

2.1 MACHINERY AND INDUSTRIAL ENGINEERING

Increasing meaning of manufacture and technology for competitiveness of enterprises causes that engineers are still and still more confronted with complicated issues having great market, economical, social and ethical consequences. Industrial engineering grants the appropriate professionalism to solve these issues of enterprise practice.

The ambition of industrial engineering is to prepare specialists who are able to search and implement system solutions of manufacturing and supply problems, to increase efficiency of enterprise processes, who are able to plan and project manufacturing processes and systems, to provide their high productivity and reliability and to eliminate all sorts of losses and costs which do not create value added. The indivisible part of the professional profile of an industrial engineer is also his ability to participate in creation and implementation of related innovation activities which are necessary to increase competitiveness permanently.

Characteristics

Industrial engineering is a multidisciplinary branch combining knowledge of the engineering field and experience of enterprise management. This branch should use all available sources inside the company as effectively as possible, which are e. g. information itself, financial sources, human work, knowledge and abilities of people etc. Therefore, its main task is to rationalize, optimize and improve manufacturing and non manufacturing processes. Industrial engineering deals systematically with methodology aimed to project, plan, implement and to improve processes and implementation ability in the innovation field with the target to provide their high efficiency and competitiveness. Changes are applied at practice through projects which shall eliminate all losses and to provide the highest possible productivity. Industrial engineering can be also understood as searching of methods how to perform and manage enterprise processes in a simpler and quicker way with bigger quality and flexibility.

There is a great number of definitions available to characterize industrial engineering and they more or less cover its true meaning; however, in their consequence they have the common base. The author's definition is the following one:

Industrial engineering is the comprehensive social discipline, whose main function is to grant knowledge and abilities necessary

to simplify, improve, accelerate and streamline enterprise activities. Tools and methods of industrial engineering like project management, quality management, modelling and simulation, system engineering and tools of statistics are used not only by enterprises in many industrial branches but also in institutions of financial services and in other fields of non-manufacturing spheres.

Short view to the history

The essential ideas of industrial engineering (IE) were put in practice and in the educational process by such personalities like F. W. Taylor, W. Shewhart and H. Ford and it was done already since from the first mid 19th century. The important personality at the next formulation of IE contents and strategy was Japanese Shiengeo Shinga who since the forties formulated the "IE school" which has been studied by the whole industrial world up to now.

The American Institute of Industrial Engineers (AIIE) was established in 1948 and this started another IE phase. This phase is characterized especially by completion of classical empiric methods by new theoretical approaches based especially on mathematical methods, operational research, simulation modelling, etc.

Thanks to the development of computer hardware and software, means originated during the second mid 20th century and these means were determined to analyse more extensive and more complicated manufacturing processes and systems. At the same time, in this time period tools (programs) begun to be created and these tools (programs) were based on usage of human potential and its motivation at solution of these tasks. This period gave the birth of generally well known tools as CAD (Computer Aid Design), CAM (Computer Aid Manufacturing), CAQ (Computer Aid Quality), PDM (Product Data Management), CIM (Computer Integrated Manufacturing) and many others are.

At the beginning of the 21st century all above mentioned tools were covered by the term "Digital Factory". The digital factory is

being dynamically further developed within IE, it uses knowledge management elements at the current time as well as globalization, digitizing and artificial intelligence elements and as a whole, it is now designated as a "Smart Factory" [Dvořák 2010].

During the recent ten years, industrial engineering has passed through a great development and it had to react very quickly to new needs of industry and new business systems. Companies started to establish new organization units which were primarily aimed at the industrial engineering fields, which really proves the importance of this branch. In spite of this, every industrial engineer faces a new challenge in new dimensions of the business system – an industrial engineer's role in pre manufacturing and development phases of the product; an industrial engineer's role in service and non manufacturing companies; minimization of the business system; narrow specialization and a bigger demanding character at details; designing of working surroundings of people at still growing older population; importance of information technologies; continuous changes in the business system and its role of the leader and carrier of changes [Denár 2011].

Organization of industrial engineering in the manufacturing process

If any organization begins to deal with building of the industrial engineering unit, at the beginning it must assess unambiguously the optimization extent – manufacture versus administration versus service versus development – moreover, connection of industrial engineering with organization strategy, the level and importance of the production system building, competence of an industrial engineer and his classification to the organization structure. Moreover, it must assess the improvement system and its strategy and to put the question whether any improvement system is available today or if a new one has to be created. It is necessary to take into account the level of enterprise culture and the level of resistance against changes and to determine what is expected from industrial engineers.

The organization of industrial engineering is dependent on the particular enterprises and companies as well as on their types of manufacture and services which they offer. The optimum work organization of this section

is not uniquely determined and even it should be not uniquely determined. The necessary condition which should be fulfilled is the fact that this section must be an independent and autonomous one and in the organization aspect, it should not be incorporated to the manufacturing department or in other departments. As e. g. [Denár 2011] mentions, the industrial engineering department should

engineering the the company. Among the main factors it is possible to mention:

- IE position within the organization structure;
- contents of its work, appropriate responsibilities and competence;
- the system how to evaluate work of this section.

Reality how the industrial engineering section is incorporated can be very miscellaneous

department or the quality department. The author [Dlabač 2011] met also the case when industrial engineering was subordinated under the logistics section, under the financial management and the audit section or even under the administration and maintenance of buildings. Which solution is the correct one? Where industrial engineering should be incorporated? May be, there is no unambiguous and generally valid answer available to answer these questions. Its incorporation should always result from the organization strategy and from the fact what the organization expects from industrial engineering and what it wants to aim its activity primarily at. And this is just often the stumbling block and one of the main carriers of later failure. In many cases, even the company's management itself has no clear idea about activities of this department or about strategy of its next development. It is very often that comic situations can happen when industrial engineers can be found in the property management department or in the maintenance department. How can such a situation occur? It is simple – the management does not know “where to put an industrial engineer” and so it subordinates him under the organization unit which is undersized at the current time or under a manager who is mostly inclined to it.

Integration of industrial engineering in the manufacturing department or in the technology department – which is the most common case at the current time – need not be naturally bad. Indisputably, there are companies which agree with this position and in the case, that the carrying and primary

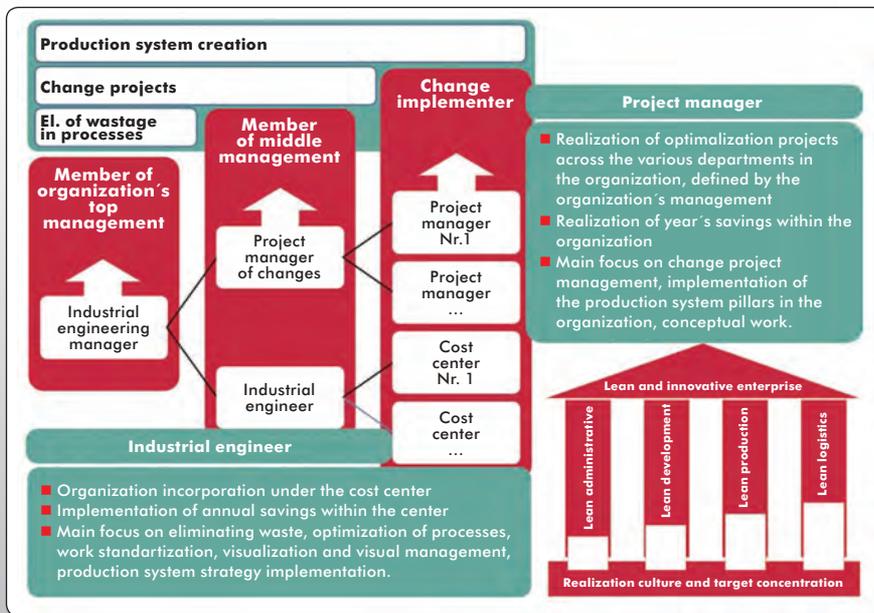


Fig. 2.1.1: Possible incorporation of industrial engineering to the enterprise structure [Denár 2011]

be incorporated directly under the general director of the particular company and he mentions the following reasons to do it:

- Industrial engineering methods must be used in the whole enterprise, not only in the manufacture.
- Independent and unprejudiced view of processes in organizations.
- Creation of the production system as a continual tool for implementation of the business organization strategy.

Industrial engineering is not such an unknown term in enterprises as it used to be sooner. Even in the Czech Republic there are many companies which have incorporated industrial engineering in their organization structure and due to this, they utilize efficiency brought by this section. In order to utilize its potential in the whole extent, it is necessary to take into account a few of factors which – in their final consequences – influence considerably efficiency of industrial

in Czech enterprises. In the most cases, this unit is incorporated in the manufacturing department, it is very often organized under the technology department or the technological manufacture preparation

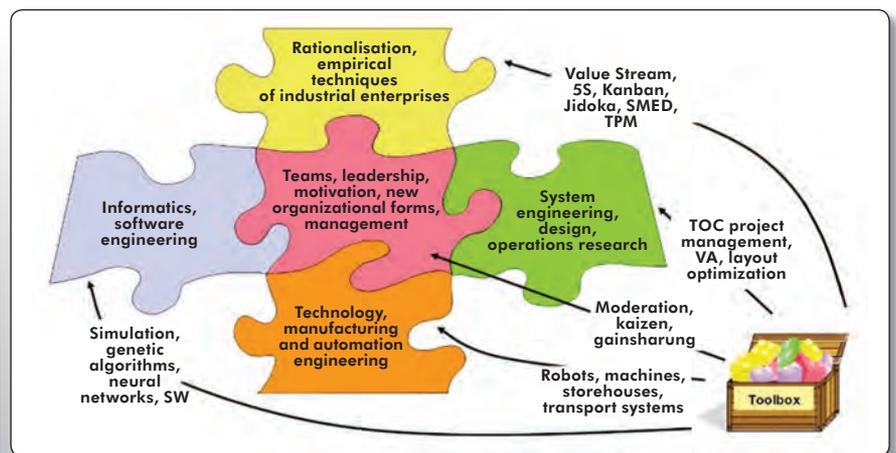


Fig. 2.1.2: Integration of branches and methods in industrial engineering [Košťuriak 2010]

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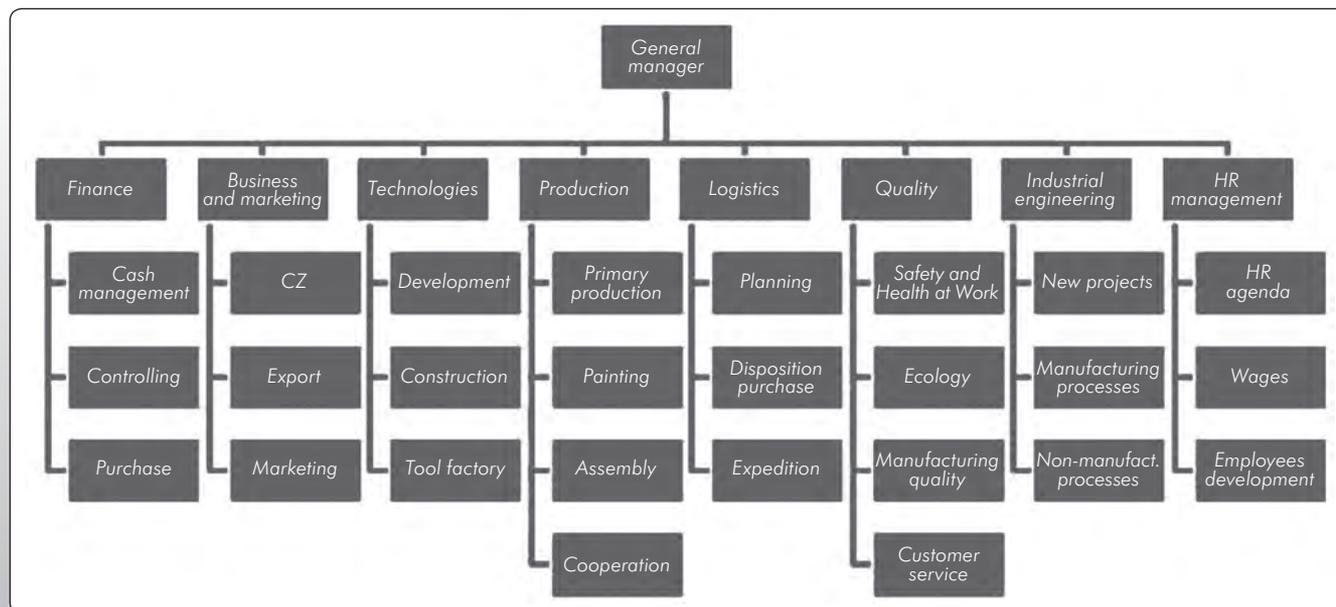


Fig. 2.1.3: Organization structure example [Dlabač 2011]

target of the department is only to improve procedures in manufacture or to solve mainly technical issues within the given product group, it can be very profitable to a certain extent. Then, this incorporation is a rather logical one. However, it cannot be expected that the substance of an industrial engineer's work will be fulfilled – i. e. optimization and improvement of manufacturing and non-manufacturing processes [Dlabač 2011]. This incorporation limits very considerably the field of its activity with regard to competencies throughout the company. Then, it is almost impossible for an industrial engineer to deal with optimization of administration processes e. g. in the commercial department, because it is sure that competencies of such a team or such a IE section do not cover this field. If the potential should be used to the full extent which is offered by industrial engineering by its function, this department must be wholly independent and autonomous and it must be incorporated directly under the general director in the organization structure. In such a case, the engineering department chairman becomes a part of the top company management. Then, he has a unique opportunity to influence efficiency throughout the whole organization structure. However, the condition of such an incorporation is conviction – or better to say goodwill to optimize not only manufacturing activities.

New trends of industrial engineering and its aiming

For long time, industrial engineering has not been only the domain of manufacturing companies. New trends in its branch can be now aimed primarily at four essential zones. The first one is represented by pre manufacturing periods and development, when companies try to involve the industrial engineer more and more in pre

manufacturing and development stages, considering the character of the industrial engineer. This can be done thanks to his valuable knowledge from the view of production system projecting. He is an excellent opponent of the designed solution and a moderator able to solve potential problems correctly.

The second sphere is represented by administration and services. For example,

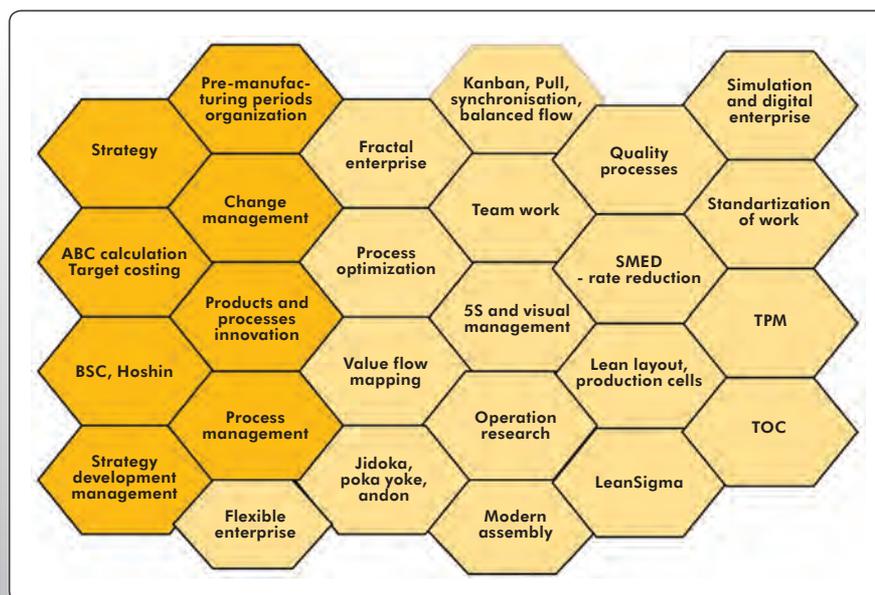


Fig. 2.1.4: Methods, tools and processes of industrial engineering [Košturiak 2010]