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PLANNING AND REALIZATION OF PRODUCTION PROCESS IN A SELECTED TEXTILE ENTERPRISE

Abstract

This article contains a brief characteristic of a selected textile company. It also presents the description of realization of selected processes directly connected with a production process, starting with foreseeing the rate of sale throughout supply and production planning, and closing with the realization and settlement of the production process in relation to turnover stock. The role of integrated computer systems in the realization of successive stages of the production process is also concerned.

1. THE CHARACTERISTIC OF THE COMPANY

The article is based on the author's cooperation with one of the companies settled in Bielsko-Biała area. The company produces and sales textile goods. The products may be divided into two basic groups:

- a) floor coverings – runners and mats, bathroom mats, step mats, etc. – produced mainly in an MTS relation (make to stock),
- b) special fabrics – non-woven fabrics for shoes, upholstery, motor industry, geo-textiles with grass seeds for protection of slopes and embankments, first aid blankets, protective transport blankets, etc. – made directly to consumers' orders (MTO – make to order).

The company has implemented the integrated computer system Rekord.ERP written by the Rekord Computer System Company in Bielsko-Biała. It has been implemented in the following departments: production, logistics, trade, finance, human resources, accounting and also it has been introduced to management informative systems. The package of Rekord.ERP is a module system that consists of number of basic and additional modules, owing to its open structure, it can be completed and improved by new additional functions and modules that satisfy the needs of a specific company.

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2. SUPPLY AND PRODUCTION PLANNING

2.1. Introduction

The production planning process in a selected model company refers to goods produced in an MTS (make to stock) relation, which means a range of floor coverings, and it is realised in the following stages (Fig. 1):

- preparing quarterly sales forecasts,
- making monthly sales forecasts,
- making monthly production plans,
- starting orders (production orders).

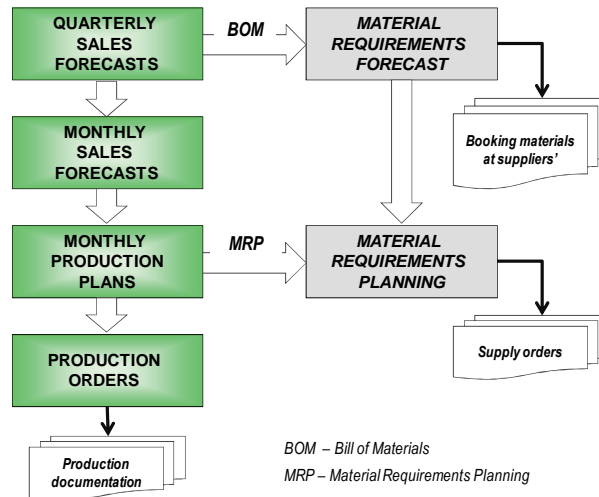


Fig. 1. The model of production and material requirement planning in a company

The successive stages of production planning and forecast directly influence material requirements foreseeing and planning. This process is of a special importance to major materials that have to be initially booked and ordered in the exact amount D_m (formula 1) at the suppliers' two months ahead in a quarterly arrangement.

$$D_m = \sum_{w=1}^W F_w \cdot n_{mw} \quad (1)$$

where:

D_m – quarterly demand for the material m ,

F_w – quarterly sales forecast for product w ,

n_{mw} – consumption standard of material m in a product w , (norm of material usage)

W – the quantity of products.

The current orders for booked materials are sent accordingly to monthly production plans in monthly or two weeks' batches. The quantity of individual materials Z_m is established on the basis of an MRP (Material Requirements Planning) procedure (formula 2).

$$Z_{m_i} = \sum_{z=1}^Z R_{mz} - \sum_{x=1}^X S_{mx} - \sum_{y=1}^Y P_{my} \quad (2)$$

where:

Z_{m_i} – the quantity of i-order for material m ,

R_{mz} – the quantity of material m indispensable for a production order realization z (planned material expenditure in an analysed period of time),

Z – the total number of production orders completed in an analysed period of time,

S_{mx} – the actual quantity of material m in stock x ,

X – the total number of storehouses,

P_{my} – the amount of material m booked in an order y (planned material m receipts in an analysed period of time),

Y – the total number of all supply orders in an analysed period of time.

Moreover, the above is true on condition that the total quantity of material booked for a quarter of the year is bought (formula 3).

$$D_{m1} = \sum_{i=1}^I Z_{m_i} \quad (3)$$

where:

D_{m1} – quarterly demand for material m ,

Z_{m_i} – the quantity of i-order for material m ,

I – the total number of all supply orders completed in a given quarter of the year.

Poz	Indeks	Nazwa Indeksu	Ilość w planie	Jm. mag.	Termin wykon.
2	WZ 0801-0801-08	Chłopek WZ 0801-01-08 70 cm	150 MB		2007-01-05
5	WZ 0801-0801-08	Chłopek WZ 0801-08-08 70 cm	150 MB		2007-01-05
7	WZ 0801-0801-08	Chłopek WZ 0801-08-08 70 cm	150 MB		2007-01-12
28	WZ 0801-0801-08	Chłopek WZ 0801-01-08 70 cm	500 MB		2007-01-12
29	WZ 0801-0801-11	Chłopek WZ 0801-02-08 80 cm	400 MB		2007-01-12
42	WZ 0801-0801-08	Chłopek WZ 0801-08-08 70 cm	200 MB		2007-01-19
45	WZ 0801-0801-15	Chłopek WZ 0801-02-08 100 cm	2000 MB		2007-01-19
46	WZ 0801-0801-15	Chłopek WZ 0801-02-08 100 cm	1400 MB		2007-01-19
48	WZ 0801-0801-15	Chłopek WZ 0801-02-08 100 cm	1500 MB		2007-01-19
54	WZ 0801-0801-15	Chłopek WZ 0801-02-08 70 cm	700 MB		2007-01-19
55	WZ 0801-0801-11	Chłopek WZ 0801-02-08 80 cm	1000 MB		2007-01-31
56	WZ 0801-0801-11	Chłopek WZ 0801-02-08 80 cm	400 MB		2007-01-31
59	WZ 0801-1101-08	Chłopek WZ 0801-01-08 70 cm	600 MB		2007-01-31
60	WZ 0801-1101-11	Chłopek WZ 0801-01-08 80 cm	300 MB		2007-01-31
68	WZ 0801-0801-15	Chłopek WZ 0801-02-08 100 cm	3000 MB		2007-01-31

Fig. 2. The file of sales forecast and production plans in the Planning module

The planning process is supported by the Planning module used in a computer systems company (Fig. 2). Sales and production planning departments are involved in the realization of the planning process.

2.2. Quarterly sales forecasts

The need of constructing quarterly sales forecasts, above all, results from the access to main raw materials indispensable for producing goods. It is necessary to send a preliminary order for raw materials that are needed (to book them at the suppliers') for next quarters of the year. Hence, the foreseeing does not have to be constructed with a maximum accuracy for specific goods (products with fixed dimensions), but it can be done on general terms by referring to material square metres of specific patterns and designs.

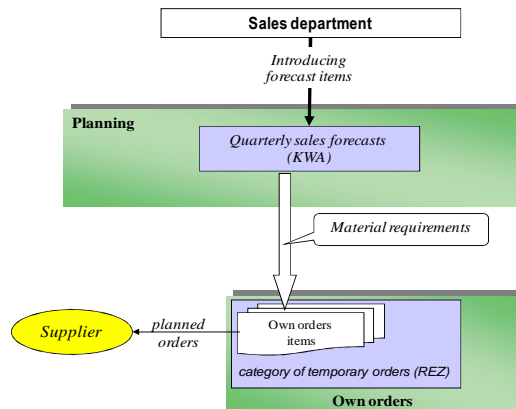


Fig. 3. Preliminary orders (reservation) for raw materials

Quarterly forecasts are prepared by the sales department staff, and they contain the division into individual months according to both sales analyses from the previous periods and registered long-term orders placed by consumers. These plans are created in terms of range (with no distinction between specific products – it means that the product widths are not considered) and given in square metres. The plan items are entered in the Planning module in the *Quarterly Forecasts Category (KWA)*.

On the basis of a developed structure of products that have become a part of plan items, material requirements are established and they form the base for a supplies department for a preliminary reservation of raw materials at the suppliers' (Fig. 3).

2.3. Monthly sales forecasts

Monthly sales forecasts, and similarly quarterly forecasts, are prepared by the sales department on the basis of sales analyses from the previous periods and registered external orders. These plans have to include the quantity of raw materials booked according to quarterly forecasts (Fig. 4).

Indeks surowca	Nazwa surowca	Norma: KWA-2005-10%	Norma: MIM-2005-10%	Norma: MIP-2005-10%
	brąz (3167)	9,992	5,551	0
	j.brąz (707)	257,183	259,945	173,274
	c.brąz (711)	9060,9	7736,216	7553,231
	bordo (307)	691,061	768,688	683,038
	złoty (204-205-707)	116,924	64,958	0,201
	niebieski (534)	287,112	720,296	348,271
	turkus (644)	887,353	848,578	1090,092
	rudy (204)	3006,13	2471,297	2445,631
	brąz (763)	505,04	659,429	541,673
	krem (210)	926,256	421,661	667,201

Fig. 4. Comparison of quarterly and monthly sales forecasts and production plans

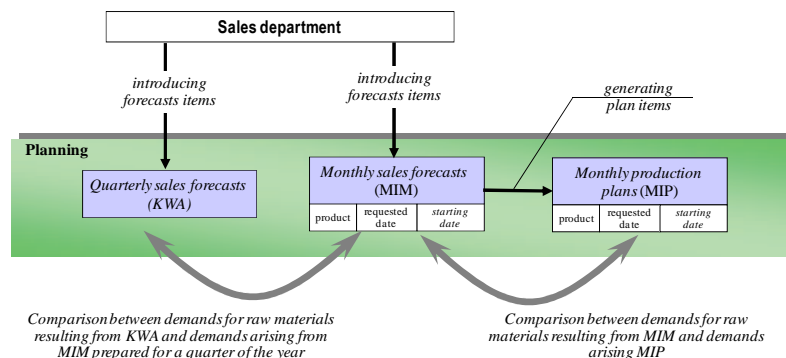


Fig. 5. The relation between separate groups of forecasts and plans

These forecasts are prepared with an accuracy for specific products (including dimensions), the realization date is established (the requested date) in a weekly table.

The plans are introduced in the Planning module in the Plans category *MIM – Monthly Sales Forecasts* that is specially designed for them. On the basis of approved forecasts, *Monthly Production Plans (MIP)* are generated by the system. Figure 5 illustrates the relations between individual groups of forecasts and plans. The approved items in sales forecasts are blocked to prevent any changes. Possible changes in sales forecasts (and thereby in a production plan) that are going to be made by the sales department, have to be agreed with the production department.

2.4. Monthly production plans

Monthly production plan (MIP) items are generated by the Planning module on the basis of:

- 1) the approval of monthly sales forecasts items,
- 2) confirmation of orders placed by consumers,
- 3) orders that are being completed at the moment,
- 4) the current level stock.

The approved items in *monthly production plans (MIP)* are the base for ordering materials (Fig. 6) by the supplies department and starting orders for ready-made goods by the production department (Fig. 7).

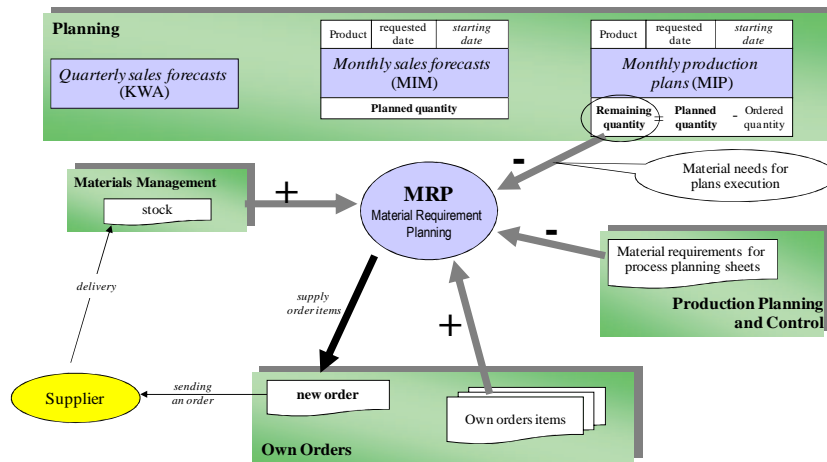


Fig. 6. Ordering materials

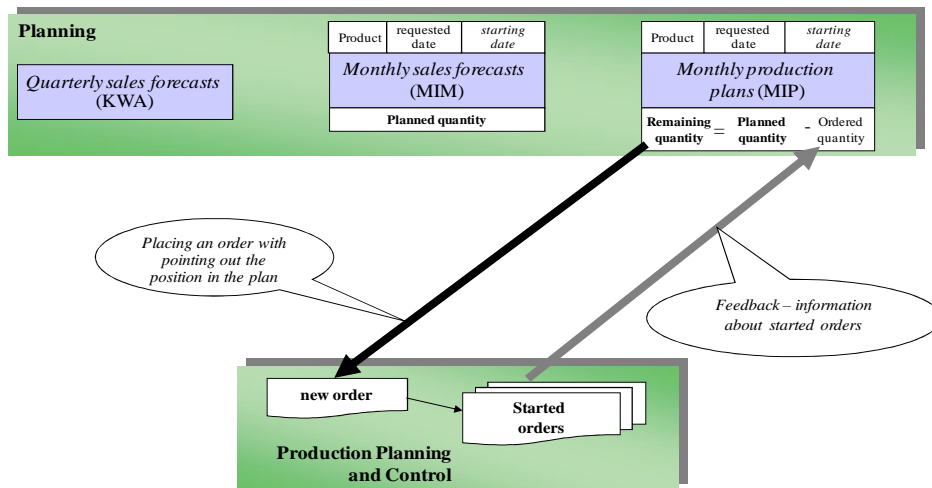


Fig. 7. Starting production orders

On account of the fact that the sales department can take short-term orders from consumers, it may be necessary to correct the production plan that is being carried out. Due to the fact that any changes in the plans influence directly the material requirements and the production plan

items accomplishment (approved previously), all corrections have to be agreed with the production department (fig. 8):

1. Introducing a new position in a *monthly production plan* with determining the required quantity and the realization date (requested date) – *marketing department*.
2. The analyses of possibilities of producing a new item – *production department*. Verification of the demand for raw materials on the level of raw material index (the preview of the quantity and the number of orders where it is required).

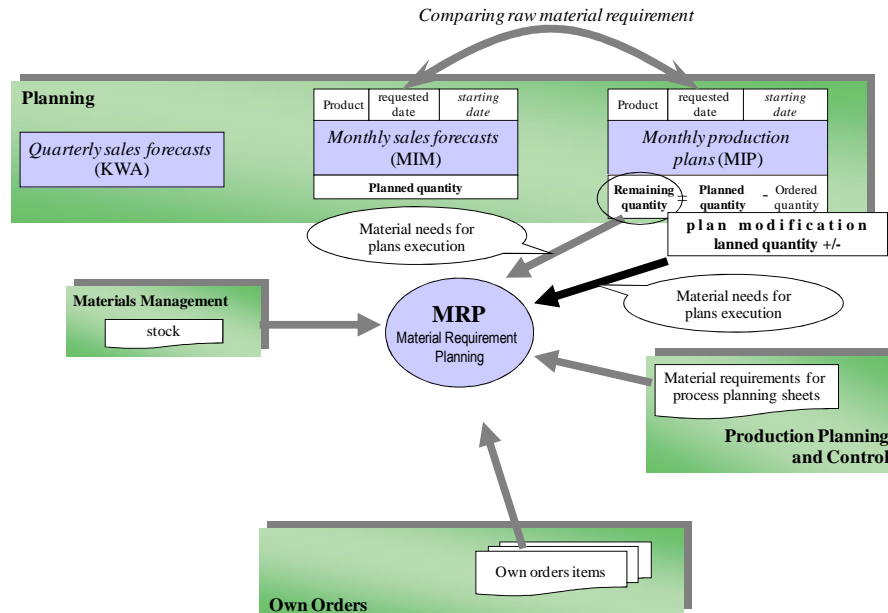


Fig. 8. The model of making changes in a monthly production plan

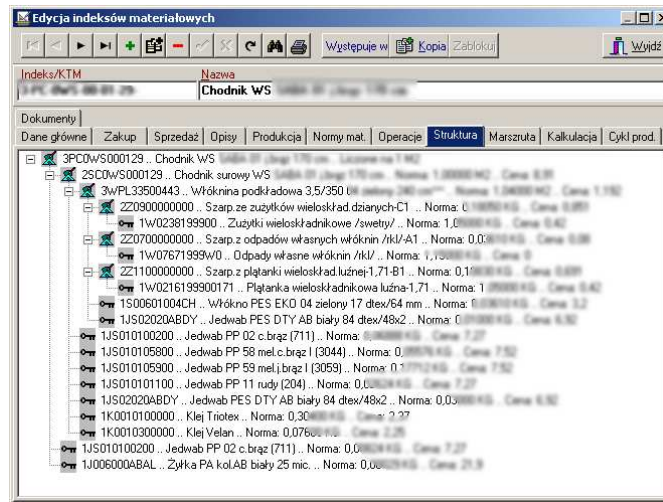
3. Introducing a possible date of order realization to a new position (a confirmed date) and also establishing a date when a new position in the plan should be confirmed by the marketing department – *production department*.
4. Confirmation of a new position in a *monthly production plan* or cancelling it (removing the position from the plan) – *marketing department*.

3. THE REALIZATION OF PRODUCTION PROCESS

3.1. The preparation of the production

Production orders are started on the basis of demands made by a supplies department. Material requirements and planned labour intensity for another stages of the production process realization result from the standard data introduced in the Technical Preparation of Manufacturing module of the computer system. The exemplary data are illustrated in Fig. 9.

a)



b)

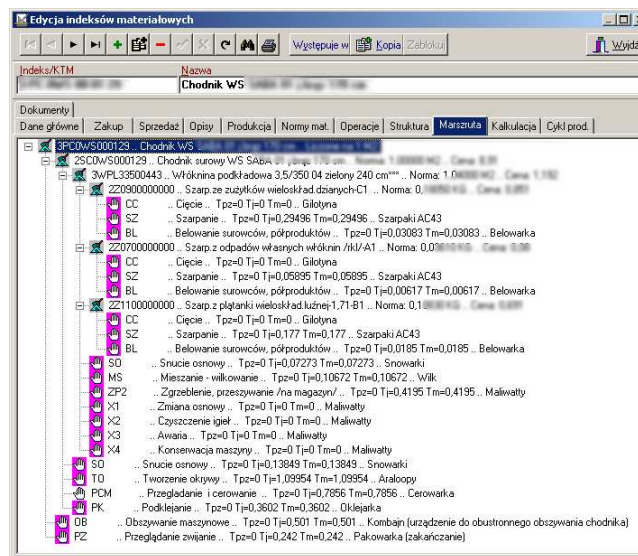


Fig. 9. The structure (a) and the route (b) of an exemplary product

The standard consumption of separate components is determined according to their percentage share in the product. Following the percentage share calculated by a technologist, the computer system calculates the range of a components consumption in a structural product unit or a half-finished product (Fig. 10).

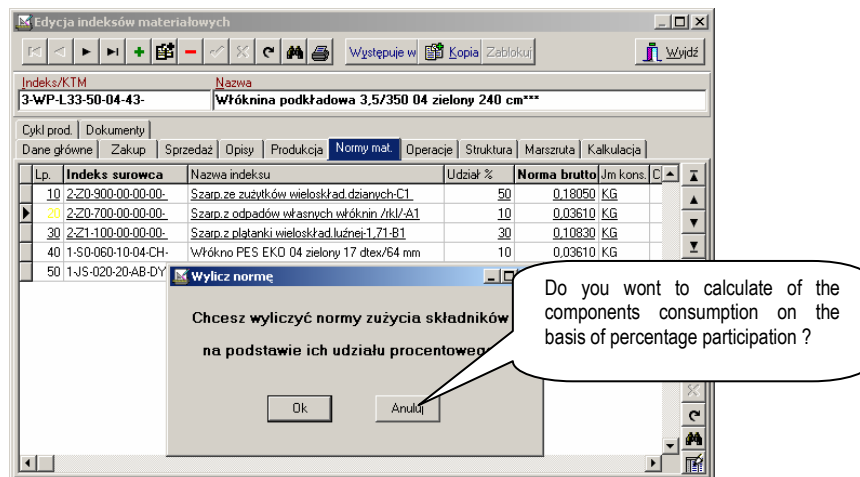


Fig. 10. The components edition of an exemplary half-finished product

A distinctive feature of the analysed company is the fact that the technical costs of production may be considerably influenced by the choice of the appropriate components. Relating to this fact, the designed technological variants differ mainly in the raw material composition (Fig. 11). These differences change the production cost even in the range of 50%. This results in the necessity of an accurate identification and the settlement of components.

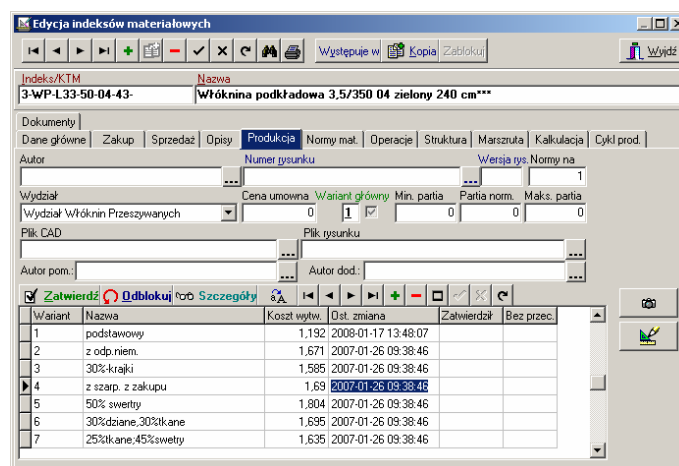


Fig. 11. Technological variants of an exemplary half-finished product

3.2. The organization of the production process

The production process of floor coverings is divided into four main stages (Fig. 12):

1. *Orders for rag cloth* – the orders include raw material cutting, tearing and balling the rag cloth.
2. *Orders for ground non-woven fabrics* – the orders include mixing-tearing, carding, and stitching (and also producing the warp).
3. *Orders for raw runners* – producing the cover with Aralooop, mechanical and/or manual darning and glueing (producing the warp is also included).
4. *Orders for finishing the products* (runners and mats) – hemming and sewing, combing and rolling up, and additionally, orders for mats include cutting and packing.

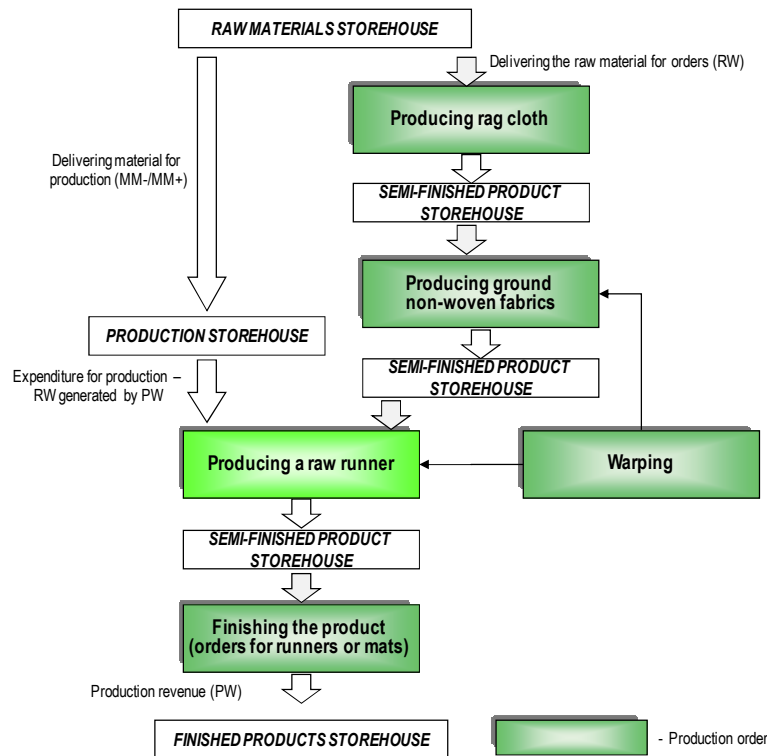


Fig. 12. Basic stages of the production of floor coverings

Figures 13 and 14 show the diagram of exemplary order realizations for half-finished products (ground non-woven fabrics and raw runners). These orders are started centrally in the Production Department that is responsible for supply, balancing the demand for materials and production, starting, controlling and coordination of the realization of production orders by separate production departments.

On the basis of started orders and generated process planning sheets prepared by the production departments, production documents are printed (orders and process planning sheets for an order realization). Figure 15 presents some illustrative documents. These documents (completed with pieces of information saved in the computer system) are the basis for delivering materials and half-finished products to departments, they also are the order for production realization and they enable the registration of completed tasks.

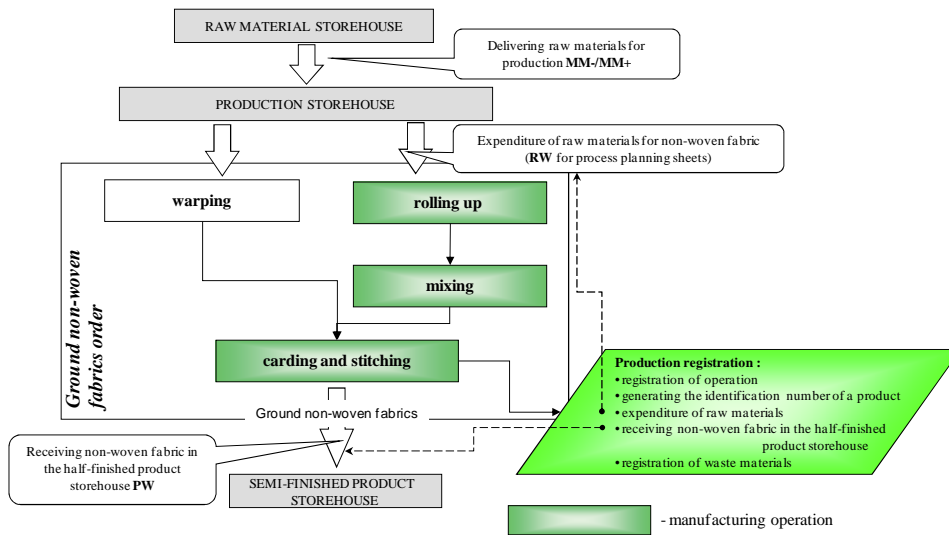


Fig. 13. The diagram of the order realization for ground non-woven fabrics

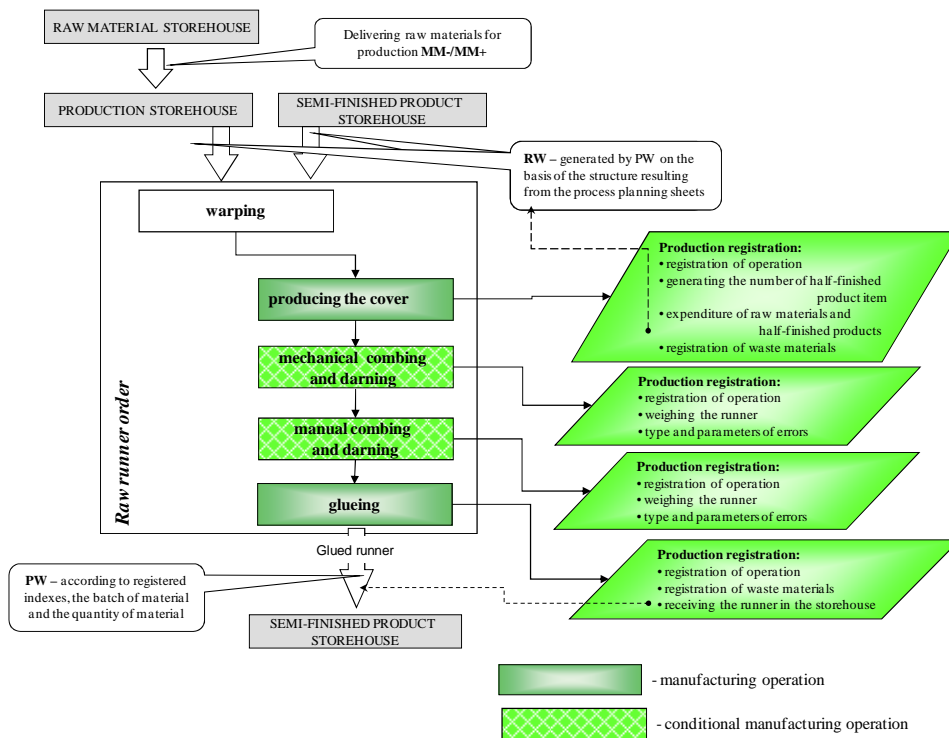




Fig. 14. The diagram of the order for raw runners realization

a)

BRECO Sp. z o.o.		Data wydania: 2008-01-24 Strona 1	
PRZEWODNIK PRODUKCYJNY NR: WY3/2007/0123/001/005		Wykonać do 2008-01-17 21:59:59	
3WPC72509935B		Włóknina pod koc przemysłowy 7/250 99 rkl 200 cm zar. 18 608,50 MB	
Sposób pakowania: 25 sztuk w beli 150x200 na każdej beli nalepka z rozmiarami i ilością kocy w beli			
			
*** SKŁADNIKI ***			
LP	MAG INDEKS	NAZWA	Udział % NA OPER. N. BRUTTO JM
50	02	1S00601004CH Włókno PES EKO 04 zielony 17 dtex/64 mm	15 1 339,81 KG
60	02	1JS02020ABDY Jedwab PES DTY AB biały 84 dtex/48x2	0,94 KG
70	MP1	2Z0920000000 Szarp.ze ścinek dzianych-C3	30 2 679,62 KG
80	MP1	2Z3000000000 Szarp.z odpadów krajk i włókniny igłowanej PP/PES z no	5 446,60 KG
90	02	2Z2300000000 Szarpanka wieloskładnikowa	10 893,21 KG
110	MP1	2Z0900000000 Szarp.ze zużytków wieloskład dzianych-C1	30 2 679,62 KG
120	MP1	2Z0700000000 Szarp.z odpadów własnych włóknin /rkl/-A1	10 893,21 KG
			100 8 933,02
*** OPERACJE ***			
LP	KOD STAN.	NAZWA OPERACJI	OBSADA
			
			1,5
30	MW	Zgrzeblenie, przesywanie /na zlecenie/	
Koniec			

b)

BRECO Sp. z o.o.		Data wydania: 2008-01-24	
Przewodnik/dyspozycja na ARALOOP'A		Wydz: ARA	
Przewodnik (dyspozycja) nr: AR3 2007 0064			
do wyrobu: 2SC0WS000119 3383		Ilość: 1 500,00 MB	

Operacja: 20 Tworzenie okrywy		Stanowisko: Araloopy	
2SC0WS000119		Chodnik surowy WS SABA 01 j.brąz 120 cm	

Operacja: 20 Tworzenie okrywy		Stanowisko: Araloopy	
2SC0WS060419		Chodnik surowy WS ROMA 04 zielony 120 cm	

Fig. 15. Exemplary production documents
a) ground non-woven fabric, b) raw runner

3.4. Production registration (the production operation and stock turnover)

In connection to needs related to the necessity of the exact identification, material and half-finished products settlements that were delivered for individual orders, and also owing to the fact that the used computer system is open, among other things, it was possible to design and create a specialised additional production registration module (Fig. 16). The production is registered by the employees directly involved in the production process and it is done on the basis of process planning sheet with the use of registration stands that have been prepared for this purpose (Fig. 17).

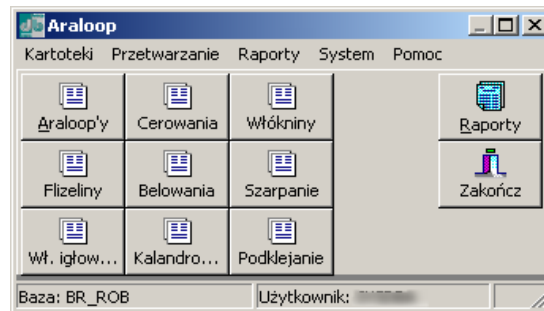


Fig. 16. The main window of production registration module



Fig. 17. The production registration place

After producing every single piece of a product (half-finished products, finished products), the worker records all essential pieces of information related to the realization of the operation (Fig. 18). On the basis of recorded data by the employee and read off from the scales (integrated with the registration stand), the computer system:

- logging the realization of technical operation;

- generates the identification number of manufactured half-finished products/finished products (the number of the item);
- generates (with specific operations) expenditure documents for materials and half-finished products on the basis of the half-finished product number given by the worker and the data on the components written in the process planning sheets – the quantity of delivered materials is established according to the weight of a registered product and the percentage of its components;
- generates (with specific operations) a revenue document for products (half-finished products, ready products) – the quantity results from the amount recorded at the registration, and the number of batch is compatible with the number of an item generated by the system.

a)

b)

Kat	Lp zlec	Nr sztuki	Indeks	Nazwa indeksu
AR3	001	3076461	2SCOWS000119	Chodnik surowy WS SABA 01 j.brąz 120 cm
AR3	002	3076462	2SCOWS060419	Chodnik surowy WS ROMA 04 zielony 120 cm

Fig. 18. Production registration laps
a) non-woven fabrics, b) raw runners

According to the introduced pieces of information, the product label is printed (Fig. 19). This enables to identify the product and facilitates running the stock turnover (including the product sales).



Fig. 19. Exemplary labels of products and half-finished products

4. STOCK TURNOVER

Figure 20 is the illustration of the stock turnover layout. In order to hold store men responsible for entrusted raw materials and half-finished products, and at the same time to make it possible to prepare a precise material settlement for orders without any unnecessary organizational difficulties, the components expenditure is carried out in two stages:

- reallocation of raw materials for production (production and department storehouses);
- an automatic expenditure according to manufactured / registered products (half-finished products, finished products) and the consumption norms written down in the process planning sheets.

The reallocation of products to the sales storehouse MM-/MM+ and preparing the external delivery documents (WZ) is realized with data collectors (Fig. 21a) and product item numbers that precisely identify the sort and product quantity (Fig. 21b). The product item numbers, when the products are transported to the sales storehouse or while being loaded, are read in from the labels to the data collectors memory. After linking the device with the computer, a text file with the list of numbers is exported and according to it, the turnover document items are formed.

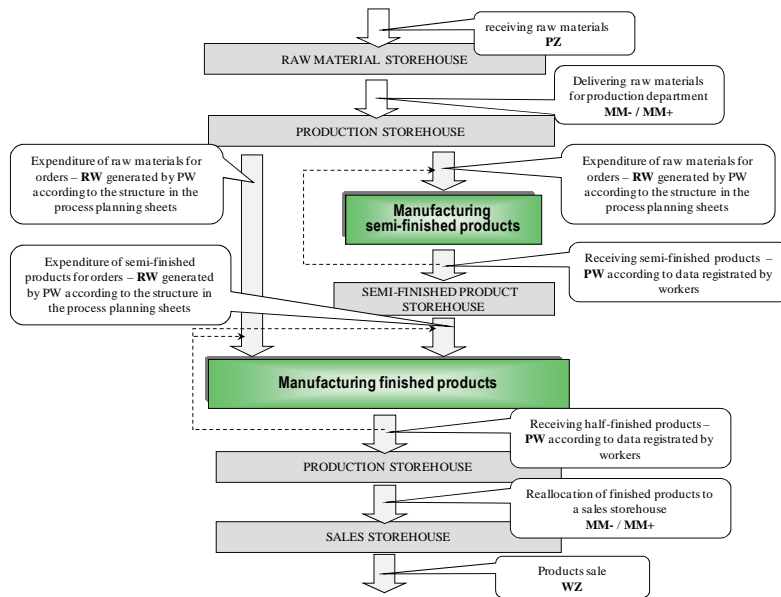


Fig. 20. The simplified diagram of stock turnover in a company

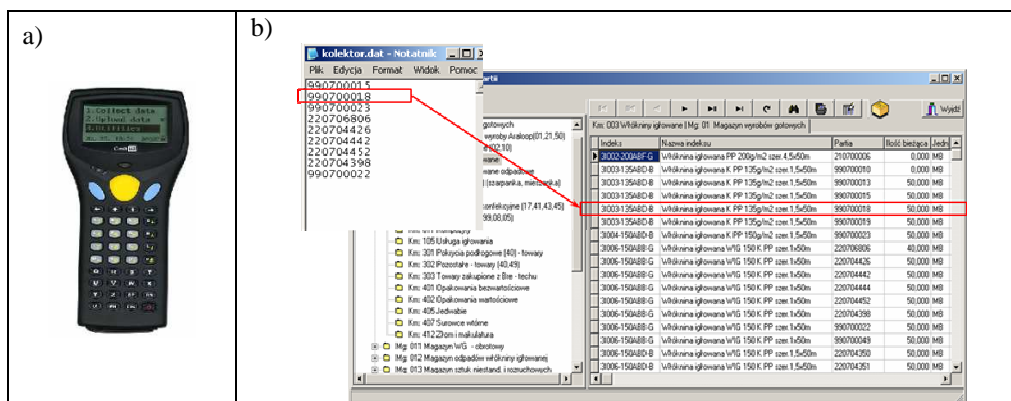


Fig. 21. The use of data collectors in forming stock turnover documents
a) the example of a data collector, b) product identification in stock

5. THE INTEGRATION OF THE COMPUTER SYSTEM WITH THE PRODUCTION LINE

The companies that use or introduce computer systems that support the enterprise management, more often aspire to the integration (linking) of the computer systems with the machines they owe (numerically controlled machines or an automatic line). The planned linking of a

stitched non-woven fabrics production line in a company that uses the Production Planning and Control module of an integrated computer system, can be the example of such an integration.

a)



b)



Fig. 22. The components of stitched non-woven fabric production line
a) final needlepunching unit, b) control desk

The line is composed of a number of units (Fig.22) that are responsible for next stages of the production of stitched non-woven fabric. The basic components of the line are:

- dosage-feeding system,
- accurate expander with a shaft,
- mixing chamber,
- system of carding machines with a piling machine,
- preliminary and final needlepunching machine,
- winding reel.

The integration process will permit:

- adjusting automatically technical parameters of separate line elements according to records in a computer system connected with separate products,
- registering corrections of technological parameters introduced during the production process,
- recording time parameters (related to the line operation) – stoppages, starting orders, the time of finishing product items, etc.,
- creating even accounts of the production order realization.

6. SUMMARY

Introducing the integrated computer system and creating the right supply procedures, to large extent, have organized and facilitated the supply process, especially in the area of critical materials that have to be booked at the suppliers' two months ahead in a quarterly cycle and also have to be bought in full. The system allows for the current control and verification of the ordered materials usage.

Parallel designing and introducing individual dedicated modules of the production registration that besides the registration of finished operations of production processes, enable to generate turnover documents according to real parameters of a product, and also allow to prepare the detailed settlement of material costs and control systematically the order realization and the material consumption. Particular effects have been observed in the area of the settlement of cooperation.

The next stage of improving the computer system in a company that involves the integration of the production line with the management supporting system will allow to keep the detailed process parameters tied to the specific product, to automate programming of the production line, and to analyse the production process more precisely. And owing to the process parameters registration, it will be possible to analyse the parameters influence on the product description.

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