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Learning scenarios in SAP for wind turbines manufacturing

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Abstract

The paper presents a conceptual model of learning scenarios in SAP, so that it is easily assimilated by students who still do not have direct contact with activities in the economic environment. The case study is configured for different planning situations acquisitions, necessary for obtaining the raw materials for wind turbines, more specifically for obtaining the generator, which is a standard equipment. The different scenarios presented in the conceptual model are designed, that it's not as easy to increase the nacelle, respectively the generator manufacturing capacity as it is with other components. Based on this model, the students can learn to work both with concrete transactions of "Purchase orders" for certain and isolate orders and as well with transactions of a "Scheduling agreement" for firm orders that last long periods of time. This model demonstrates that the challenge of any new processes of generator manufacturing can be defined in SAP (Systems, Applications, and Products), as one of the main providers of the ERP (Enterprise Resource Planning) software package.

Keywords: generator, supply, manufacturing, material, requirement, planning.

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1. Introduction

The development of educational wind energy projects, characterized by a very low cost and as a clean source of energy, has created new major business opportunities within manufacture and materials innovation. The appearance of wind energy projects have a significant potential which contributes to a sustainable development in green energy and aims to improve and implement new technologies which streamline the implementing process of RE projects (Zamfir, 2011). The wide increase and diversification in the field of wind energy farms has become a vital subject, consequently, the projects developed in education aims to develop and implement new methods, algorithms and philosophies, respective systems based on IT infrastructure.

SAP (Systems, Applications, and Products) solution covers all the business processes to obtain strategic advantages, through the additional functionalities from SAP ERP (Enterprise Resource Planning). SAP has revolutionized the business world. The efficiency has been multiplied in time, because of the further innovations that were being made solutions. The development of the Internet has determined a new revolution in the world of ERP – today, the ERP systems are parameterized so that are able to use the internet. This makes the access of the user to the database of the company possible by a single mouse click, completely obviating the barrier imposed by the distance. SAP is a category of software applications for managing the activities of the companies. SAP can be compared to a box wherein there are introduced data (Inputs), which are analysed, stored and processed in such a way that they can provide at the output the data, data requested by users (Outputs). An ERP application has as a main purpose to simulating business processes within a company. The concept of "process" defines the manner in which a company works, the set of operations, procedures and decisions that make the company work, all these being defined by a general term of "business processes". The main objective of the Department of Production is to produce in conditions of maximum efficiency the product range defined by the Department of Marketing. This simple definition hides a lot more processes, which are quite complicated in reality, such as production planning. The information that results from the production planning process is provided by the Supply Department.

SAP manages a company logistics processes, automatizing as far as possible the necessary steps. The production, the sales and the acquisitions represent the operational key processes. The production can be triggered by a sales order or it demands an independent planning and the necessary acquisitions are triggered by the resulting demand from product planning or by the selling of the products that are in stock.

The paper, further, shows the two scenarios created in the designed model, so that the students to be able to learn with concrete transactions of “Purchase orders” for certain and isolate orders and as well with transactions of a “Scheduling agreement”.

A wind turbine consists of three fundamental parts: the tower, the nacelle, and the rotor blades (Aubrey, 2007).

The tower is made up of a steel lattice, similar with the electric guns, or of a tubular steel which has an inside ladder to the nacelle that contains: 1. the gearbox that increase the low rotational speed of the rotor shaft in several stages to the high speed needed to drive the generator; 2. The brake system; 3. The generator that converts mechanical energy into electrical energy; 4. The yaw system, that rotates the nacelle to face the changing wind direction; 5. The power converter; 6. the transformer that converts the electricity from the turbine to higher voltage required by the grid; and 7. The pitch system that adjusts the angle of the blades to make best use of the prevailing wind.

The greatest challenge as regards manufacture, namely in the acquisition of raw materials for obtaining a wind turbine, is the continuous updating and optimization of the manufacturing orders and the optimization of the processes due to the changes of the requirements, based on the optimization of the acquisition process. This is the reason why for the usage situations necessary for wind farms projects, for which, in the SAP system can be configured based on contract agreements,

called “Scheduling agreements” (SA). The wholesome problem that is being put is that of configuring the system for projects of generators installed in remote areas with specific parameters functioning conditions, in which case the conceptual model system configuration acquisition of SAP must be based on a firm order purchase, called "Purchase orders "(PO).

The paper suggests a conceptual model of base data that are based on data included in the database, Called "Master Data", which is stored in the server. In this sense, each student creates in SAP, for each generator production process, his own module “Master Data”, which must to include the following: the record of the finite product, of the subassemblies which are going to be made, and of the raw materials for the manufacture of the rotor (of the hub and of the blades) (Hays, 2007). These data are used by the SAP system to establish the BOM (Bill of Material) (Weidner, 2006) that represents the ordinogramme of a finite product or subassemblies and contains all the raw materials, materials, or subassemblies which belong to its componence, as well as the adherent quantities. Further, based on the BOM is generated in the system the operational flow within the production process, to generate the system of the MRP (Material Requirements Planning) resources planning, to compute the production price, to update the price according to the contracts with the suppliers, to create materials stocks, to create and outline production orders, and to automatically display all the materials movements all along the product manufacturing cycle.

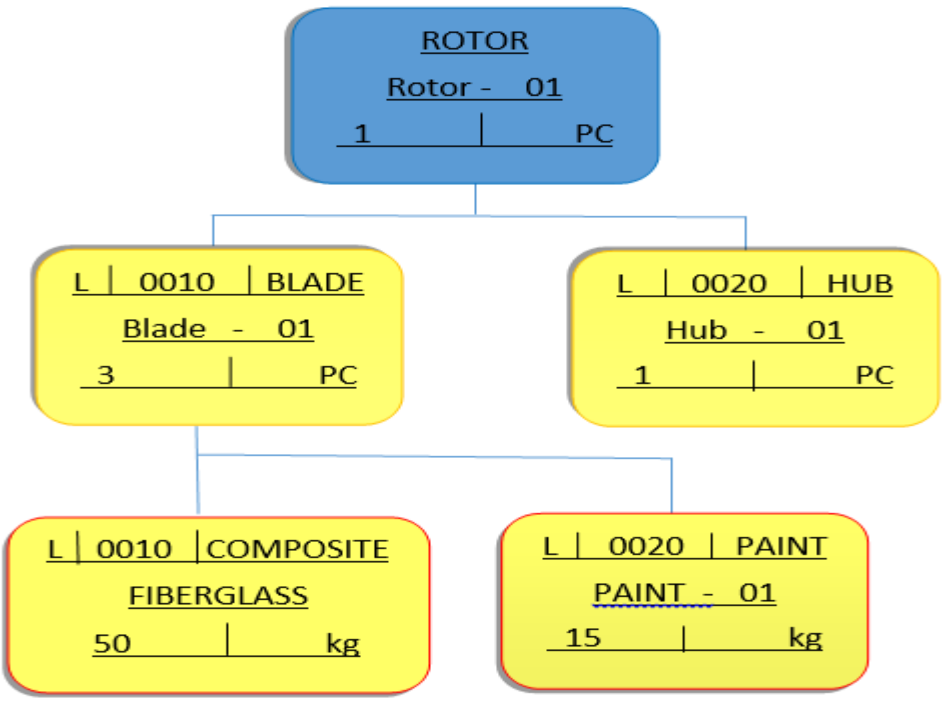

Figure 1. BOM for the manufacture ROTOR

1.1. Scenarios in SAP for wind turbines manufacturing

To illustrate the conceptual model that alternates the two acquisition situations offered by the SAP system as regards the acquisition process, the following stages of the system use will be run through, so that the production process may develop whatever the design requirements of the production orders:

a) The Master Data creation, the establishing of the finish product, subassemblies and row material parameters;

b) The BOM creation consistent with fiscal year;

c) The identification and registration of the suppliers for the purchased materials;

d) The creation of the Scheduling Agreements (SA), if necessary;

e) The MRP running, the automatic computation of the required supply according to customer requirements;

f) The orders sending to the suppliers;

g) The materials taking over.

2.1 In the case of using Scheduling Agreements

The situation of the purchase process through SA is valid when studying the situation of project management for the development of wind farms is being studied. An SA is a contract in electronic media which contains all the details negotiated between the buyer and the seller referring to a certain product. The main elements of an SA are as follows: the product code (Part number); the product name (a short text); the total quantity (Qty.) which the buyer binds himself to buy from the supplier; the price (Net price); the payment terms; the delivery condition (Incoterms); the validity period (Validity start/Validity end). In this case it is considered that it is achieved subassemblies and raw materials orders with monthly quantities estimated fairly accurately. In this case the conceptual model is one from Figure 2, having the following order: the process is triggered by activating the customer's command, by transaction VA01. The tripping sales order is checked for the available quantities of raw materials and parts that are needed in the manufacturing process, according to sales order quantity required. Verifying is carried on with the transaction MD04 for the finished product ROTOR. After that it is performed the same checking for the parts and raw materials. Before activating the sales order, SAP has been created a Scheduling Agreement (SA), to be able to send orders to the supplier.

Further there will be activated the automatic conducting of Material Requirements Planning (MRP) by the transaction MD02, where is stating that purchases are based on alternative SA.

By the automatic running of MRP, the system detects that, the acquisitions have already been conducted on the basis SA and according to BOM (figure 2). Once the MRP running is complete, will be displayed by automatic scroll: 5 materials were planned (1 finite product, 2 subassemblies and 2 raw materials), the result is the creation of 4 secondary requirements (2 subassemblies and 2 raw materials) and 2 planned orders (manufacture of BLADE from 2 raw materials and finished product assembly as ROTOR).

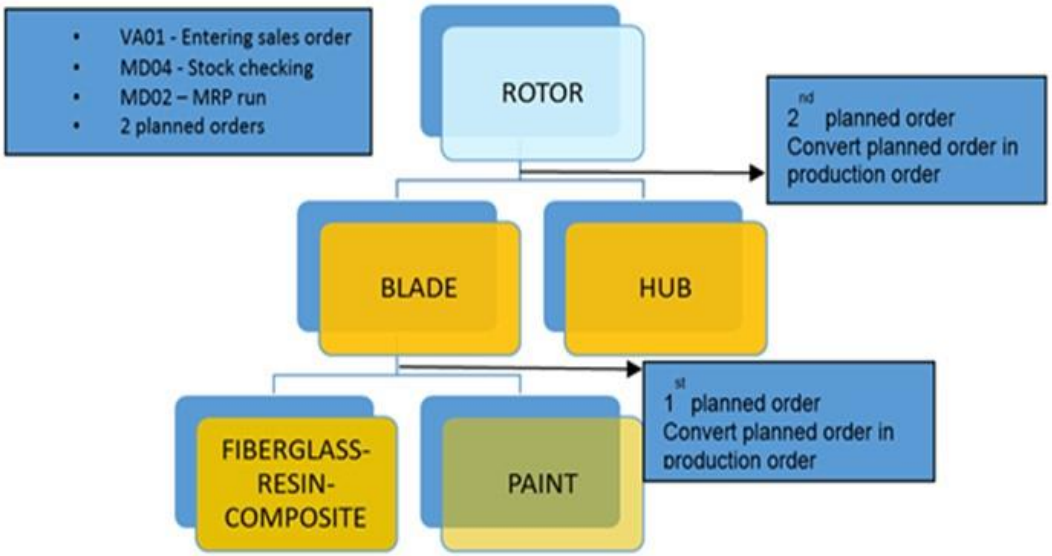

Figure 2 When using Scheduling Agreements

Further, according to the BOM, the system checks first planned order, more specifically, subassembly's manufacture "BLADE" using transaction MD04. In this transaction will be achieved double clicking on the newly generated planned order. A secondary menu will be displayed, in which the students will be able to convert the first planned order into a firm order of production. This conversion is the equivalent of the transaction CO01, which creates a firm order of production, rechecking the availability of raw materials arriving through SA. The order will be released and saved.

The order confirmation is the next step by using of the transaction CO15 production. At this moment the first planned order is considered finalized and passed to the second planned order. According to BOM check, the second planned order is the ROTOR assembly, using the transaction MD04 and the process starts again in the same way as the first planned order.

2.2 When using the alternative "Purchase order"

The situation of the acquisition process through the "Purchase order" (PO) is valid when is being studied the situation of manufacturing orders of the isolated cases of the rotors. In this case the pattern is the conceptual model showed in figure 3, with some additional elements related to the logic of the process as follows: similar to the previous situation is triggered by the activation process the customer's order (VA01). The available quantities of parts and material to the transaction MD04 are being made. Next it will be activated the MRP automatic running with the help of the transaction MD02, stating that purchases are made based on Purchase requisitions. Following the unfolding completion of the MRP system automatically displays: 5 materials were planned (1 finite product, 2 subassemblies and 2 raw materials), resulting in the creation of 4 secondary requirements (2 subassemblies and 2 raw materials) and 3 planned orders (BLADE subassembly manufacturing based on the two raw materials, manufacturing HUB subassembly and assembly ROTOR as a finished product), 2 purchase requisition.

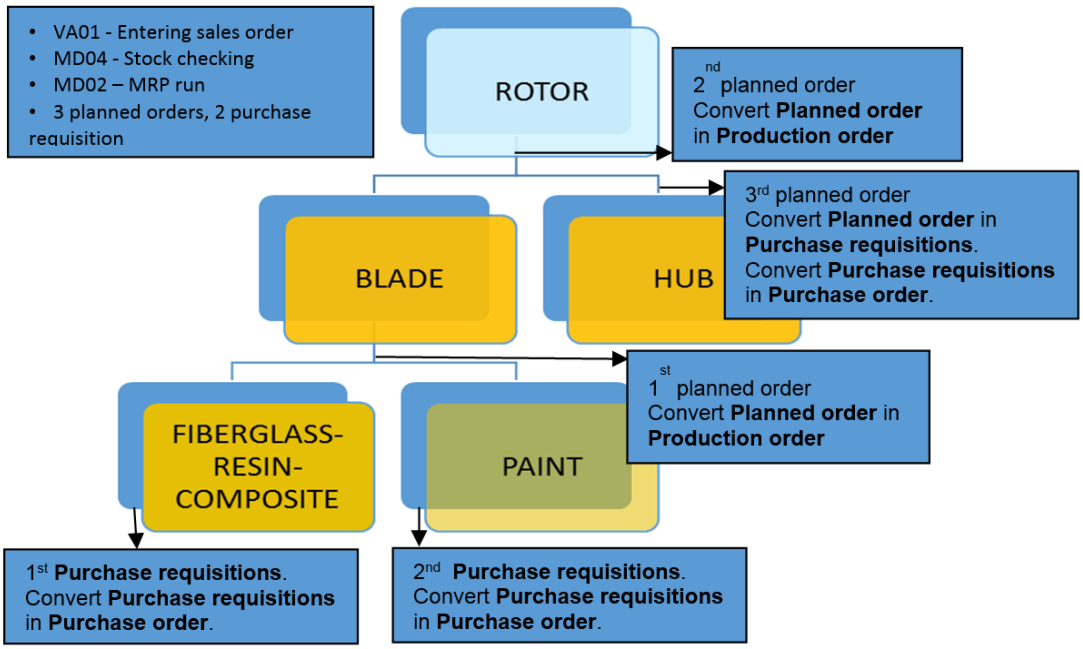

Figure 3 When using the alternative "Purchase order"

Basically, the system senses that there is not in stock the quantity required for subassembly HUB and taking into consideration that it is located on the second level of the BOM, the corresponding level of subassemblies. By running the automatic MRP, the system announces the third order planned, meaning that the element HUB is about to be manufactured. HUB element is placed on level subassemblies, but it does not manufactured and it is bought from suppliers.

This is the reason why, in addition to the conceptual model shown in Figure 2, this case requires a double conversion, the first, from planned order in the purchase requisition and next purchase requisition is converted in purchase order (PO).

Also, as illustrated in Figure 3, the 2 Purchase Requisitions have been identified for acquisition of the two raw materials: FIBERGLASS-RESIN-COMPOSITE and PAINT. The conversions and the production confirmations, respectively, for the production orders are achieved similarly with the explanations in paragraph 2.1, but correspond to Figure 3.

It is essential to note that, regardless of which alternative acquisition, SA or PO is selected, in order to receive the materials specified by the BOC, must use the transaction MIGO, but to simplify the presentation of two conceptual models, this transaction has not been detailed.

3. Conclusion

The two scenarios considered in the acquisition, based on the use of SAP, are shown in a didactic manner to facilitate the penetration and understanding of this complex information system by the students that are studying in the Universities of Management.

Through the conceptual models configured in Figure 2 and Figure 3, transactions can be understood in a natural order of the stages of production and in addition to that, it may create a much wider view

on the way in which SAP automates the information system of an enterprise in real time. The two ways of acquisition demonstrate the flexibility of use and adaptation of the system based on the real situations of the production process.

In the case of the first type of acquisition, the one based on SA, for each ordered material, there is created in SAP a frame contract, called Scheduling agreement where there are specified all the conditions that have been negotiated with the supplier – price, payment term, delivery condition, special conditions (discounts according to quantity), etc.

In the case of the second type of acquisition, based on the PO, for each material required in the production process and appearing to lack of stock must be created for each one firm order. Within each firm order, the user must enter the quantity of material, taking into account the database offer prices for different quantities agreed by the supplier.

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