 2.

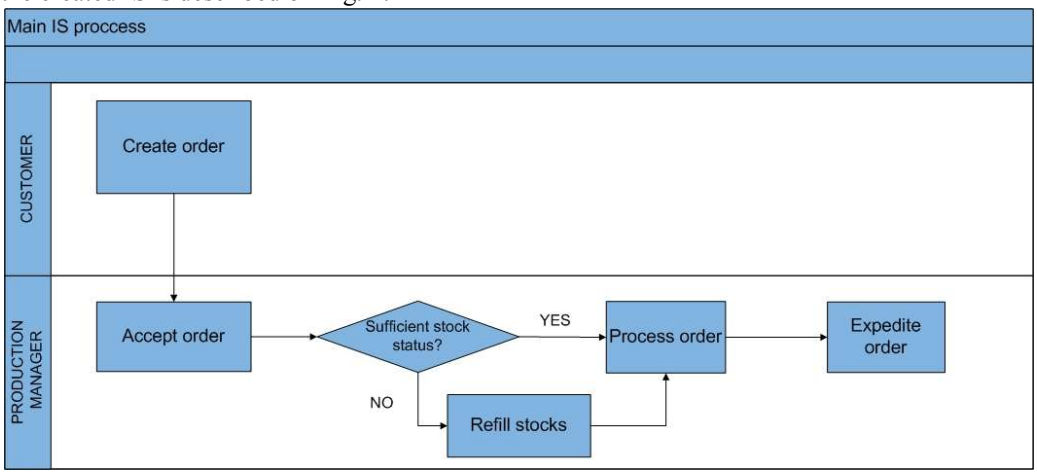

Fig. 2: Main process controlled by IS

III. DESIGN AND REALIZATION OF INFORMATION SYSTEM

During the design and realization of the information system, we use different software tools. We developed the main part of IS functionality in Microsoft Visual Studio 2010. Data model and operations connected with database were realized by Oracle products, mainly by SQL Developer. For connection between the IS and the real assembly line model, we use RsLogix.

By reason of large range of diagrams, we depict only three of them: functional diagram, data diagram and Use Case diagram.

A. Functional diagram

In this diagram, we are presenting the main processes of the fictive company, which is using the FAC. Processes that are inferior to the main process are arranged on the right. Processes, which are not further decomposed, are displayed with final symbol.

Description of blocks in the functional diagram [2]:

(0) IS of the company – Block describing IS as a whole unit that is decomposed and comprises basic structure of the IS. In further blocks, we describe the individual inputs and outputs of processes.

(1) User identification – Block used for authentication and authorization of the different users in IS. According to the role of the user, he has granted rights and he is shown the appropriate user interface. The process is not further decomposed.

(2) Company management – Block of processes serving to administrator for maintenance of IS or possible changes in databases. The process is not further decomposed.

(3) Economic department – In this block processes are connected with receiving and processing an order based on customer requirements. Stock management is also available in this block.

(4) Production – The production plan is defined according to order requirements and available resources provided by particular stocks. In the entry stock, it is required to have sufficient number of components for starting the production, while the output stock should have at least the same number of free spaces, as desired number of products is.

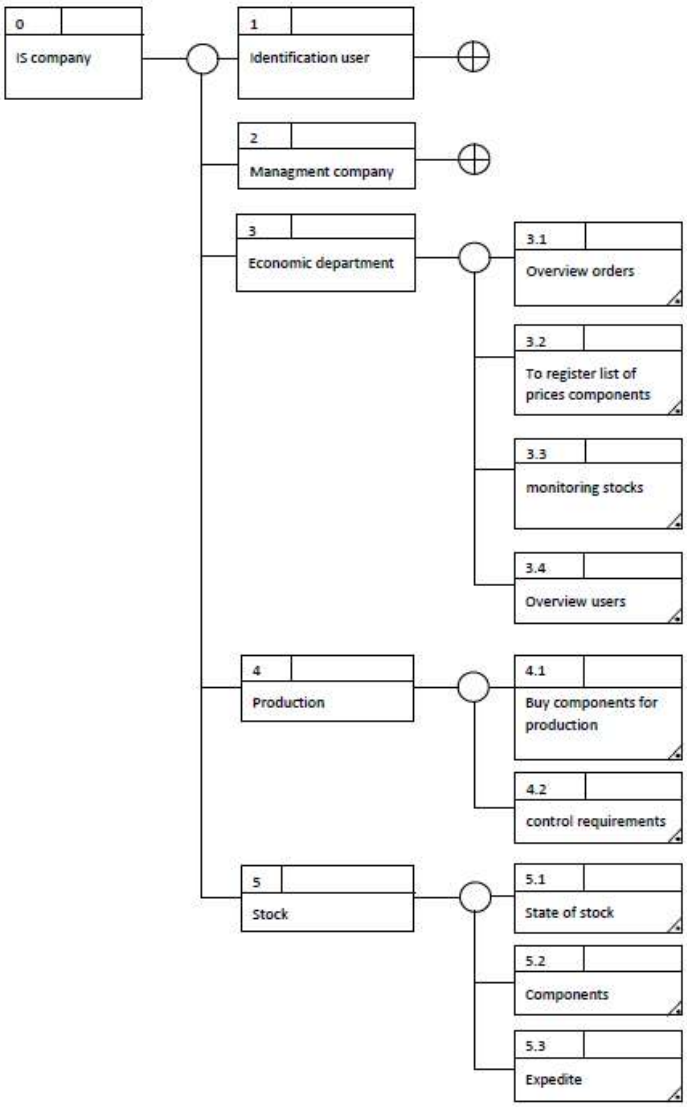

Fig. 3: Functional diagram

B. Data model

All data gained during the work with the IS, are being saved into the database. The IS communicates with the Oracle relational database. We defined data in database using relational tables. During creation of the model, we define the types and attributes of entities, as well as limiting of these attributes. Entity is characterized as one row in a table called record. Attribute is referred as a column in the table and according to its name is possible to find out, what characteristic of the record it is representing.

During the implementation of IS for FAC, we define and create 8 tables:

- Customers
- Users
- Orders
- Price_of_component
- Product
- Production
- Storage
- Storage_out

The Fig. 4 shows the structure of the data model. Name, attribute, primary and foreign keys specifically define the individual tables. Every attribute is defined more specifically by a data type. The abbreviation "P" for one of the attributes indicates that the attribute is a primary key.

The abbreviation "F" marks the foreign key. Number of non-zero (not null) is marked in the table with a star and means that the value cannot be blank.

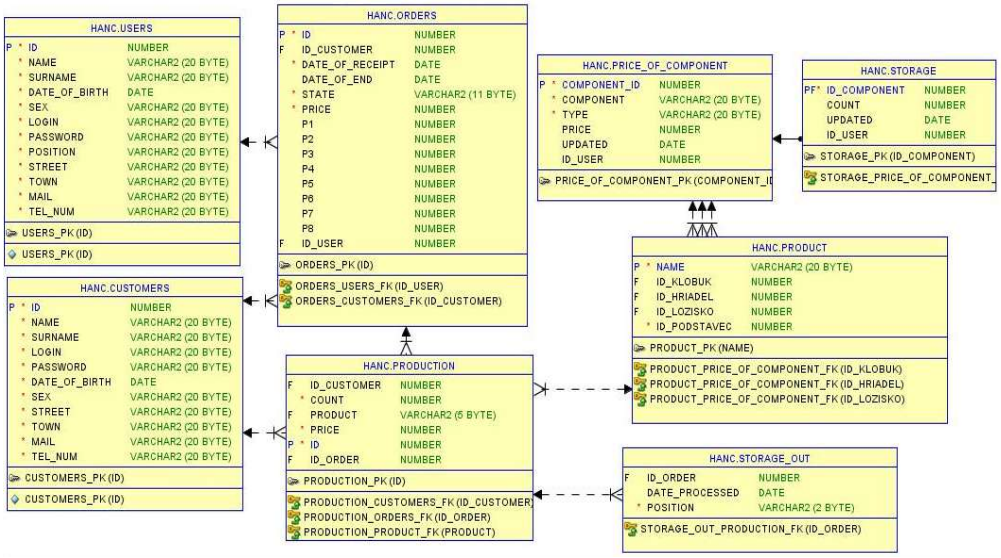

Fig. 4: Data model

C. *Use Case diagram*

Information system is decomposed to four main user modules (administrator, manager, production manager, customer). Each module has its unique set of functionalities for working with different parts of the IS. Some of the functionalities are common for more than one module. On the contrary, some of them are available only in the particular module. Availability and assignment of functions depends on the user's role in the IS.

Use Case diagram that is delineated in the Fig. 5,is showing the functionality of particular modules.

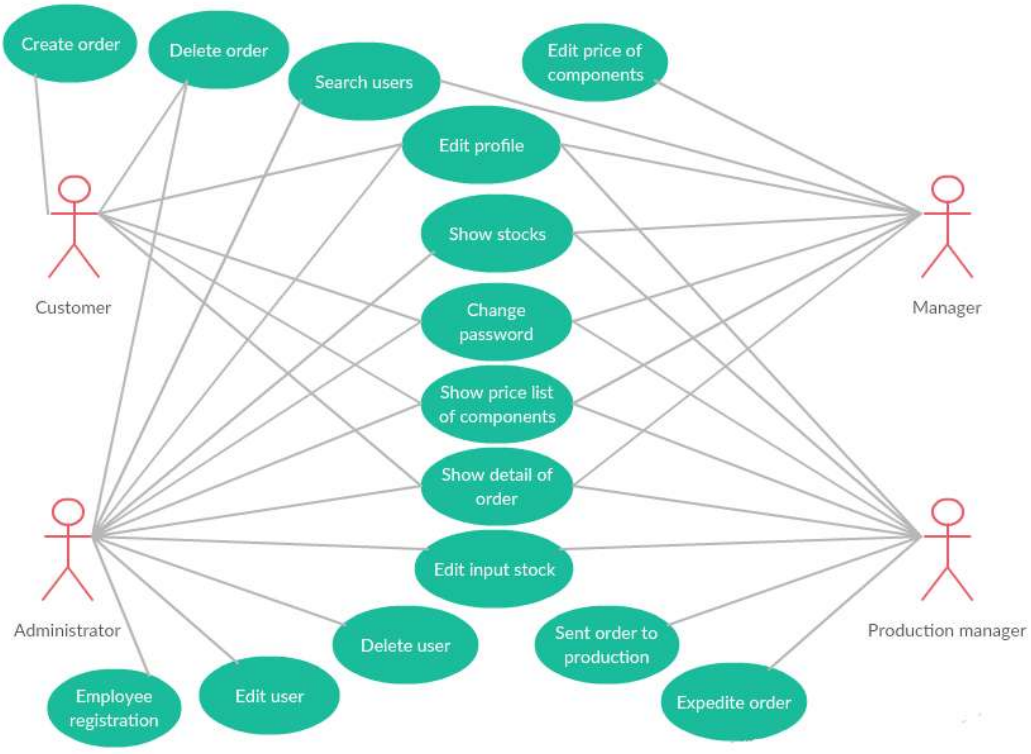

Fig. 5: Use case diagram

IV. VERIFICATION OF PRODUCTION ON PRODUCT LINE

As it has been mentioned for several times, the IS is designed for flexible assembly company. For the verification of IS functionality, we realized the connection to the server via employee module and subsequent sending of data into production line. Firstly, the customer has to create

the order, which is then sent to the employee responsible for production process. Order creation is depicted on Fig. 6.

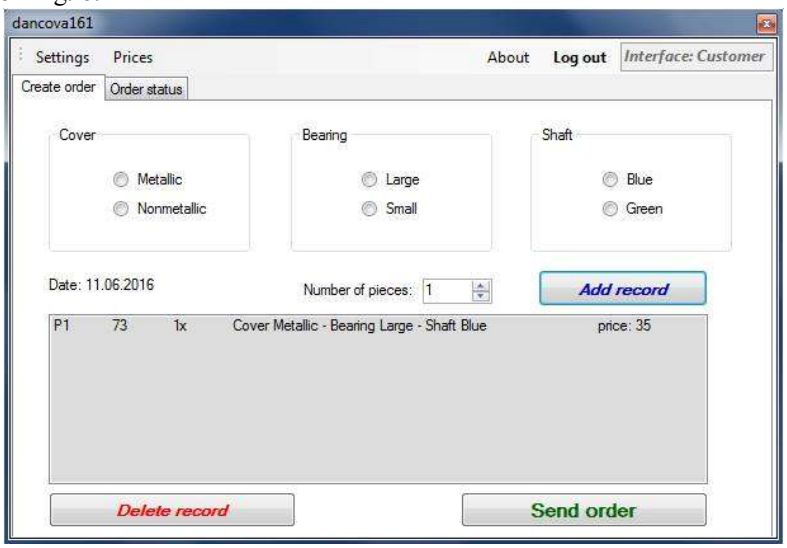

Fig. 6: Creating an order

Without a connection to the server it is not possible to send information to production department. Functionality of a button "Send to production", which activates the production process itself is secured by the conditions in the source code. The first condition for starting the production is stocks availability. The second one is confirmation of connection via text with description "ONLINE" in section "Connection to server".

To launch a production, it is necessary to click on the button "Send to production". The button would not be available, if conditions of stocks availability are not fulfilled. It means that the entrance stock has to have enough components for producing sufficient amount of products, while the output stock must have the sufficient number of free positions. Button for sending an order into the production and text allowing the dispatch of the order to the production for the both stocks can be seen at the Fig. 7.

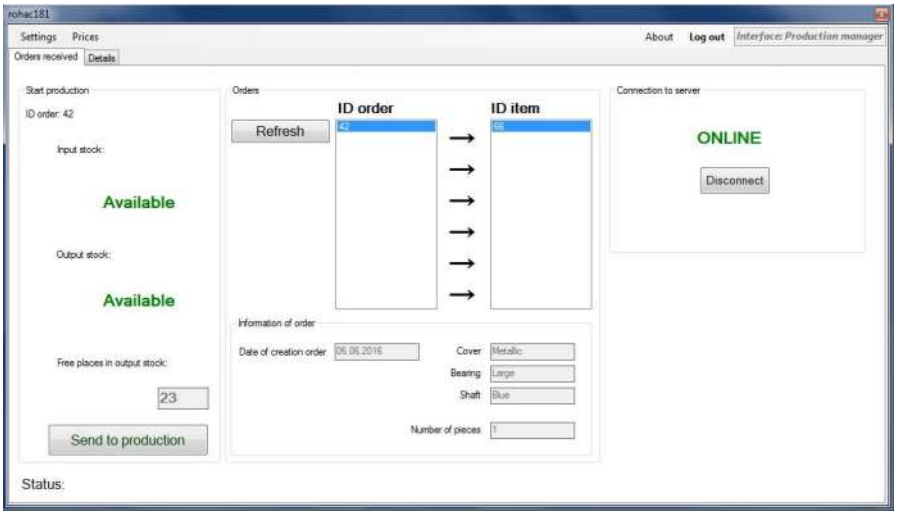

Fig. 7: Prepared stocks and server

At the beginning of production, base is randomly ejected on the belt, where its position is monitored by a camera. After finding out the coordinates of the base, this information is sent into the PLC. Mitsubishi robot reads the data with the coordinates of the PLC and subsequently transfers detected base from the belt onto the pallet, which is moved by a conveyor.

On the next post, a bearing is firstly inserted into the base from the cartridge. Subsequently, the shaft and cover are inserted into the bearing. A final product is transferred by a conveyor belt to the three-axial manipulator that takes the final product and put it into the stock. This stock is depicted on the Fig. 8 together with manufactured product.

Fig. 8: Output stock

After finishing the production, data are entered into the database. In the table of output stock is the information about the product`s position in the real output stock with the date of processing. In the table containing information about the order is the status changed on „Processed“ and order is ready for an expedition.

V. Conclusion

The main aim of this paper is design and implementation of IS for automated production line. We had to select the suitable development environment, what was the important aspect from the point of view of IS implementation. After the selection of software components and linkage of database with an application, we create individual modules with particular functionalities. We also designed graphical users` interfaces with auxiliary screens for every module. Number of listed functionalities of particular modules is not limited. In following versions of IS FAC we plan to enlarge a set of functionalities or alternatively to add new modules. There is also a possibility of interconnection of two and more informational systems of production lines into the one integrated IS.

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