

IMPLEMENTATION OF AN INTEGRATED MANAGEMENT INFORMATION SYSTEM TO A SAMPLE MACHINE INDUSTRY ENTERPRISE

1. A model of integrated management information system implementation into management structures of an enterprise

Figure 1 presents basic phases of implementing an integrated management information system into structures of enterprise management. The figure takes into consideration detailed stages of realizing pre-implementation operations and elements supporting their realization.

Pre-implementation operations

This stage includes analysis of strategic assumptions of the project related to implementing an integrated information system and the analysis of previous way of realization of the processes taking place in an organization. On this basis the concept of information systems functioning is prepared in a given economic object, and the range of necessary programme changes (customisation), as well as the range of necessary organisational changes in an enterprise are determined. This phase also involves preparing the course of action related to conducting direct implementation works and implementing organizational changes.

This phase and its documentation are of special importance for effective pre-implementation operations and for controlling their progress.

In order to improve the effectiveness of this stage's tasks realization, the following have been prepared: integrated information system model, a production process model, a set of factors influencing the realization of the production process, an initial schedule of integrated information system implementation and a set of possible algorithms of production process realization.

System's implementation

The next stage is to implement a prepared concept, according to conditions and the course of action included in pre-implementation documentation. Basic activities realized in this phase are:

- initial trainings for project participants and key users,
- system parameterisation and programming works related to adapting the system to enterprise needs,
- training the end users,
- testing system's functioning,

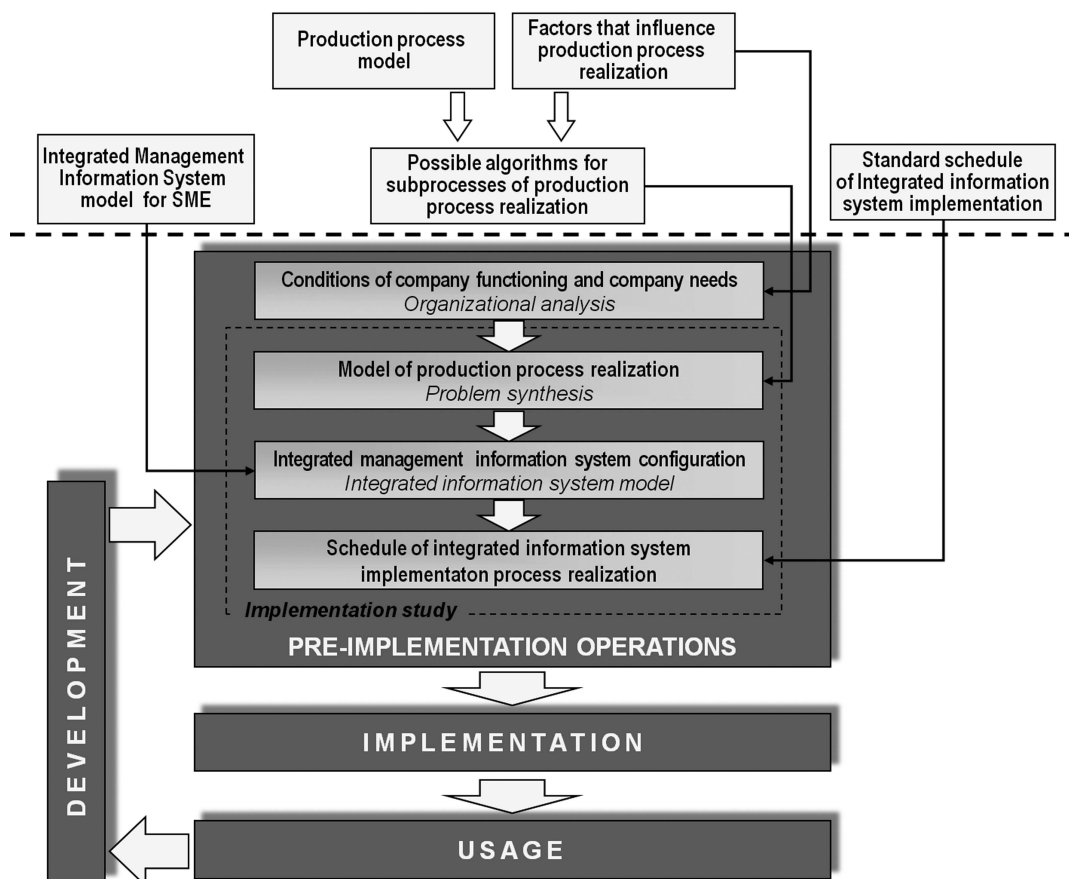


Fig. 1. Model of implementing an integrated information system into enterprise structures

- creating job instructions related to the way of working in the system on particular positions,
- current documentation of the course of implementation works,
- system's acceptance.

This stage finishes when all functions and processes determined within the previous stage (pre-implementation operations) are realized in the system.

Usage and development of the system

After implementation has been completed, the system starts to be used and exploited actively by its direct users. The first stage of operation is necessary to support system's users, who perform their tasks (often in a changed range) by means of a new tool.

The subsequent stage is „breaking-in” or „polishing” the system, when workers learn the advantages as well as drawbacks of the introduced solutions (both technical and organisational), and also find possible mistakes in system's functioning. It is important here to separate real mistakes from conclusions which facilitate work of system's operators. The former must be definitely removed, whereas the latter should be analysed from the point of view of validity and profitability of their introduction (comparing the obtained benefits with costs of their introduction).

After complete assimilation of new solutions in an organisation, it is time to evaluate in what extent the implemented solutions meet the assumed goals and in what way the available tools may be used to improve the realised processes. This phase is an element of continuous improvement of processes realised in an organisation and may be a factor which initiates realization of the next project related to integrated information system.

2. Organisational analysis of an enterprise

Main activity of the enterprise is producing packaging devices for food items. About 10% of products are ready-made constructions, but the majority are products modified by the constructors. Apart from the basic activity, the company manufactures spare parts and renders services.

The produced constructions are highly complex (5-6 level structures, with about 450 components on the last level – of purchased parts). They are characterised by modular structure – a constructional frame works as a base, on which different specialist assemblies are installed (power units, feeders, dispensers, welding units, etc.). Basic materials used for production are sheet metal and steel profiles, as well as electro-mechanical units and pneumatic actuators.

Products are manufactured directly on order; the production cycle of packing machines amounts for two to six months.

A detailed analysis of the factors influencing the way the production process is realised is presented in table 1 below. The integrated information system in the analysed area shall be used by:

- *Project Management Office* (5÷6 people) and *Technological Department* (10÷12 people) – creating indexes for products and half-products, preparing constructional documentation and manufacturing documentation;

- *Marketing and Sales Department* (4÷6 people) – preparing offers, registering and realising orders, invoicing;
- *Accounting Department* (2÷3 people) – calculating product prime costs, settling price lists, cost analysis of orders realization;
- *Production Preparation Department* (4÷5 people) – realising manufacturing orders;
- *Machining Department* and *Assembly Department* – registering performer operations of the manufacturing process;
- *Quality Control* (3 people) – registering incompatibility which appeared during production process realization and delivery control;
- *Supply Department* (6÷8 people) – creating indexes for materials, realising supply and cooperation orders;
- *Finished Products Warehouse* (1 person), *Half-products Warehouse* (1 person), *Materials Warehouse* (1 person) – handling reserves and warehouse turnover on particular stages of the production process.

3. A model of production process realization

3.1. A general model of the production process

A general model of production process realization in the analysed enterprise is presented in figure 2.

The production process of a new catalogue product is initiated by Marketing and Sales Department on the basis of market research or basing on orders for non-standard solution placed by a receiver. On the basis of the formulated requirements, constructional and manufacturing documentations are prepared and the order for manufacturing a new machine prototype is launched. After exploitation tests have been performed and required certificates obtained, the construction is offered as a standard solution.

In case of catalogue products, short time of order realization is of special importance, as the production process is divided into two stages:

- 1/ manufacturing components (elements and assemblies) which build different products – on the basis of sales,
- 2/ manufacturing specialist equipment and machine assembly – on the basis of given order from a receiver.

3.2. Preparing constructional and manufacturing documentation

Product manufacturing is realised on the basis of own constructional and manufacturing documentation, which is created in the Project Management Office. Product development is realised basing on:

- market research performed by Marketing and Sales Department, on the basis of which the so called Product Development Plans are created and orders for prototype production are launched,
- demand communicated by receivers (placed orders for non-standard solutions).

Products are highly complex (fig. 3). In order to shorten the production process and lower unit manufacturing costs, the so called 'basic machine' has been picked for each product group, whose structure includes repeatable modules in all products from a given group. Complete product structure includes the basic machine and modules (assemblies) as its equipment.

1	PRODUCT KIND	Catalogue – many versions
2	PRODUCT DESIGNATION	Made to order (MTO)
3	WAY OF SETTING PRODUCT PRICE	Calculation of the planned manufacturing cost
4	TIME OF ORDERS REALIZATION	Determined each time
5	PRODUCTS COMPLEXITY	High complexity, multi-level structure
6	PRODUCT CONFIGURATION	Configurable
7	ALTERNATIVE MANUFACTURING PROCESSES, MATERIALS SUBSTITUTES	There exist alternative processes and materials substitutes
8	DOCUMENTATION SOURCE	Own
9	LEVEL OF DETAIL OF CONSTRUCTIVE-TECHNOLOGICAL DOCUMENTATION	Detailed
10	TYPISATION OF PRODUCT COMPONENTS	The same elements and half-products compose different products
11	USING CONSTRUCTIONAL AND TECHNOLOGICAL ELEMENTS SIMILARITY	Creating documentation basing on similar sets and elements
12	PRODUCTION TYPE	Directly related to orders
13	PRODUCTION TYPE	Unit, and on the level of half-products small series production
14	RHYTHMICITY OF PRODUCTION	Non-rhythmic
15	PRODUCTION REPEATIBILITY	Repeatable
16	PRODUCTION PROCESS REALIZATION CYCLE	Long (2-4months)
17	WAY OF PRODUCTION FLOW ORGANISATION	Serial
18	SPATIAL ORGANIZATION OF THE MANUFACTURING PROCESS	One site + cooperation
19	COOPERATION	There are technological operations realised outside the enterprise
20	DOCUMENTATION ORGANISATION OF THE MANUFACTURING PROCESS	Materials and tasks are issued on the basis of job order documents
21	WAY OF SETTLING PRODUCTION	According to orders
22	PRODUCTION EMPLOYEES	High technical culture
23	FORM OF EMPLOYEE REMUNERATION	Time-based
24	MATERIALS RANGE	Differentiated
25	WAY OF ISSUING OF MATERIALS	Detailed control and record of the received materials
26	MATERIAL COSTS	High (about 50% all costs)
27	DELIVERY CYCLE	Relatively short (up to 2 weeks)
28	WAY OF SELLING	Retail
29	WAY OF INVOICING DELIVERIES	Invoice for each delivery
30	MEANS OF TRANSPORT	Does not limit delivery volume
31	SALES PROCESS ORGANISATION	Sales realised by one organisational unit
32	WAY OF INVOICING	Invoice on the basis of the goods issued note

Table 1. Factors influencing the realization of the production process

On the stage of determining materials for components, especially the parts constituting the basic machine, alternative materials are defined. For some parts, alternative manufacturing processes are also created. Choosing the material (configuration) and the manufacturing process variant takes place on the phase of order launch. Possible deviations from the project (exceeding the defined alternatives) are considered on the stage of manufacturing orders realization (in job order cards) after they have been agreed with a constructor and/or a process engineer.

Constructional and manufacturing documentations are created, as long as it is possible, basing on constructional and/or technological similarity of parts. After finding similar parts, assemblies, structure and/or processes are copied and modified. That is why, there is a need to design a proper classification and coding system of the elements made in

the enterprise, and to implement them in the modules supporting works on the stage of technical production preparation. The majority of manufacturing operations (machining, manual processing, welding, thermal processing) are realised inside the enterprise. For the operations that are performed outside (mainly galvanising), product structure and the manufacturing process consider components and operations which enable cooperation management.

In case of non-standard products, new solutions are designed only after the order has been placed and confirmed. The design process of new sub-assemblies is realised in line with the process of realising complementary orders (within which the ordered goods are produced). On the offering stage, Project Management Office estimates the costs of designing and producing a new sub-assembly basing on similar parts and sub-assemblies.

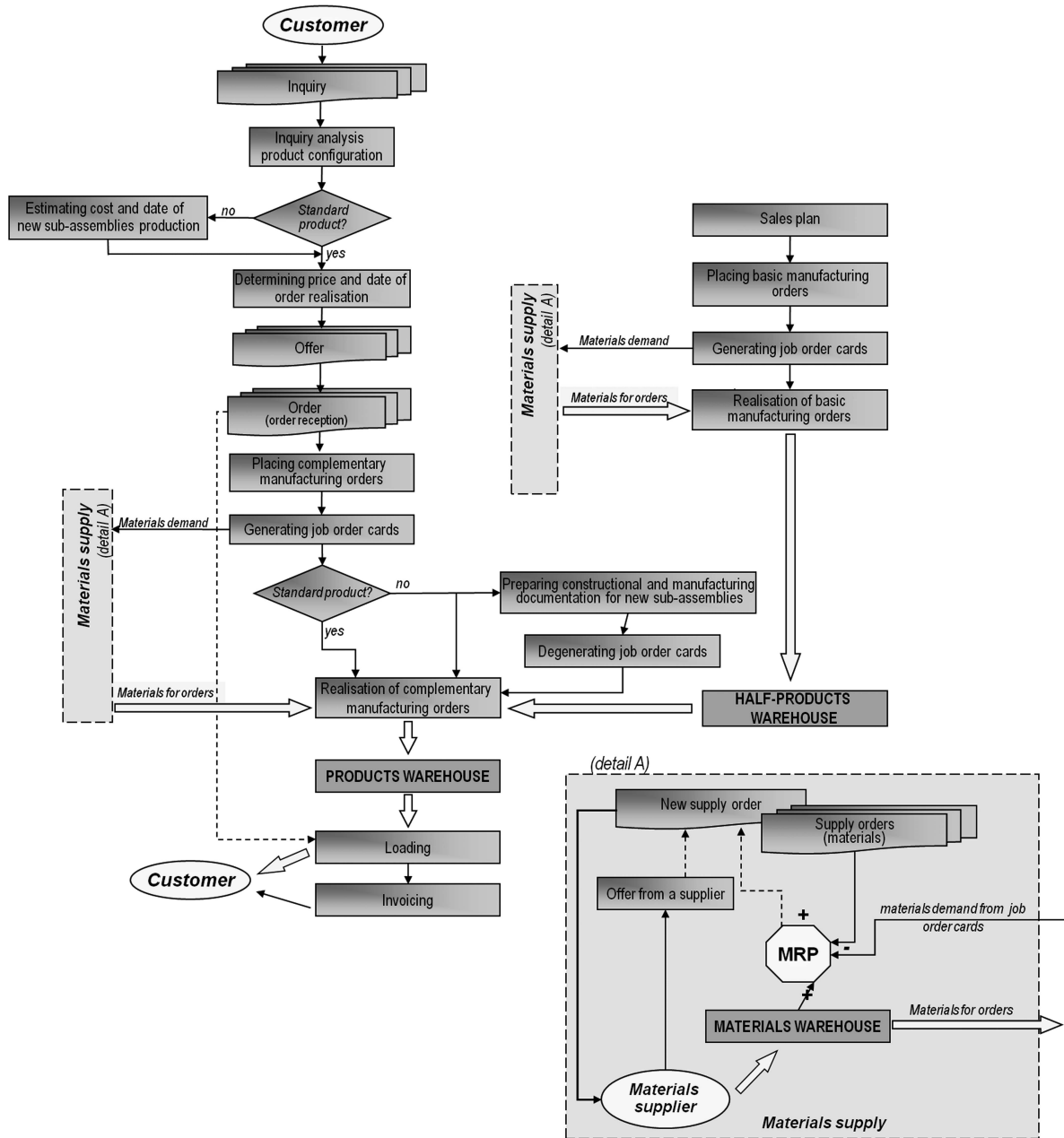


Fig. 2. General model of the production process realised in the enterprise

	Dane główne	Zakup	Sprzedaz	Produkcja	Normy mat.	Operacje	Struktura	Marszruta	Kalkulacja	Cykl prod.
	PN-74-M-82207			Przekład w 7a	Norma: 1,0000 SZT ..	Cena: 1585,96				
	PN-74-M-82207			Talozki głowne 7a	Norma: 1,0000 SZT ..	Cena: 277,27				
	PN-74-M-82207			Talozki zlozne	Norma: 1,0000 SZT ..	Cena: 150,72				
	PN-74-M-82207			PN-74-M-82207	Norma: 18,6280 KG ..	Cena: 0,00				
	PN-74-M-82207			Przekład w 7a	Norma: 8,0000 SZT ..	Cena: 52,02				
	PN-74-M-82207			Przekład w 7a	Norma: 1,8130 KG ..	Cena: PN Norma AISI 304 ..				
	PN-74-M-82207			Przekład w 7a	Norma: 1,0000 SZT ..	Cena: 114,91				
	PN-74-M-82207			Przekład w 7a	Norma: 4,9230 KG ..	Cena: PN Norma AISI 304 ..				
	PN-74-M-82207			Przekład w 7a	Norma: 12,0000 SZT ..	Cena: PN Norma PN-74/M-82207				
	PN-74-M-82207			Talozki głowne 7a	Norma: 1,0000 SZT ..	Cena: 466,85				
	PN-74-M-82207			Talozki głowne 7a	Norma: 1,0000 SZT ..	Cena: 391,49				
	PN-74-M-82207			Talozki głowne 7a	Norma: 15,2410 KG ..	Cena: 15,90				
	PN-74-M-82207			Talozki głowne 7a	Norma: 8,0000 SZT ..	Cena: 43,97				
	PN-74-M-82207			Przekład w 7a	Norma: 0,0450 M ..	Cena: 336,00				
	PN-74-M-82207			Przekład w 7a	Norma: 1,0000 SZT ..	Cena: 99,28				
	PN-74-M-82207			Przekład w 7a	Norma: 1,0600 KG ..	Cena: PN Norma AISI 304 ..				
	PN-74-M-82207			Przekład w 7a	Norma: 9,0000 SZT ..	Cena: PN Norma PN-74/M-82207				
	PN-74-M-82207			Przekład w 7a	Norma: 1,0000 SZT ..	Cena: 1379,25				
	PN-74-M-82207			Talozki głowne 7a	Norma: 1,0000 SZT ..	Cena: 277,27				
	PN-74-M-82207			Talozki głowne 7a	Norma: 1,0000 SZT ..	Cena: 150,72				
	PN-74-M-82207			PN-74-M-82207	Norma: 18,6280 KG ..	Cena: 0,00				
	PN-74-M-82207			Przekład w 7a	Norma: 8,0000 SZT ..	Cena: 36,43				
	PN-74-M-82207			Przekład w 7a	Norma: 0,0600 M ..	Cena: 150,00				
	PN-74-M-82207			Przekład w 7a	Norma: 1,0000 SZT ..	Cena: 114,91				
	PN-74-M-82207			Przekład w 7a	Norma: 4,9230 KG ..	Cena: PN Norma AISI 304 ..				
	PN-74-M-82207			Przekład w 7a	Norma: 12,0000 SZT ..	Cena: PN Norma PN-74/M-82207				
	PN-74-M-82207			Talozki głowne 7a	Norma: 1,0000 SZT ..	Cena: 466,85				
	PN-74-M-82207			Talozki głowne 7a	Norma: 1,0000 SZT ..	Cena: 391,49				
	PN-74-M-82207			Talozki głowne 7a	Norma: 15,2410 KG ..	Cena: 15,90				

Fig. 3. A fragment of a sample product structure

3.3. Accepting customer orders

The process of order reception is composed of two stages. First, an offer is prepared in answer to an inquiry, which is a basis for an agreement and order registration after it has been accepted.

Prices of the offered products are determined on the basis of the offer price list, prepared by the Marketing and Sales Department (fig. 4). Particular items in the list are calculated basing on a defined algorithm of prime cost calculation related to producing particular equipment components (fig. 5). Inquiries are analysed in Marketing and Sales Department, where particular customer requirements are taken into account and, consequently, product is configured and the offer is prepared:

- In case of standard products (composed of already manufactured sets), a product is configured using the assemblies existing in the system and the offer is prepared on the basis of the price list which contains prices of basic machine and particular components of its equipment,
- In case of non-standard products, Project Management Office takes part in the offering process and analyses customer requirements, determines a possible date of design works completion for new or modified assemblies and estimates manufacturing costs by comparing them to similar ones – detailed constructional and manufacturing

documentation for new assemblies is prepared after placing an order by a customer.

An offer prepared this way is then negotiated, taking into consideration possible alternative equipment variants which influence both product price and its functional parameters (e.g. efficiency).

An accepted offer is a basis for signing an agreement for product delivery and for registering an order in the system. Once an order has been confirmed, the design process of new assemblies starts, or sometimes the existing ones are modified, and finished products manufacturing orders are launched.

3.4. Manufacturing process realization

The manufacturing process of finished products is divided into two main stages (fig. 6):

- 1) basic orders – producing components (elements and assemblies) which build different products,
- 2) complementary orders – producing sub-assemblies of optional equipment and finished product assembly.

Basic orders are launched on the basis of sales plans prepared by Marketing and Sales Department. Within these orders, the components (elements), which are found in all machines of a given type are manufactured. They are launched for 3-4 pieces of a basic machine of a given type. The manufactured components are recorded in Half-product Warehouse, from where they are received for assembly realised within particular complementary orders.

The aim of these orders is to lower order realization time and to decrease unit cost of manufactured products (by increasing the volume of production lots).

Complementary orders are launched by Marketing and Sales Department directly on the basis of registered and confirmed orders, which consider particular equipment agreed with the receiver. Within these orders, elements are manufactured and assemblies which constitute alternative equipment of a given machine types and assembly of a complete machine is realised.

Before realization starts, each basic and complementary order is confirmed by Marketing and Sales Manager, Financial Manager and Technical-Production Manager. After acceptance, Production Preparation Department generates job order documents, which are a base of:

- supply process realization – planning demand for materials and other purchased components,
- creating production schedule and planning load of particular production means.

High product complexity and the fact that a range of components frequently appear within the structure of a given product causes that within an order, as well as within different orders, repeatable components appear. In relation to this, job order documents (both in case of basic, as well as complimentary orders) are generated in two steps. On the first stage assembly manuals and manuals for non-repeatable elements/assemblies are created. In the second one, on the basis of the MRP procedure (formula 1), additional orders are generated, within which repeatable components are manufactured, which appear in structure of many products. Such situation results in lowering manufacturing costs due to larger product batches.

Lp.	Nazwa indeksu	Cena jedn.
005	Drocznik bezposredniego polgromienia	8 611,99 zł
	Rzeczniak	5 468,51 zł
007	Przemiatnik	1 628,88 zł
008	Wielki rozdzielacz	4 949,47 zł
009	Wyprowadzenie	380,56 zł
010	Ciepota sprężonego	1 356,65 zł
011	Materiały technologiczne	184,84 zł
012	Fluor bezposredniego polgromienia	992,34 zł
013	Opłatek papierowy	18 490,90 zł
014	Przebiegiwa kontrolna	1 458,51 zł
015	Obrotowy	3 682,52 zł
016	Przebiegiwa post. blok	66,47 zł
017	Zespół elektromechaniczny	3 722,88 zł

Fig. 4. A fragment of an offer price list

Konto	Nazwa rodzaju kosztu	Wartość	Procent	Liczone od
001	Materiały bezposrednie	8 970,16 zł		
011	Koszty zakupu	269,10 zł	3	001
021	Wartosc półproduktów	1 430,37 zł		
031	Obróbka obca	0,00 zł		
101	Place bezposrednie	5 978,21 zł		
301	Narzut ZUS	1 404,88 zł	23,5	101
305	Koszty wydziałowe	11 222,29 zł	152	101+301
32X	>>> Techniczny koszt wytworzenia	29 275,02 zł	100	001+011+01

Wariant: Koszt wytworzenia: 29 275,02 zł Indeks roboczy

Koszty sprzedaży: 1 463,75 zł 5,000%

Wielkość zysku: 9 221,63 zł 30,000%

Cena obliczona: 39 960,40 zł

Fig. 5. Calculation of an offer price list item

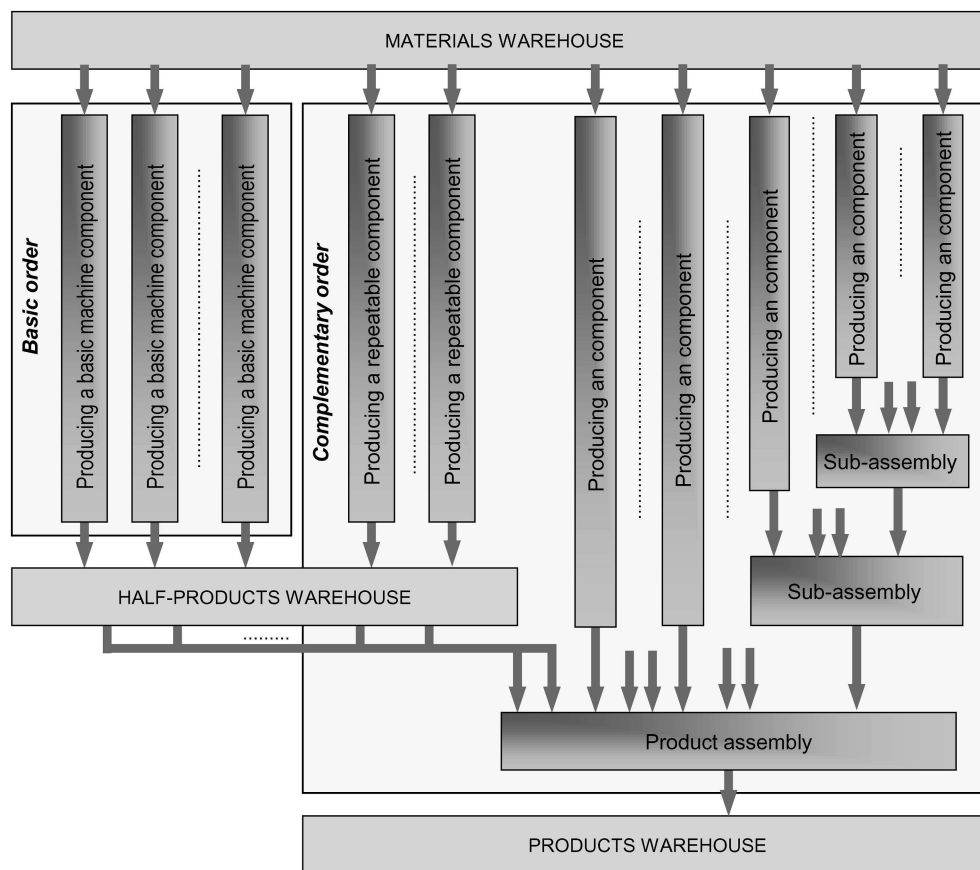


Fig. 6. General structure of manufacturing orders

$$Z_{di} = \sum_{z=1}^Z R_{mz} - \sum_{x=1}^X S_{dx} - \sum_{y=1}^Y P_{dy} \quad (1)$$

where:

Z_{di} – the volume of i -th order for manufacturing of a d element,

R_{dz} – number of d elements necessary to realise the manufacturing order.

Z – number of all manufacturing orders, for which job order documents have been generated.

S_{dx} – current stock of d elements in warehouse x ,

X – number of all warehouses,

P_{dy} – number of d elements in the realised order y (planned income of d elements in launched manufacturing orders),

Y – number of all manufacturing orders.

It should be noticed that in many cases the design process of non-standard sub-assemblies will be realised together with the manufacturing process. After it has finished, job order documents will be generated for the realised orders, within which newly designed sets will be manufactured. Production Preparation Department prints job order documents (fig. 7), on the basis of which manufacturing orders realization is started in departments, and whose tasks are:

- to dispose issuing materials for production,
- to determine work objects flow by manufacturing positions,
- to identify work objects,
- to dispose subsequent machining operations to be performed,

- to allow registering of realised manufacturing operations by production employees.

Job order documents are delivered to the workstation realising the first operation in the manufacturing process. The data from the document instructs a worker to take out proper amount of material from the warehouse. Material is issued from the warehouse for specific job order documents and a materials issued document is created in the module of Warehouse Management (with reference to a job order document).

After each manufacturing operation is completed, a worker is obliged to immediately register it. Registration is performed on specially adapted computer station (e.g. computers in special dust-proof casings) placed directly on the production hall, by means of the module of Hall Operation Registration (fig. 8). The data registered in the system includes: worker's code, technological operation code within the given job order document, number of machined work objects, actual realization time divided into worker's and machine's work.

After registering, work objects together with the job order document are transferred to the next machining stand.

Within manufacturing operations, self-control is carried-out. However, in case of the process of producing individual elements is terminated and in case of final control of a finished product, the control has been written as a separate technological operation realised by Quality Control Department workers.

In case of incompatibilities, they are registered in the module of Registering Operations by Quality Control workers.

Data generowania: []		Strona: 1	
PRZEWODNIK WARSZTATOWY NR: 001			
Nr pełny zlecenia: []		Priorytet: [3]	
Nr rysunku: [] tk		Termin realizacji: []	
wersja: 1		Ilość: 1	
*** SKŁADNIKI ***			
Nr.przew.		Norma	Mag.
002	Pręt ciagniony 0H18N9		2 SZT N
003	Rura kwadrat 0H18N9		1 SZT N
*** OPERACJE ***			
Oper. Stan / [Nr]	Opis / zabiegi operacji	Grupa plac.	Typ Tj
10 RM [13]	Pobrać poz. 1 i 2, dopasować, przygotować do spawania - roztrasować. Ustalić wymiar rury poz. 2. Pomoc przy szczepianiu. Korygować po spawaniu.	05	0,00 0,10
20 MF [18]	Frezować na wymiar ustalony w montażu. Ogrzować, zatamować krawędzie.	06	0,45 0,10
30 MX [16]	Składać, szczepiać i spawać zgodnie z rys.	07	0,20 0,20
40 RO [20]	Oczyszczyć z odprysków - szczołkowić spawy. Przygotować do matowania.	06	0,20 0,16

Fig. 7. A Fragment of a job order document

They register the number of repairable and irreparable re-jects, the symptoms and causes of incompatibility occur-rence as well as suggested remedial measures.

The last operation in the manufacturing process is control-ling the quality of a finished product performed by Quality Control unit. The operation involves, among others, electric tests or noise measurement. On the basis of the performed analyses, a quality certificate and compliance declaration with Polish work safety norms are issued.

After the last operation realised within the order has been registered, the product is transferred to Product Warehouse, and half-products (made to stock) go to Half-products Ware-house, from where they are taken for machine assembly or-ders. A warehouse worker creates a delivery from production document in the Materials Management module on the basis of order number (the bar code on each job order document).

Cooperation

Cooperation is handled without the need for wareho-use turnover. The structure of products (for which chosen operations are made outside the enterprise) is extended by a characteristic cooperation compo-nent (e.g. anodising, chroming, electroexcavation, laser cutting etc.), and technological itinerary – by cooperation operations (fig. 9).

On the basis of cooperation component, cooperation service is ordered (an order is created in Own Orders module). Then, on the basis of goods issue note for cooperation, they are delivered to a cooperant. After the service has been realised, the fact, together with service cost is registered in Production Registration module.

3.5. Supply

Ordering materials and parts takes place mainly on the basis of dependent demand – resulting from ge-nerated job order documents, taking into considera-tion warehouse inventory and previously confirmed supply orders – the MRP procedure.

Due to differentiated product range of ordered ob-jects, all purchase indexes have been assigned to specific groups related to responsible people (traders).

The supply orders registered in the system form a basis for receiving materials/parts to the warehouse. Received goods documents are generated directly on the basis of a registe-red supply order. The delivery quality control is carried out when the delivered objects are received to the wareho-use. In case of incompatibility, the complaint procedure is initiated.

3.6. Sales

Due to specificity of produced goods, the manufactur-ing process is not limited to releasing products and generat-ing a sales invoice, but it also includes operations related to installing a machine in the place of usage, its start-up and performing exploitation tests. Together with the product,

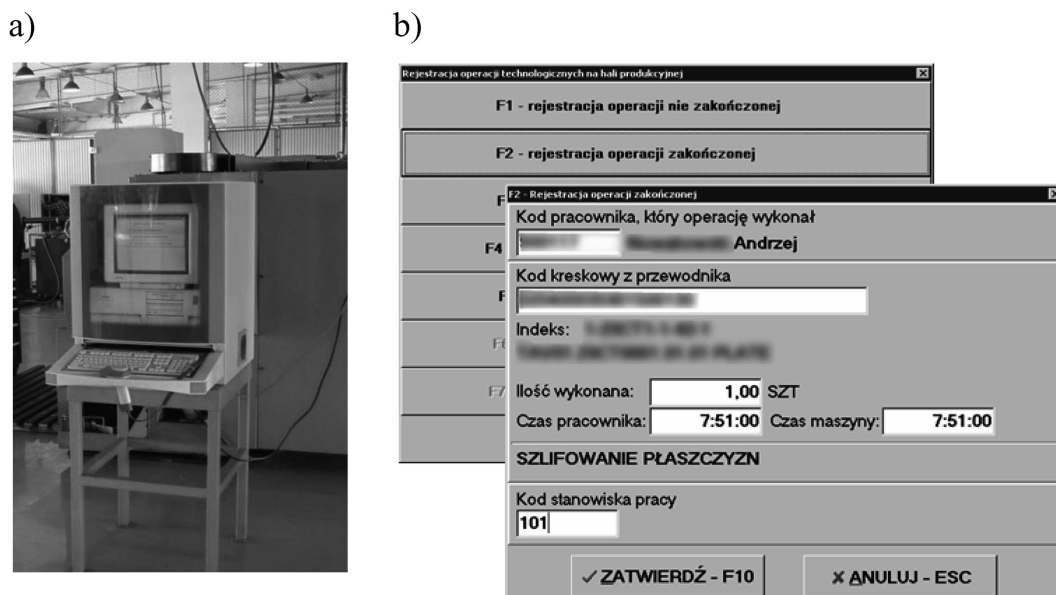


Fig. 8. Production floor Operation Registration a) position of registration, b) interface

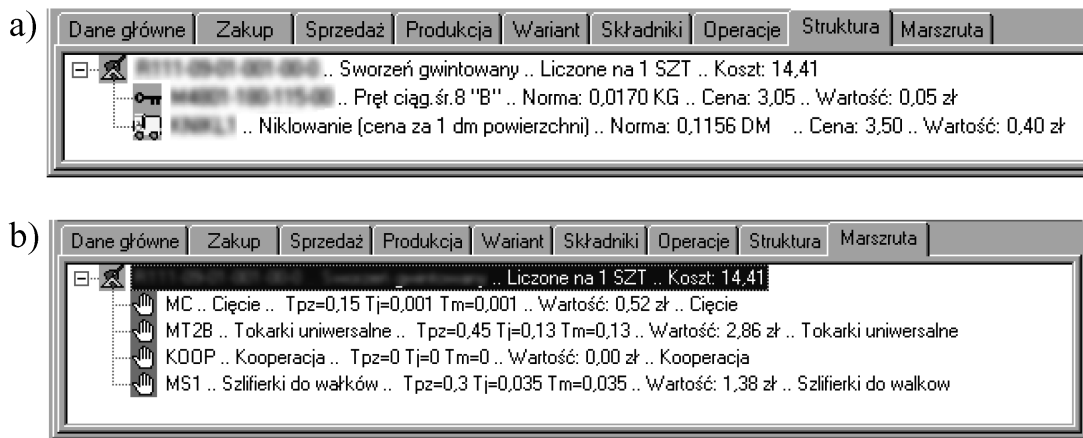


Fig. 9. Sample structure (a) and technology (b) of an element machined in cooperation

a receiver obtains complete documentation (Technical-Motional Documentation, Tests Protocols, Certificates etc.). Issued goods document related to a finished product is generated basing on receiver's order, and an invoice is printed on the basis of this note, taking into account conditions determined in the order.

3.7. Storing

Stocks of materials and purchase parts for assembly are recorded with accuracy to materials and delivery lot index in fixed prices. Such situation allows for delivery identification of materials used in particular manufacturing orders (and, consequently, in products) and for calculating real materials costs of orders.

Finished products on the Product Warehouse and half-products on the Half-Products Warehouse are recorded with accuracy to the batch identifying the manufacturing order, on the basis of which they have been produced. Fixed price is calculated on the basis of planned order costs calculated according to a defined algorithm. A general model of warehouse management is presented in figure 10.

4. Integrated information system model

The integrated information system for the analysed enterprise related to realising processes consists of the following modules:

- Technical Production Preparation,
- Sales Orders,
- Invoicing,
- Production Management,
- Production Registering,
- Warehouse Management,
- Supply Orders.

A scheme of information flow between different modules in the course of manufacturing process realization is presented in figure 11.

Inquiries, subsequent offer versions and finally placed orders (determining specific machines) as well as signed agreements are registered in *Sales Orders* module.

In *Production Management* module, on the basis of sales plans, orders are placed for manufacturing a basic machine and, on the basis of registered orders complementary orders are made. Each complementary order corresponds to a single

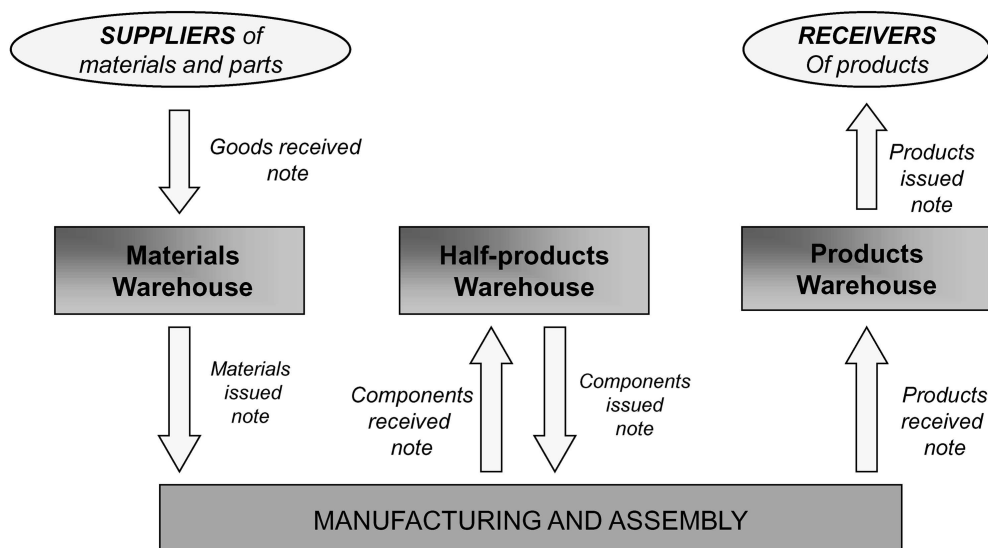
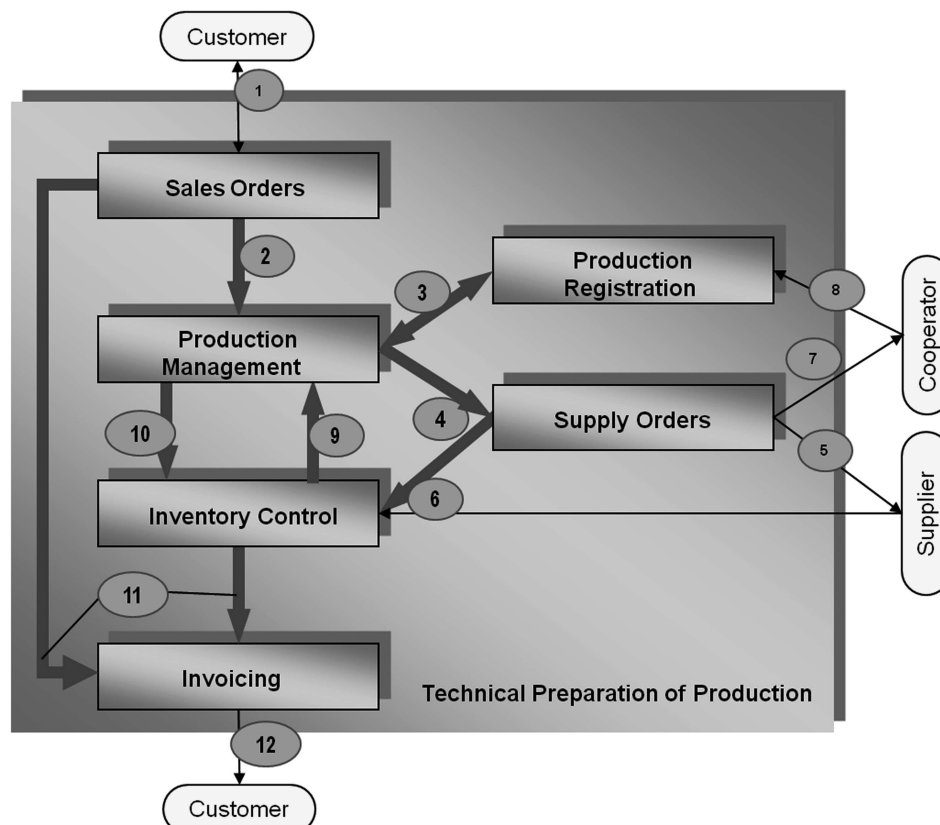


Fig. 10. A general model of enterprise warehouse management



1. Registering an inquiry, preparation and issue of the offer, negotiations, signing agreement, order reception.
2. Launching manufacturing orders on the basis of customer order or the sales plan.
3. Registering realised manufacturing operations.
4. Generating materials demand and cooperation demand.
5. Ordering materials.
6. Receiving materials delivery.
7. Ordering cooperation.
8. Registering cooperation.
9. Releasing materials and half-products for orders.
10. Transferring finished products and half-products to the warehouse.
11. Creating a goods issued note and the invoice on the basis of order and current stock.
12. Issuing products to the receiver- assembly and start-up.

Fig. 11. Integrated information system model

order. After the objects of particular orders have been configured and realization variants chosen, job order documents are printed. Elements which often appear in product (or half-product) structure are joined together and their manufacturing is realised within one job order document. In the course of order realization, job order documents are often additionally generated for newly designed elements and sets of non-standard (individual) equipment.

Realization progress for particular job order documents (orders) is updated on-line thanks to real-time registrations (after each operation) realised by production employees in the module of *Production Floor Operation Registration*. Cooperation is realised by the module of *Supply Orders* – where, on the basis of supply from job order documents (*Production Management*) cooperation orders are created and the module of *Production Registration*, where the performed cooperation is registered.

After orders are finished, goods received notes are created – of receiving products and half-products to the warehouse (the *Inventory Control* module). Materials and half-products necessary to realise particular manufacturing operations are

released from the warehouse on the basis of a job order document (the *Inventory Control* module).

The sales process is realised by *Invoicing* module, where on the basis of sales orders positions, issued goods documents are created, and then invoices are created.

Supply management is carried out in the *Supply Orders* module. It is where purchase needs basing on materials demand from job order documents, current stock and already placed supply orders are generated (the MRP procedure for materials). These needs, put together with registered offers from suppliers form ordering points, which are a basis for creating supply orders. Registered orders are a basis of generating documents of received goods.

5. Schedule of implementation realization

The final stage of pre-implementation operations is analysing labour intensity and time consumption of tasks necessary to be realised in the course of integrated information system's implementation and preparing a schedule of implementation operations realization (fig. 12).

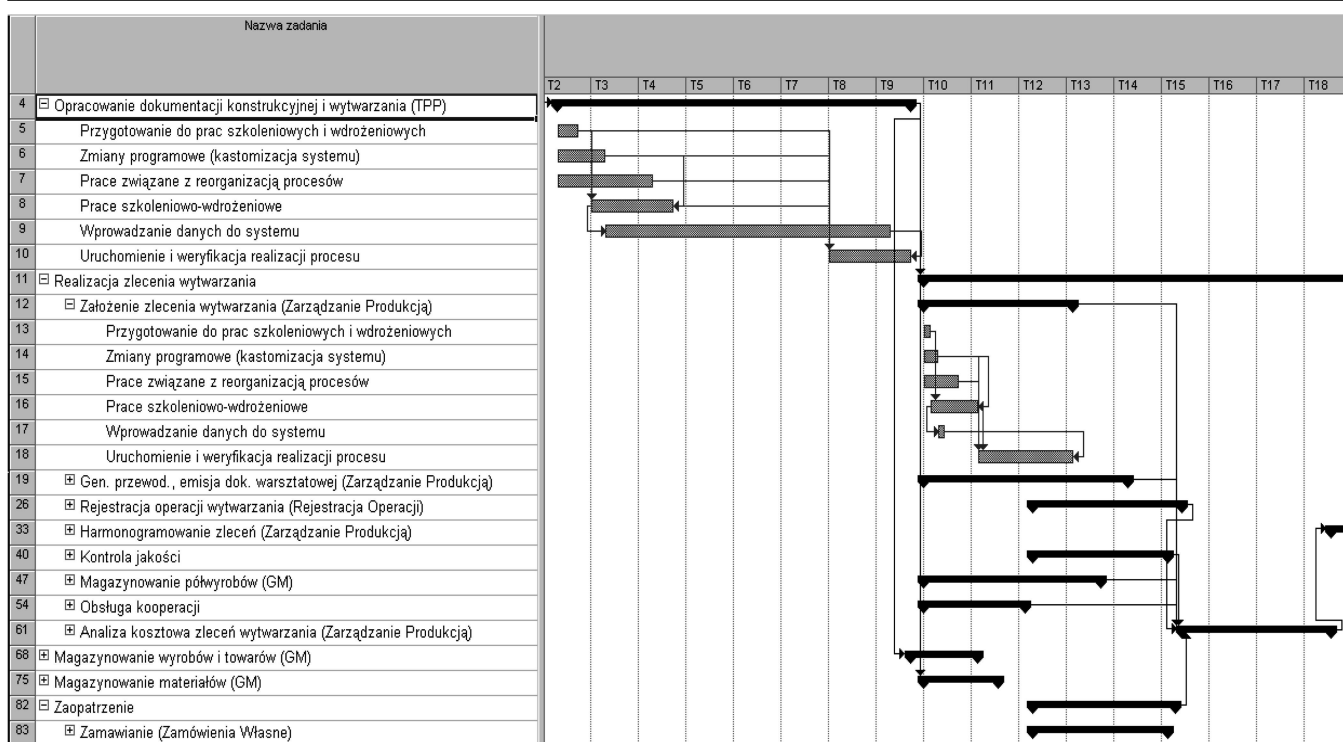


Fig. 12. A fragment of prepared schedule of integrated information system's implementation in an enterprise

It shows that integrated information system implementation in this enterprise takes about 26 weeks (6months). In practice, however, it took 12 months. The difference was caused, among others, by the fact that realization times estimated in the schedule are shortest possible times, without taking into consideration a range of limitations, like e.g. real calendar dates. In order for the schedule to be used in practice, it is necessary to take into account the following factors during its creation:

- real dates resulting from the calendar,
- parallel projects and current tasks, both on the side of suppliers and receivers of integrated information system,
- a schedule of training and implementation visits.

6. Summary

A next stage of realising the project of integrated information system implementation in an enterprise was carrying out implementation works, as a result of which the system included all areas related to basic processes realized within the manufacturing process. The most important effects of system's functioning include:

- possibility of creating precise offer calculations which are basis for offer valuation,
- ordering information about product structures and their components,
- updated information about progress of realised manufacturing orders,
- automation of generating orders for components which appear in many products,
- supporting the supply process.

In order to improve the realised processes, system's functioning is currently being extended in still new areas, using modern functional and infrastructural solutions, e.g. introduction and usage of bar codes and mobile terminals in the

area of warehouse turnover, building expert systems to analyse connections between assembly orders and orders for repeatable components, improving mechanisms related to planning of order realization in time and of analysing production means load. It should be noticed that these activities are significantly related to reorganization of particular processes in an enterprise, and only secondly – to using IT system, although possibilities of the implemented integrated information system is a driving force of many changes.

References:

- [1] Adamczewski P.: *Zintegrowane systemy informatyczne w praktyce*. Wydawnictwo MIKOM, Warszawa 2003.
- [2] Banaszak Z., Kłós S., Mleczo J.: *Zintegrowane systemy zarządzania*. Polskie Wydawnictwo Ekonomiczne, Warszawa 2011.
- [3] Gunia G.: *Implementacja zintegrowanych systemów informatycznych w małych i średnich przedsiębiorstwach*. „Zarządzanie Przedsiębiorstwem” Nr 2/2009,
- [4] Gunia G.: *Wdrażanie zintegrowanych systemów informatycznych*. Wydawnictwo Fundacji Centrum Nowych Technologii, Bielsko-Biała 2009.
- [5] Gunia G.: *Zintegrowane systemy informatyczne zarządzania w praktyce produkcyjnej*. Wydawnictwo Fundacji Centrum Nowych Technologii, Bielsko-Biała 2010.
- [6] Lech P.: *Zintegrowane systemy zarządzania ERP/ERP II. Wykorzystanie w biznesie, wdrażanie*. Difin, Warszawa 2003.
- [7] Mleczo J.: *Komputerowo wspomagane planowania przebiegów procesów produkcyjnych*. Wydawnictwo Fundacji Centrum Nowych Technologii, Bielsko-Biała 2008.

Key words:

integrated information systems, production process, machining industry.

Abstract:

The article briefly characterises a model of implementing integrated information systems. Next, it describes realization effects of subsequent stages of pre-implementation operations in a sample enterprise from machine industry: starting from organisational analysis of the enterprise, through a model of production process realization and a model of integrated information system, ending on the schedule of implementation realization. Finally, the effects of integrated management information system implementation and current directions of system development in an enterprise are presented.

IMPLEMENTACJA ZINTEGROWANEGO SYSTEMU INFORMATYCZNEGO W PRZYKŁADOWYM PRZEDSIĘBIORSTWIE PRZEMYSŁU MASZYNOWEGO

Słowa kluczowe:

zintegrowane systemy informatyczne, proces produkcyjny, przemysł maszynowy.

Streszczenie:

W artykule krótko scharakteryzowano model implementacji zintegrowanych systemów informatycznych. Następnie opisano wyniki realizacji kolejnych etapów prac przedwdrożeniowych w przykładowym przedsiębiorstwie przemysłu maszynowego: począwszy od analizy organizacyjnej przedsiębiorstwa, poprzez model realizacji procesu produkcyjnego i model ZSI, na harmonogramie realizacji wdrożenia kończąc. Na zakończenie przedstawiono efekty wdrożenia ZSI oraz bieżące kierunki rozwoju systemu w przedsiębiorstwie.

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