

INFORMATION SYSTEMS FOR SUPPORTING PRODUCTION PROCESSES IN A COMPANY MANUFACTURING ROOF METAL SHEETS - A CASE STUDY

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Abstract:

Due to strong globalization processes and the dynamics of market changes in a highly – competitive environment, leading-edge companies today are made to constantly develop in order to ensure their effective functioning. It is modern information systems that are responsible for the effective planning and management of company resources and which enable companies to expand their business. The implementation of the information system is a real challenge for the managing staff, operating workers, customers and subcontractors, especially in a production company, which is why it should be thoroughly planned and carefully conducted. The article presents the main conclusions from the process of the implementation and exploitation of ERP system by the leading manufacturer of roof and facade metal sheets in Poland. It outlines specific market needs in roofing sheet industry, followed by the characterization of basic production process in a given company and the presentation of advantages of applying IT tools for supporting production processes. The article also describes some problems which the employees of the company may have encountered during both the implementation and exploitation of the information system.

Keywords: ERP, ERP implementation, SME, production, IT for manufacturing

1. INFORMATION TECHNOLOGIES SUPPORTING PRODUCTION PROCESSES

More and more often production companies are made to introduce advanced IT solutions for supporting production processes in order to function effectively on a turbulent market. IT systems help companies ensure real-time availability of information about ongoing production processes. IT tools enable companies to organize and categorize production processes, standardize data processing and integrate subcontractors (Zalewski, 2011, p 181). That, in turn, may enhance the company's effectiveness, improve quality as well as maximize customers' satisfaction (Zięba & Obłąk, p. 1).

Among a group of systems which support the management of production processes, the following systems may be found (Rodak 2013, p. 1):

- systems which enable process visualization and monitoring,
- systems responsible for monitoring an effective use of machinery and managing production processes,
- information management systems concerning the company's machinery fleet.

Not only do IT solutions deliver information about production processes but they also ensure an integration between production process management systems and applications which support other business processes in company, such as design processes, planning, procurement, inventory, sales, complaint management. It is also crucial to ensure information flow between process management systems and modules responsible for fixed assets and equipment management or HR. The right combination and implementation of these systems helps the company to easily plan production processes involving all the material and human resources available in a given company.

Detailed and up-to date production costs calculation additionally requires a combination of process management systems and financial and payroll systems. The data delivered by these systems, including the cost of raw materials consumed, labor, media and machinery costs together with the mechanisms of distribution keys, cost distribution lists and automatic accounting procedures enable system users to calculate production costs in an accurate way. Comprehensive and up-to-date information about the production process and production costs combined with complex logistic information lead to taking informed and rational decisions regarding the company's future functioning, broadening the scope of the production of the most profitable items or reorganizing some business processes which might involve deceleration in manufacturing less profitable products.

Empirical evidence shows that there is a lack of complex IT solutions which would allow production companies to fulfill their needs as far as logistics, finance, accounting and production process management is concerned. It results from the fact that while some of the procedures, due to legal requirements, are quite similar in different companies (finance, accounting, logistics, complaint management), production processes are individual and unique to each company. Therefore, it is usually difficult, if not impossible, to implement specific production process procedures into a given, commonly available IT software.

Since there is a lack of a ready-made IT solution, the company may decide to build a new, tailor-made IT system which would meet all its requirements. However, such a solution would be probably adopted by large companies or group of companies of an identical or similar profile due to considerable costs, long completion time as well as high complexity and significant risk involved. Currently, there exists no economic rationale for building a complex IT system from scratch on by small or medium-sized companies. The only solution is to integrate an existing production system (which has been developed in an individual company for years) or a system purchased from an external deliverer specializing in a given field with an ERP system responsible for managing the company's remaining business activities.

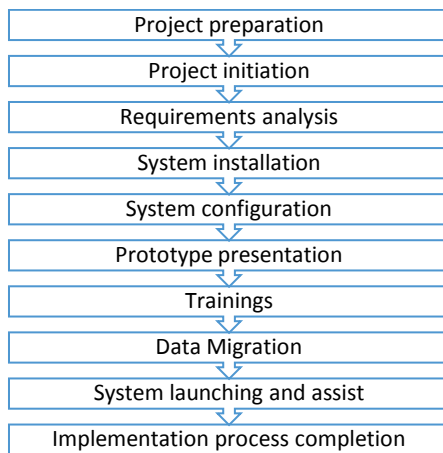
No matter how effective they could be, introducing two separate IT systems into a company hardly ever leads to building a coherent and unfailing mechanism which would support the functioning of the whole organization. Synergic effects connected with integrating specialist IT tools for managing production processes with an effective and efficient ERP system for supporting the company's remaining business activity require a thorough planning and complex implementation. The process ultimately leads to introducing one coherent IT solution made up of a variety of dependent components.

2. THE IMPLEMENTATION OF IT SYSTEM

Implementation may be defined as starting to use an IT tool in practice, i.e. handing over the system from those who build it to those who are going to use it or one of the stages in a system life cycle, involving introducing an IT tool into a given company (Wiechetek, 2014, p. 354).

Implementation is a very complex enterprise from a technological, organizational and business point of view. It constitutes one of the most difficult stage of the IT system life cycle and it often results in failure or achieving only partial success. It is not mere launching of a new IT tool into a company that should be the sole goal of IT system implementation. IT system implementation should lead to meeting the company's primary objectives such as enhancing its effectiveness or gaining competitiveness (Dyczkowski, 2008, p. 25). The main stages of IT system implementation have been presented in picture 1.

Picture 1: The main stages of IT system implementation



Source: own work.

The implementation process may be conducted according to different models: cascade model (sequential movement between various stages), iterate model (allowing going back to previous implementation stages), spiral model (repeated, iterative movement through the stages of planning, risk analysis, configuration, verification) or prototype model (going through all implementation stages with the use of a more and more enhanced prototypes of the system). Many manufacturers of IT software for supporting company management have their own implementation methodologies, among others Accelerated SAP (SAP)¹, Microsoft Sure Step² (Microsoft), which make it easier for a company to implement specific IT solutions.

In order for an implemented system to meet its users' expectations, it is not only necessary to choose the right IT solution (Shaul and Tauber, 2013, p. 55:18), but also initiating proper cooperation with the deliverer of implementation services. Even the best IT system will not fulfill the company's expectations if it is not properly implemented (Alaskari et al., 2012, p. 1). The effectiveness of implementation considerably depends on the preparation of the implementation process. At this stage it is necessary to identify key success factors as well as potential implementation barriers. Proper preparation requires both the specialist knowledge of how the company functions and the possibilities that the system offers. Experience in conducting implementation projects and vast interpersonal skills matter, too.

Successful implementation involves the cooperation between the representatives of the company which implements the system (project manager, specialist consultants, system engineers, technicians) and the key employees, into whose company the system is introduced. Thus, managing communication is truly important so as to ensure that both groups cooperate rather than work

¹ <http://scn.sap.com/docs/DOC-48920> (18.02.2016).

² <https://mbs.microsoft.com/customersource/Global/SureStep/home> (18.02.2016).

separately, with the common aim of achieving the same goal which is enhancing the company's performance.

The analysis of literature shows that successful implementation depends on three main groups of factors: human factors, the course of the implementation process and technical factors (Hairul et al., 2011, p. 2181). The research conducted among a group of Polish small and medium-sized enterprises (Wiechetek, 2015, pp. 1480-1481) proves that key implementation factors include the experience and the expertise of the members of implementation team; communication skills, discipline of the company's employees where the system is implemented, elasticity, the ease of use and administration of the system implemented, persistence, determination and understanding the company's needs by the members of implementation team.

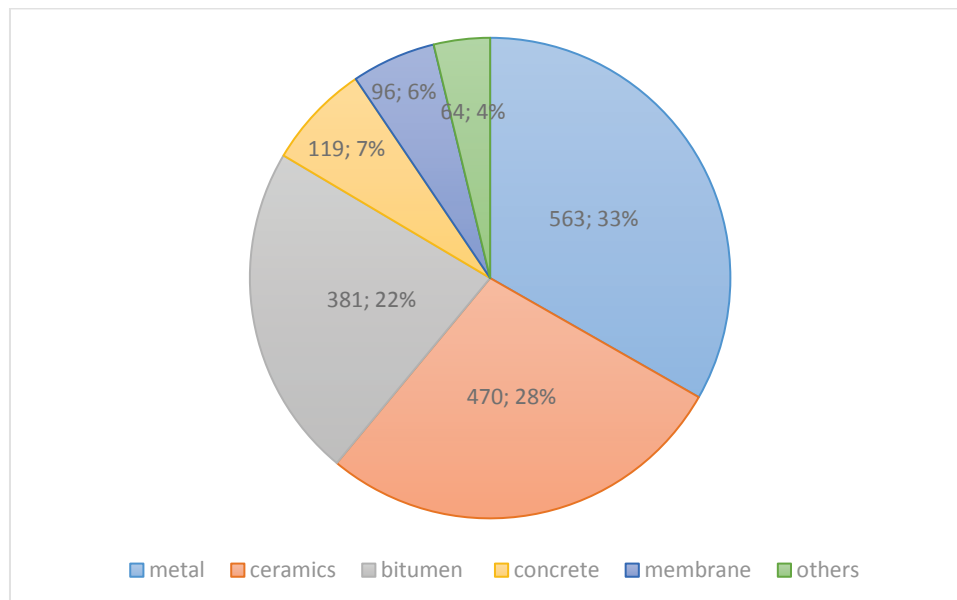
The major barriers which negatively influence the implementation process include (Wiechetek, 2015, pp. 1482-1483): employees' resistance, the risk of additional costs arising during the implementation process, frequent changes of requirements made by customers; functional differences between the new system and the system used so far, employees' insufficient motivation to take on extra duties connected with implementing a new system, organizational and infrastructural or technical barriers. The main reasons why the implementation process often fails is technical rather than human factors (Amid et al., 2012, p. 233).

IT system implementation is a huge challenge especially for production companies. The dominant role of production processes themselves and their unique character often determine the need for implementing two separate IT solutions (one – in order to facilitate production processes and the other – to improve the company's remaining business activity. Finally, it is necessary to integrate the two systems so that they could constitute a coherent and effective unit.

3. THE CHARACTERISTICS OF METAL ROOF SHEET INDUSTRY

Metal roof sheet industry has 33% market share and, being the leader, it precedes manufacturers of roof sheets made of ceramics, bitumen or concrete.

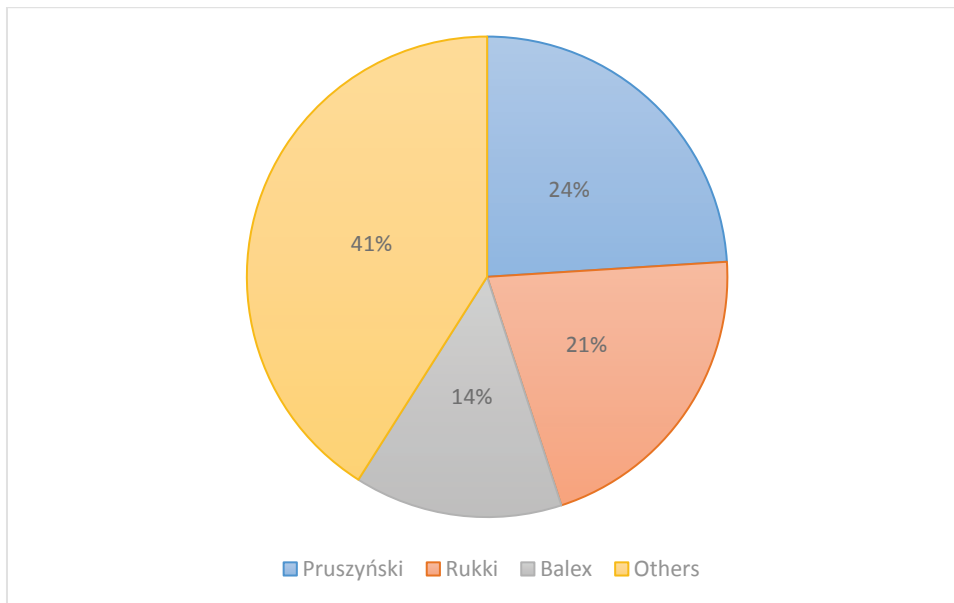
Figure 1: Sales of roof sheets in 2014 in MLN PLN and percentages



Source: own work according to Rynek Pokryć Dachowych w Polsce - Prognozy rozwoju na lata 2014-2020, PMR Market Insight, November 2014

However, as opposed to ceramic roof sheets, the sales of metal roof sheets is spread among a number of manufacturers. 41% of all metal roofs was sold by production companies other than three leading manufacturers of metal roof sheets.

Figure 2: Metal roof sheet industry in Poland in 2014



Source: own work according to Rynek Pokryć Dachowych w Polsce - Prognozy rozwoju na lata 2014-2020, PMR Market Insight, November 2014

Metal roof sheet industry has a quite specific sales model. The manufacturers of metal roof sheets distribute their products to both wholesale points of sale (where the products are redistributed) and professional roofing companies as well as final customers themselves. Ceramic and bitumen roof sheets are sold exclusively to professional roofing companies whereas metal roof sheets may be bought by individual customers, e.g. in home-improvement stores or via DIY channel. That proves a specific tendency which differentiates metal from ceramic roof sheets. Metal roof sheets are mainly used to cover or modernize existing roofs, which individual customers may do on their own without the help of a professional roofing company. In contrast, ceramic roof sheets are primarily used in new buildings. That is why metal roof sheets have a smaller market share than ceramic sheets on the new building construction market. This tendency has remained the same for years, which is why it attracts little interest from design companies or architecture firms cooperating with real-estate developers.

Metal roof sheet industry faces external risk factors since it depends on the world economic situation. That may refer to product demand and investment opportunities but it primarily concerns the cost of raw materials which could considerably change over a period of time. According to *Polish Union of Steel Distributors*, which is an organization dealing with price and trend analysis on the steel market, the price of steel changed by 30% from 2010 to 2015.

Time-varying prices of steel considerably influence the competitiveness between metal and ceramic roof sheet manufacturers. Ceramic roof sheet manufacturers do not ultimately depend on the price of raw materials since the ceramic roof sheet production companies are usually located near clay deposits and they extract the clay from raw soil themselves.

To sum up, metal roof sheet industry has a lot to offer, yet steel roof manufacturers run a risk of fluctuations in steel prices. Furthermore, metal roof sheets may be soon regarded as a little old-fashioned, and, therefore, substituted with more modern, ergonomic and ecologically-friendly coverings. The fact that melting steel consumes a lot of energy (extraction and processing) is of importance as far as steel prices and, consequently, steel market future potential are concerned.

4. THE COMPANY CHARACTERISTICS

The company is located in Poland. It was established in the 1970s. It owns two modern plants which process about 60 000 tons of steel coated sheet yearly. The company employs 500 people. The organization has distribution departments in Slovakia and the Czech Republic. The company also exports its products outside the European Union. There are two main distribution channels. The most

important channel is the retail channel – the company has a network of 130 sales points, which is a unique feature on the European market since none of the remaining roof sheet manufacturers in Europe has such a complex distribution network. Another important distribution channel is a wholesale channel – the company has its wholesale points that redistribute the company's products both nation- and worldwide. The company has been steadily developing and in 2015 its revenues from sales made up 330 million pln. The company's financial results between 2013 and 2015 are presented in Table 1.

Table 1: The company's financial results between 2013 and 2015

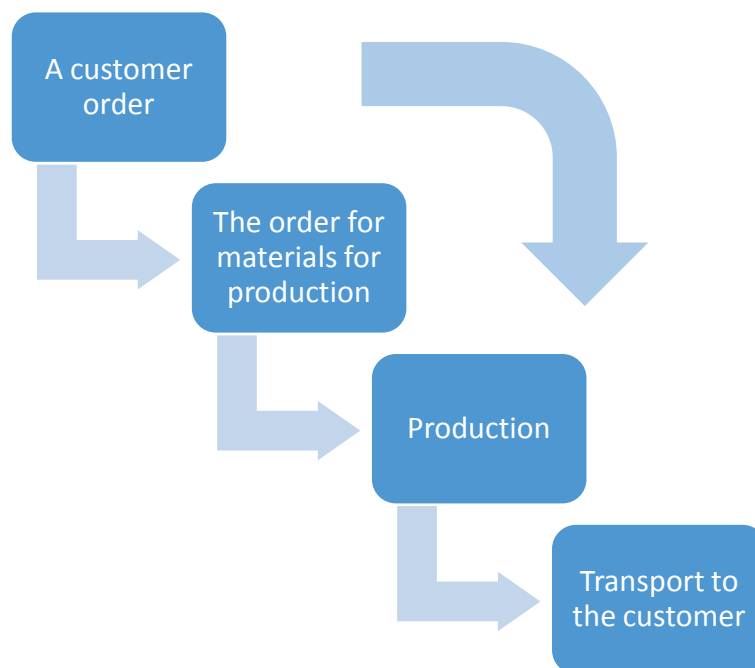
	2013	2014	2015
Revenues from sales	253 796 025,53 PLN	307 831 212,45 PLN	330 060 577,26 PLN
Operating expenses	246 550 863,91 PLN	298 015 162,21 PLN	317 107 957,17 PLN
Profit from sales	7 245 161,62 PLN	9 816 050,24 PLN	12 952 620,09 PLN
Net profit	2 939 244,35 PLN	6 470 702,87 PLN	9 484 077,38 PLN

Source: own work

The company invariably invests in new technologies, improving on its machinery the quality of its products. Currently, the company is the leading manufacturer of steel roof sheets in Europe.

5. IT SYSTEM FOR SUPPORTING PRODUCTION PROCESSES

Picture 2: Process: from a customer order to production and transport



Source: own work

A company which implements an ERP system is focused on automatizing the production process to the maximum. Production in the company described in the article is in 90 % based on individual customers' orders – the customer contact a sales point (retail or wholesale) and orders a specific type of roof sheet. It might be a roof panel, roof tiles or trapezoidal metal sheet. The customer specifies the material from which the sheet is to be made (terne, shiny, galvanized etc.), its colour and thickness. They further determine the amount of the product that they need, with or without the assistance of a professional who could help calculate the amount / length of individual elements required to construct a roof.

The sales assistant has to introduce all the above-mentioned parameters into an ERP system. He or she checks the availability of the raw material needed to produce a specific product that the customer

orders. If the raw material is in stock, the order is placed at the end of order queue awaiting production. If the material needed is not available in stock (it happens that materials which are atypical as for their colour, thickness etc. are not stored by companies due to their low turnover), the sales representative informs the employee of the purchase department of the need to purchase the material in question. The employee responsible for the purchase of materials sends the order for the missing material to a steel mill. Additionally, the same employee is responsible for the inventory of materials with the highest turnover in the production process. It enables him or her to track the history of orders in the ERP system, set the minimum amounts of materials kept in the inventory and react to new trends on the market of roof sheets. Being aware of the delivery dates of particular materials, the employee may estimate when the given order is going to be produced and having that kind of knowledge, they may plan for the roof sheet to be finally cut out.

ERP system helps coordinate the arrival of the material into the company's warehouse. Steel which arrives from a steel mill is rolled into the so-called circles, each of which is marked with a special tag containing the information of its parameters (weight, length, colour, type of coat etc.). The warehouse employee puts each circle into ERP system, giving the circle its unique number and specifying the above-mentioned parameters. Thanks to this, each sales department employee can see the availability of the given material and is, therefore, able to precisely specify the delivery of a given order to the customer. What's more, there exists a special reservation subsystem for reserving materials for future production. Since the ERP system provides information of which orders have been placed with a steel mill and the delivery date of materials may be consequently estimated, the sales person may book a specific amount of the material although the material itself is not yet in stock. Thanks to this mechanism, the customer is sure to have his order fulfilled at the time of the delivery of the next part of steel. Such a mechanism helps avoid unnecessary misunderstandings if, unexpectedly, cumulative orders appear and it makes it sure that the order, for which the reservation has been made, is going to be filled at a time specified.

Once the order has been placed and the material needed for the production has been secured, the planning of the production process starts. Production planning takes place in ERP system and it is controlled by a production planner. The planner has a special panel in front of him or her where they can see each machine in the production hall. Moreover, while seeing the queue of production orders which arose from customers' orders, the planner may change the sequence of orders which are cut out on particular machines. The queue of production orders is unique to each machine, because each machine can cut out one particular pattern of a roof sheet. There are 15 machines in the production hall, so the planner can see each of the 15 queues of orders. The queue is a living entity which is dynamically changes over time. New production orders created on the basis of customers' new orders are added to the queue while other disposals may be cancelled or modified. It is the planner's decision that some of the disposals are moved to a different (lower or higher) position in the queue for production. Production orders for a particular type of roof coating pattern are electronically placed on particular machines. They contain specific information regarding the number of sheets, their size and the material from which they are to be made. Using the computer associated with a particular machine, the machine operator places an order with the warehouse person. Specific type of material should be then sent from the warehouse to the production department. The warehouse person has a mobile appliance on which he or she can read the disposition and manage the demand for a specific material. Forklifts, conveyor belts or gantries are used to transport a given circle of steel to the production site. When the material arrives at the production site, the machine operator uses the computer system to confirm that the proper material for production has been delivered. The employee of the warehouse of materials handles the queue of demands for circles of steel, takes care of logistics and the delivery of proper materials to proper machine operators.

If the material from which a given order must be cut out is delivered to the production machine, the machine becomes primed and programmed. A circle of steel is installed and the machine operator sends information from the system that the machine may be programmed with a given order for production. It happens automatically and the information concerning the size and length of the final product is transferred to a computer inside the machine, after which the production process starts. The computer inside the machine is programmed with the number of sheets and the size of the final product which must be cut out. After the production process is finished, the computer inside the machine sends back the information about the completion of the production process to ERP system. Next, the employee of the warehouse of final products uses the forklift to put the product in the

warehouse case and specifies the location of the product in the warehouse, using a mobile device in the system.

Simultaneously, on seeing the production process being complete, the employee of the transport department may plan the delivery of the product to the customer. It is already possible to plan the transport of products when the production orders are placed in queues. The transport planner completes a set of orders and chooses the right car for the future transportation of products, considering their length and weight. As the product loading hours are set, the employee of the warehouse of final products uses the system to find a group of orders which are to be loaded onto a particular car. Using the mobile device installed on the forklift, he or she tracks the location of given orders in the warehouse and loads the products into the vehicles. The driver receives proper documents generated and printed by the system from the transport dispatcher. The driver hands over one copy of documents to the customer and the other copy, signed by the customer who confirms the reception of products, must be brought back to the company.

6. BENEFITS AND PROBLEMS RESULTING FROM THE IMPLEMENTATION OF IT SYSTEM FOR SUPPORTING PRODUCTION PROCESSES

The production process described in the previous chapter is inextricably connected with IT operations. The implementation of such a system brought the following benefits:

- IT system contained all the information necessary for making all types of decisions connected with finance, sales, the development of products or widely understood production and logistics management,
- -order placement, raw materials replenishment and the very process of sending the products are all dealt with by IT system, which influences instant information flow between all the parties involved in the process,
- the improvement of the turnover of raw materials, products and final goods – thanks to information derived from IT system, the company is in a position to flexibly react to changes in inventory (surpluses, shortfalls) as for materials, products and goods for sale,
- IT system gathers all the operations conducted on production machines, thanks to which it is possible to simulate or predict machine deterioration, plan MOTs or the exchange of machine parts and, therefore, foresee some of the company's costs,
- thanks to data collected in the system, it is possible to calculate the technical cost of production and consequently, record all the costs for the needs of accounting and management reporting,

The following problems connected with the IT system implementation have been identified:

- the resistance of the company's employees to introducing a new system, resulting from their aversion to change or fear of losing a job (there exists a stereotype that computers may replace humans),
- the personnel could feel overburdened due to the necessity to combine their everyday duties with partaking a variety of project works – this resulted to delays in project implementation, overtime pay and the rise in company's total costs
- the rebuilding of business process during project implementation resulted in temporal chaos in production departments until the employees have finally adapted to changes ,
- the modifications of the scope of the project during project implementation have led to delays and an increase in costs. This is a standard problem connected with projects and it results from an inaccurate analysis of the project scope at the beginning stage or the changes that took place in the company while the project was already being implemented and which should be acknowledged in the new system.

7. CONCLUSIONS

When taking a decision about implementing an IT system to support production process, the company improves its functioning on one hand and on the other it has to be ready for intensive and challenging work at least during the implementation and the start of a new application. However, the benefits from introducing a novel IT solution are considerable as they improve the company's market competitiveness thanks to the automatizing the production process from placing an order by the customer, through ensuring the availability of raw material for production and facilitating the production itself to delivering the final good to the customer. Metal roof sheets market imposes the need to

introduce a variety of innovative IT solutions in a widely-understood production process. Firstly, it helps shorten the length of the whole production process – from the moment an order is placed to the delivery of the final good. IT increases the effectiveness of production itself, shortens its time, automatizes logistic operations and facilitates financial bookkeeping. The implementation of IT system into a company involves the organization's key personnel, from whom it is required to complete some extra duties connected with project work. Motivation and determination are crucial for the project's success or failure, as it is the knowledge and experience of the company's key employees that are indispensable for building an implementation strategy and doing all kind of analytic work to help IT system real business processes in the company. Without the informed knowledge of its experienced users, IT system would be a useless application which will not meet the demands and expectations imposed upon it. It is trained and creative personnel that is able to so model business processes in the system that the company will substantially benefit from the system implementation. System improvement and development depends on the company's key personnel who, with time, are able to notice the loops in the system which can be dealt with by some new functions. That will help the company's to steadily improve, which is crucial in a dynamic fast-changing business environment.

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