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SCIENCE AND INDUSTRY IN A COUNTRY OF CHANGES

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PIOTR DRZEWIECKI

engineer, mechanical technician, industrialist, President of Warsaw

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Ladies and gentlemen,

The abundant scientific, inventive and innovative achievements of Polish creators of technology are too little popularized on the international level. The Constitution for science, as being resolved by the Parliament of the Republic of Poland in 2018, has many provisions which are expected to change the existing situation. The engineering environment, acting within the frames of the Federation of Engineering Associations – Polish Chief Technical Organization (NOT), has undertaken a decision on revival of English version of Polish Technical Review which was published by SIGMA-NOT Editorial House many years ago. We are coming back to the mentioned publication. Its aim was before and will be - in the future - the promotion of technical solutions, developed in Polish universities, research institutes, scientific centres, i.e. in the environment which creates the scientific and development background of Polish economy.

Engineering associations, acting in the frames of Polish Chief Technical Organization, represent all domains of technique. Their members may be proud of many inventions and solutions being on a high level of technological advancement. We express the opinion that they should be presented not only in the country but also abroad.

When we commenced renewal of the scientific-technical journal Polish Technical Review, we addressed the outstanding Polish scientists and inventors, working in Poland and abroad, and asked them to present their achievements in the mentioned periodical. We expect we will find the way to the persons who are interested in their application. It would allow establishing cooperation between Polish scientific institutions and foreign companies. On one hand, it would be the possibility of commercializing technical solutions of Polish industrial science and on the other hand, the occasion for recognizing the expectations and requirements of the companies situated outside the borders of Poland.

We offer you, ladies and gentlemen, the renewed quarterly with rich traditions and we hope that it may become a useful instrument of popularization on innovative solutions of Polish authors of engineering thought on foreign forum. We expect cooperation of the engineering environment with the research & development background and representatives of the enterprises.

We wish you good and useful reading of our new-old journal.

Ewa Mańkiewicz-Cudny
The President of FSNT-NOT

Ladies and gentlemen,

It is my great honour and pleasure, as the Chief Editor, to present to you the newest edition of POLISH TECHNICAL REVIEW. Reactivated, after 25 years' pause, the magazine that presents scientific and professional achievements of Polish scientists and engineers will take a part in knowledge, innovativeness and Polish technical thoughts' popularization, in Poland as well as abroad.

During 30 years of existence on the publishing market, POLISH TECHNICAL REVIEW has been disseminating the progress of knowledge, achievements and contemporary problems, the history of technical concepts and achievements, as well as the profiles of outstanding people of science and technology. The subject matters, which were presented in the magazine were always comprehensive – in the pages of POLISH TECHNICAL REVIEW there were discussed the achievements from all technical fields.

I will do my best to make the new editions of POLISH TECHNICAL REVIEW the source of knowledge and inspiration for whole Polish engineering community.

I wish you a pleasant and inspiring reading.

Michał Szota
Editor in Chief

dr hab. inż. Bożena GAJDZIK, dr inż. Sandra GRABOWSKA, prof. dr hab. inż. Andrzej WYCIŚLIK

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EXPLANATORY PREVIEW OF DIRECTIONS OF CHANGES IN DEVELOPMENT OF INDUSTRY 4.0

POGLĄDOWE UJĘCIE KIERUNKÓW ZMIAN W ROZWOJU PRZEMYSŁU 4.0

Summary: *The paper is commenced with the citation of Klaus Schwab, founder and the Executive Chairman of the World Economic Forum; "We are at the beginning of a technical revolution that is fundamentally changing the way we live, work and relate to one another (...) (Schwab, 2016, p.12)". The environment of scientists and business practitioners speaks more and more frequently on the new challenges for the industry in connection with the Fourth Industrial Revolution. Industry 4.0 is a result of development of cyber-physical manufacturing processes within the frames of the 4.0 industrial revolution. Scientists, politicians and entrepreneurs discuss the trends of changes in the industry. Industry 4.0 sets the new areas of changes in the area of production and management of total chain of supplies (SCM, Supply Chain Management). The present paper has been created on the grounds of literature study concerning the area of the discussed subject. The authors of the article have compiled the industrial changes, as discussed in publications and created a list of the key trends of the changes. The present work may become a voice in discussion on the direction of the changes in Industry 4.0.*

Keywords*: the fourth industrial revolution, Industry 4.0, directions of changes*

Streszczenie: *Cytując Klausa Schwaba, założyciela i przewodniczącego World Economic Forum: „Stoimy u progu technologicznej rewolucji, która gruntownie zmienia sposób, w jaki żyjemy, pracujemy i współistniejemy (…) (Schwab 2016, p. 12)". Coraz częściej w środowisku naukowców i praktyków biznesu mówi się o nowych wyzwaniach dla przemysłu w związku czwarta rewolucją przemysłową. Przemysł 4.0 jest rezultatem rozwoju cyber-fizycznych systemów wytwarzania w ramach czwartej rewolucji przemysłowej. Naukowcy, politycy, przedsiębiorcy dyskutują o kierunkach zmian w przemyśle. Przemysłu 4.0 wyznacza nowe obszary zmian w sferze produkcji i zarządzaniu całym łańcuchem dostaw (SCM). Niniejsza praca powstała na podstawie studium literaturowego w przedmiotowym zakresie tematu. Celem publikacji było przybliżenie czytelnikom kierunków (tendencji) zmian w Przemyśle 4.0. Autorzy publikacji kompilując omówione w publikacjach zmiany przemysłowe, utworzyli listę kluczowych kierunków zmian. Praca może stanowić głos w dyskusji nad kierunkami zmian w Przemyśle 4.0.*

Słowa kluczowe: *czwarta rewolucja przemysłowa, Przemysł 4.0, kierunki zmian*

Introduction

Since the dawn of the history, we have observed a development of technical solutions which have to improve production. Under the conditions of dynamic changes in the environment which became intensive by the end of the 20th century, the enterprises are forced to introduce constantly the changes in the particular areas of their activity in order to maintain their competitive position. The introduction of modern technical solutions as compared to other market participants is the extremely significant activity for functioning of every enterprise. Industrial changes are concentrated on technology, time and quality. Combination of ICT, industry and Internet lie behind the conception of a new industry. The idea of "Industry 4.0" that was introduced in 2011 by Henning Kagermann, professor of physics and former President of SAP management, has been transformed into strategy for development of German industry. Recently, it has become also a very popular slogan, used to determine the changes concerning industrial sector in the period of shaping a new phase of development, being called the Fourth Industrial Revolution. The fourth industrial revolution that was commenced in 2012, utilizes the following technical solutions: automation and robotics, digitalization and Internet and is based partially upon the achievements of 3.0 industrial revolution (Industry 3.0 was identified with the growth in automation and IT systems, mainly in respect of production planning and control). Industry 4.0 is, therefore, the consequence of the development of changes, performed during the stage of the 3.0 industrial revolution. On the present stage, we already speak about full automation of production, robotics in systems, specified as cyber-physical manufacturing systems due to the fact of introducing the equipment into the network with the use of internet standards. Development of automation and robotics of the industrial operations is aimed at creation of artificial intelligence, that is (in a big simplification) self-improving devices (objects). The changes in manufacturing technologies and development of digitalization and Internet have brought the changes in the industry. The range of the changes is determined by the economic development of particular countries and investing possibilities of the enterprises. At present, Industry 4.0 is implemented already in highly-developed countries, including Germany, USA and Japan. Other countries initiate also the activities, aimed at development of industry 4.0. Not all sectors introduce the newest solutions of the fourth industrial revolution; Automotive belongs to the key ones. The process of introducing the changes proceeds gradually; it may be anticipated that the changes will become intensive in the coming decade and in further years of the contemporary century. The question: which directions of changes determine (describe) Industry 4.0, is the issue which was adopted as the aim of the paper: "Explanatory preview of directions of the changes in development of Industry 4.0". The design of the work includes the characteristics of the basic trends of changes. The paper contains also a scheme of the discussed trends of changes in Industry 4.0.

Trends of changes in Industry 4.0 – towards cyber-physical manufacturing processes

Development of Industry 4.0 means, first of all, a full automation and robotics of production, with the utilization of ICT and IT in respect of control of equipment and communication in the systems: man – machine (P2M), machine – machine (M2M), man – man (P2P). It means also an access to the data within the frames of cloud computing. Smart factory is a virtual (digital) copy of real world, utilizing Internet of Things (IoT), (Chui, 2010, pp.1-9). Systems – CCPS – are structures combining IT and OT (operating technology). Production is included in communication solutions within

Internet of Things – IoT (Ashton, 2016) and Internet of Services – IoS. The applied production technology in industry 4.0 is Advanced Manufacturing due to the automatic search for and introduction of the best solutions for manufacture of the products, with the existing resources of the enterprise and after consideration of personalized needs of the customer (Hermann, 2015). Industry 4.0 utilizes many technologies, including business analytics, robotics, printing 3D (Industry 4.0 – Summary report, 2015).

The fundamental direction of changes in the area of production, recognized as the initial (basic) includes further (as compared to Industry 3.0) automation of the manufacturing processes. The successive equipment with a limited work, implemented by man, is introduced to manufacturing areas. The number of robots and industrial manipulators, employed in manufacture of the products, is increasing. According to the data of the International Federation of Robotics (IFR), in 2015 there was sold the record – until now - number of industrial robots i.e. 240 thousand pieces (by 8% more than in 2014). The highest growth dynamics in 2015 was recorded in the east Europe (29%). The total number of industrial robots in the world is equal to 2 million pcs. Value of the discussed sector (sales, software and service) in 2015 amounted to 32 billion USD (Pieriegaud, 2016).

The directions initiating the further development of Industry 4.0 include also digitization (digitalization) of the industry. The terms "digitalization" and "digitization" are often used interchangeably (Ciesielski). Apart from digital economy, there are also other terms such as new economy, e-economy, network economy (Pelts and Waldfogel, 2012; Gajewski et al., 2016). The development of digitization in economy results in development of digitization of the industry. Therefore, analogically, we may speak about new industry, e-industry and network industry. Digital transformation in the industry, especially in the area of production is called digital manufacturing technology. The components of digital manufacture technology include digital data, automation, connectivity and digital customer access (Greenstein, Goldfarb, Tucker, 2013). Digitization more and more differentiates the companies and classifies them into winners and the defeated. Its limitation mainly to sales and marketing will not assure the permanent competition advantage because the borders of competition are changing and disappearing; it will be held within the frames of new arising ecosystems. The studies of McKinsey, as conducted among the world companies indicate that the average level of their digitization is equal to 37%. The truly digitized business models are found sector of media, e-commerce and in the high-tech area. About 49% of the companies implement digitalized strategies of sales and marketing. Digitization includes also products and services (21%) (Pieriegiud, 2015). There is no Industry 4.0 without Internet of Things (IoT). Internet has become a basis for information revolution, enabling creation of new forms of communication. IoT in industry 4.0 cannot function without Big data and Analytic Data (Ashton, 2009; Barciński, 2016, 2016; Chui, Lőffler, Roberts, 2010, pp. 1-9).

Owing to the development of Internet, the cyber-space is being created that combines people and equipment (Wellman, 2001, pp.227-252). More than three quarters inhabitants of Poland have an access to Internet and a decisive majority uses it regularly. It is followed from the report "Information population in Poland in 2018, published by the Main Statistical Bureau (GUS). About 77.5% of persons in Poland used Internet in 2018 (by 1.6% increase as compared to 2017). The percentage of households, equipped with computers was also increased. In 2018, it amounted to 82.7% (by 0.9% more than in 2017). Almost 96% of the companies in Poland have an access to Internet. There is increased the number of the companies using mobile links (67.6%), cloud services (11.5%), e-commerce (33.6%), e-administration (71.3%) and social media (30.3%) (The Main Statistical Bureau, GUS, Report "Information Population in Poland in 2018).

The mentioned three directions, i.e. automation, robotics, digitalization of IT technology and access to Internet have been recognized by the authors as the initiating/basic for the development of Industry 4.0. The mentioned directions were initiated as early as in the second half of the previous century and are continued and their further development contributes to introduction of the changes in manufacture of the products and logistics at the level 4.0.

In turn, the key direction of the changes without which there is no Industry 4.0, includes creation of new systems of manufacturing lines. First, the new solutions include the devices, furnished with sensors. The sensors, as being installed in the devices of the manufacturing line, transmit information to a computer network that links the equipment and people (M2M, P2M, and P2P). The data from the computer network are transmitted to the system of data collecting and processing. The systems of processing supply the data for decisional analysis. The mentioned equipment is controlled by the systems with the utilization of feedback information what facilitates the successive (better) production via introduction of the changes. The scheme of a new manufacturing system is given in fig.1.

The highest form of development of manufacturing systems includes building of cyber-physical systems (CPS). CPS means integration of computing and physical processes (Lee, 2006). CPS is integration of computation, networking and physical processes (Tőrngren, 2016 a). In the descriptions of CPS we can distinguish some key words: integrate physical, embedded, networking, IT systems, IoT, Industry 4.0 etc. (Tőrngren, 2015; Wang et al, 2015; Lee, Bagheri, Kao, 2015). CPS are embedded computers and networks which monitor and control the physical processes, usually with feedback loops where physical processes affect computations and vice versa. On a more technical level CPS is embedded computational systems equipped with network capabilities (Lee, Seshia, 2015; Wang et al., 2015). Embedded systems are major drivers of innovation for current high-tech products. CPS are part of a globally connected world where products, devices and objects interact beyond classical application boundaries and form the internet of things, data and services (Lee, 2006). CPS is integration of computational with physical processes. The system consists of (Lee et al., 2015):

1. Smart Connection
2. Data-to-information Conversion
3. Cyber
4. Cognition
5. Configuration.

In the mentioned above systems, a customer has a significant meaning; if he needs anything, he takes a mobile device. In the USA, we speak already about mobile-first what means that in various situations, when we need information about service or product; we take a mobile device that we have

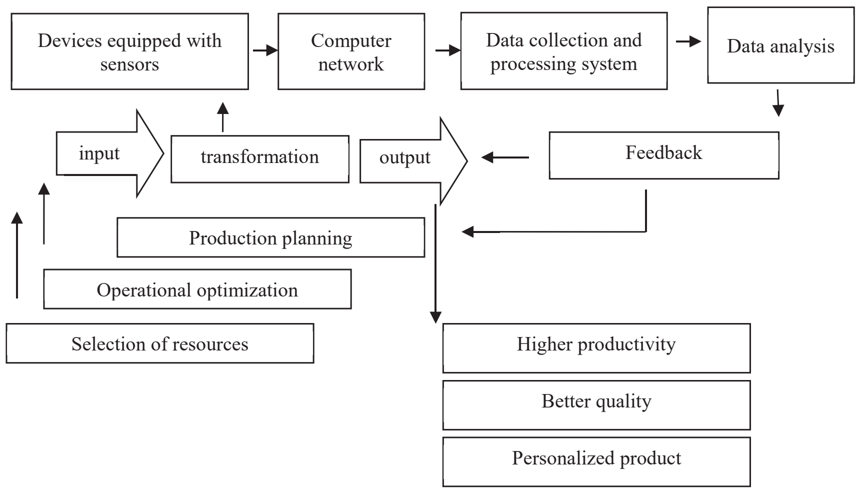


Fig.1. Scheme of production in Industry 4.0
Source: own development

at reach of hand. When using mobile devices, the people order products or services which concern strictly the specified person. The products are therefore personalized (customization).

The successive trend in development of Industry 4.0 is investing in manufacture of the products the properties of which meet the individual needs of the customers. The client uses IoT. A strong competition and growing expectations of the clients on the contemporary market cause that together with the increase of production effectiveness, the customization of the product takes place; it is manufacture of the products when the client decides on the product. At the same time, the price of the product should be approximate to the price of the products, manufactured in mass production. Such possibilities are guaranteed by the conception of Industry 4.0 that assumes building of completely integrated system of suppliers,, producers and customers, creating cyber-physical systems that are capable of implementing many functions and activities, imposed by production, logistics and management. In consequence, the chain of supplies becomes more elastic and production is more effective and quicker. Production on demand changes also storage and logistics. Owing to printers 3D the warehouses are more and more personalized (Bauerhansl, Hompel, Vogel-Henser, 2014; Gracel, 2017).

Industry 4.0 is not limited only to the mentioned changes because its essence consists in permanent adaptation to new external conditions and internal possibilities. A final direction of changes includes smart production that creates a new value for customer (Blaik, 2018; Kaliczyńska, Dąbek, 2015, pp. 51-63).

General information on the direction of changes in logistics

The process of control of equipment via access to Internet exceeds the production and includes also transportation means, systems of ordering, storehouses (Wang, 2016, pp. 259-268). Logistics, as introduced within the frames of Industry 4.0, is implemented using the newest solutions of communication in cyber-physical systems. In logistics 4.0, we introduce digitization of all possible operations of transmitting the products from point A to point B (Bauernhansl et al., 2014). In logistics 4.0, we assume greater (than until now) adaptation of operations according to the expectations of the customer via creation of new values and their higher utility for the customer. The mentioned client is a creator or the products (personalization) as well as of specification of logistic service (he chooses the parameters of logistic process according to his needs) (Blaik, 2018). His meticulous (detailed) decisions are implemented by logistic companies which cooperate mutually in a greater degree than before (the process of sharing the information) in the process of supply of a product to a customer – Quick Response Logistics – QRL). The Quick systems use IT technology, bar code of the products and cash registers with laser readers. The systems of quick reaction reduce the time of operations, facilitate the reduction of reserves in the whole system and have a favourable effect on meeting the requirements of the customers (Welman, 2001, pp. 227 – 252).

General information on the direction of changes in organization and management

The changes resulting from the requirements of Industry 4.0 impose restructuring or even creation a new business models in certain areas of management. In the future business realities, what was earlier the domain of many market participants, it will be offered within one application by one player. The tendencies will be shaped deeply by the expectations and experiences of the customers, creating the potential of transforming almost every sector, as least within the frames of B2C area. In consequence, during the few coming years, the companies will be forced to specify their strategies and business models in a completely different way – not only in relation to traditional market competitors but to the consume, being in statu nascendi.

The adaptation of the enterprises to Industry 4.0 requires considerable investments on automation, robotics and digitization which allow employing more intelligent communication technologies in the future and also developing innovatory models of business, considering new strategies of business, innovatory vision and mission of the enterprise, new culture of work, being oriented to teal organization, new systems of management of staff and, also, organizational structures, considering the necessity of on-line work (realities of virtual organization) (Gajdzik, Grabowska, 2018).

The creators of innovative business models in Industry 4.0 are not afraid of questioning the adopted way of thinking and introduce new solutions for a new group of customers (e.g. colour-changing material for clothes), via a new channels of sales and form of deliveries (e.g. autonomic vehicles), new way of establishing the prices or a source of incomes (e.g. apart from sale of coffee, Tchibo company generates the revenues coming from the sales of utility products).

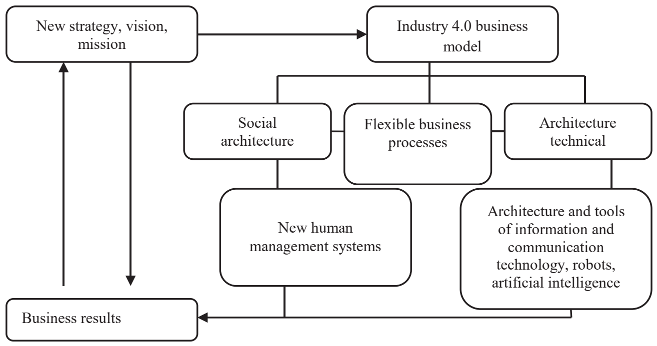
If we want to create a conception of business model of the enterprises functioning in the age of Industry 4.0, we have to begin with two basic assumptions (Prahalad, Krishnan, 2010);

- Value is personalized, that is, specified by the experience, acquired at a given time by a single consumer (the phenomenon will be called N=1 where N is a number of customers) who initiates the process of production and participates in designing of the product (customization). The product, as offered by the company is a proposal for a customer who participates in its modification and adopts it to his expectations and he gains also the satisfaction that he will receive the product which meets his expectations. Value is based upon the exceptional personalized experiences of the clients. The enterprises must concentrate on one customer. Irrespectively of the number of the customers, the attention is focused on the central position of the unit. Owing to orientation as to the needs of the individual client, it is possible to receive, in return, his ideas and conceptions, or directly materialized product. Such approach to the customer means treating him as active receiver and modifier of the product, i.e. pro-consumer what is the main assumption of the conception of Industry 4.0.
- The companies, serving the customers in the chain of values, are horizontally integrated (a wide range of cooperation of the entities) and cooperation between the participants is very flexible (on demand, as any company is not so big in respect of range and dimensions as to meet all expectations of individual consumer in a given time). The resources are a limitation, or rather the access to the resources in a given time (most frequently, in relatively short time e.g. implementation of order up to 24h or shorter). In the supply chain it is adopted that the resources will be taken from different suppliers and the access will be global (the mentioned trend will be marked as R=G where R means resources and G is Global) and production of the products, services and competencies have a multi-institutional nature. All enterprises have an access to global ecosystem covering also the resources. The enterprises seek for access to the resources and not only focus on their possession (the resources are global from many suppliers, often

from any place in the world) (Salvesen, 2014; Szymańska et al., 2017, pp. 299 – 310; Kadłubek, 2010, pp.55-60).

Business model is a configuration of business processes, which combine and develop the resources, shaped in a form of social and technical architecture of the enterprise (a simplified system of such model is given in Fig.2).

Fig.2. Structure of business model construction, being consistent with the requirement of Industry 4.0



Source: own development

In the area of management systems, the changes in business models and business processes play a significant role. The new business conceptions are reflected in specified model, constituting a strategic and operational basis for change in configuration of products and processes in the enterprise, enabling competing on the market, being determined by the rules of the conception of Industry 4.0. a significant value of the new models will include their treating of their structure as a construction based upon the superior values such as innovativeness and effectiveness which are reached by the appropriately selected and combined model elements in smart system. The utilization of innovations which radically change a strategy of the enterprise facilitates generation of a new market space – formula of success allowing certain "omission" of the s-far existing system of competition via creation of a network of new values.

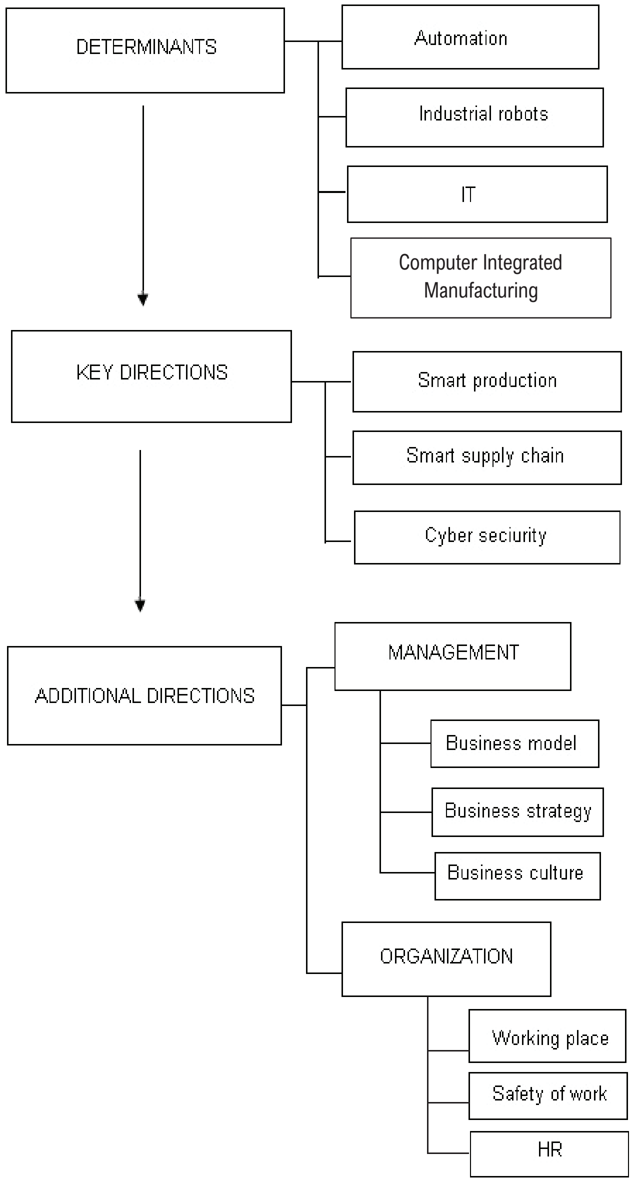
The emerging transformation of business from the conception of Industry 4.0 is based on the tendencies that cannot be reversed. The activity of the consumers, universal communication ability, convergence of technology and professional sectors, globalization of markets and global searches for resources and global access to these resources are the tendencies which are not subjected to control of any single company – hence, it is so important to create a networks of cooperation. They lead unavoidably to the world that has been described as N=1 and R=G, sharing economy, tech-life harmony, i.e. the models following the development of Industry 4.0.

The Industry 4.0 requires form the enterprises to create a new strategy, mission and vision of development. The companies are forced to construct the new organizational structures, being oriented to generation of virtual organization, working on-line, with the employees who learn constantly in a form of e-learning (Grabowska, 2018). A new culture of work is being created and consequently, the new systems of management of human resources. The changes concern also the traditional forms of management in favour of flexible process management. The problems connected with cyber-safety within the frames of social and technical architecture of the enterprise are also important.

Directions of the changes of the enterprises in industry 4.0 - summing up

Technological changes have acquired a strategic meaning in thinking and activities of many market entities, penetrating at the same time all links of the chain of values and the ways of their linking what has changed a range of competition and the way of satisfying the needs of the purchaser. Technical revolution has extended the borders of all this, what they may supply to the customers in a form of values. In the contemporary, strongly competitive manufacturing environment, the enterprises are faced against the challenge of dealing with a great amount of data, the necessity of undertaking quick decisions and implementation of flexibility of manufacturing processes (in aspect of maximally personalized products). The contemporary nature of production is shaped by the changes in paradigm from mass production into on demand production of a customer and more and more flexible control of the resources, engaged in the implementation of production (Gajdzik, 2018). The directions in the changes of the enterprises that adapt to the requirements of Industry 4.0, as discussed in the present article, are given in fig.3.

Fig.3.The explanatory scheme of the discussed directions of changes



Source: own development

Summing up

When summing up the directions of the changes of development in the idea of Industry 4.0, it should be mentioned that it is difficult to foresee how the conception of Industry 4.0 and the accompanying coming industrial revolution will be developing. We cannot be sure that the future reality will overlap the present forecasts. Together with the development of Industry 4.0, the new possibilities as well as threats for the entrepreneurs will appear. Construction of a new industry is not easy as it requires new resources of the enterprises. Formulation and adaptation to the changes is a long-lasting operation. The directions of evolution of the enterprises to the Industry 4.0 as being presented in this publication should be treated as explanatory (in general).

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DEVELOPMENT OF CHEMICAL INDUSTRY IN POLAND. ACHIEVEMENTS AND CONSTRAINTS

ROZWÓJ PRZEMYSŁU CHEMICZNEGO W POLSCE. OSIĄGNIĘCIA I OGRANICZENIA

Summary: *History of chemical industry in Poland was comprehensively outlined. A special attention was paid to the transformation of national economy in Poland early nineties of XX century and them accompanied changes of the chemical industry. Current state of the industry was characterized in detail. Availability of raw materials and innovativeness of the industry were particularly discussed. Some recommendations for the future were given.*

Keywords*: chemical indystry, historical outlook, transformatoin, national economy, innovativeness*

Streszczenie: *Zwięźle naszkicowano historię przemysłu chemicznego w Polsce. Szczególną uwagę zwrócono na transformację gospodarki narodowej na początku lat dziewięćdziesiątych XX w. i towarzyszące jej zmiany w przemyśle chemicznym. Scharakteryzowano dokładnie obecny stan przemysłu chemicznego w Polsce. W szczególności przedyskutowano sprawę dostępności surowców dla przemysłu chemicznego oraz innowacyjności tego przemysłu. Dano też pewne zalecenia na przyszłość.*

Słowa kluczowe: *przemysł chemiczny, spojrzenie historyczne, transformacja, gospodarka narodowa, innowacje*

Chemicals and polymers are key products for the national economy in the country. They are indispensable everywhere: in transportation (both fuels and construction materials), agriculture (fertilizers, preservatives and pesticides), electrical engineering, electronics and telecommunication (conductors and insulators), energy technology (fuel cells, batteries) and construction as well as in medicine and household. The old motto „Chemistry feeds, heals and dresses"[1)] remains still valid up-to-date.

Historical outlook

The history of industrial chemistry in Poland was comprehensively outlined in a reference work[2)]. Distilleries, sugar refineries, salt plants, paper mills, glassworks and zinc smelters were operated on Polish land already in the ninetheenth century. Gunpowder was also the Polish specialty that time[3)]. Just before the World War I, the occupied Poland was a serious deliverer of petroleum-derived products to the European countries from the Galicia-located crude oil refineries. At the beginning of XX century, output of petroleum was 1–2 million tons a year.

During the World War I, the chemical factories were mostly destroyed and had to be rebuilt after the Poland became independent[4)]. The most important was the production of sulfuric acid (by conversion of zinc and iron sulfides), nitrogen and phosphor-containing chemical fertilizers, soda, rubber goods (tires, hoses, gaskets, conveyor belts) and pharmaceuticals. The chemical factories in Chorzow (nitric acid, fertilizers and calcium carbide), Mościce (nitric acid and nitrate fertilizers) and Jaworzno (electrolysis of salt) were the greatest industrial achievements after the World War I in Poland. Moreover, the operation of many small pharmaceuticals-producing factories was also of a crucial importance. The new processes were based either on licences granted by foreign companies or developed at the domestic Chemical Research Institute in Warsaw (synthetic rubber, coal tar-derived products).

The World War II stopped the rapid growth of the chemical industry in Poland[4)]. The chemical factories were totally destroyed or robbed by the German and Soviet occupants. It was necessary to start from the zero level after the war. According to the communistic ideology, the Polish industry has been nationalized. Maybe, it was a right solution because of shortage of private capital resources necessary for the reconstruction. The American Marshal Plan was rejected by Polish administration according to recommendations of the Soviet occupant. Hence, all chemical enterprises became practically also state-owned ones.

The restoration of the chemical industry was carried out in very hard circumstances. There were neither modern processes nor skilled personal available. But the production was the goal. The whole population of Poland was involved in the execution of the first Three-Year Plan (1947-1949) and it was completed successfully in the area of basic (mostly inorganic) chemicals (Table 1).

Table 1. Production of chemicals [3, 4)], Gg/year

PRODUCT	Year			
	1938	1949	1970	1980
Sulfuric acid	196	276	1716	2890
Ammonia	38.5	48.8	1445	1803
Chlorine	4.3	5.0	188	309
Soaps*	53	52	114	244
Fertilizers**	96	669	1629	2095
Soda	87	120	657	762
Sodium hydroxide	30	56	310	416
Sodium chloride	417	450	2900	4510
Plastics and resins	0.7	1.8	267	546
Dyestuffs	2.0	3.8	20.8	25

** various types including washing powders;*
*** both N and P fertilizers*

The consumption needs grew however much faster than the productivity. Therefore, the former German chemical factories on the "regained grounds" (Kędzierzyn, Blachownia Śląska, Brzeg Dolny, Gliwice, Wrocław, Racibórz, Gorzów, Toruń) were set in operation in the fifties to produce some organic intermediates, monomers, carbon black, carbon electrodes, synthetic fibers and plastics. But it was still not enough to meet the demand for chemicals, liquid fuels and polymers. Therefore, a big program for "chemicalization" of the national economy started in the sixties.

A petroleum refinery was the first step in this program. The refinery has been built at Płock. It was really a great deal. According to the assumptions of the Soviet occupants, the refinery was fed with the Romashkino crude oil transported with the "Friendship" pipeline and should deliver gasoline and gas oil for the Soviet occupation troops being stationed on the Polish territory. However, the Polish managers transformed the refinery into a main domestic deliverer of petrochemical raw materials (phenol, aromatics, ethylene, propylene, ethylene oxide, butadiene, polyethylene) for the domestic chemical industry[5-7]. In the next step, the second petroleum refinery has been built in Gdańsk. It was based on licences granted by Western companies and constructed according to the Western specifications and equipment. The refinery processed Arabian crude oil and produced liquid fuels and lubricating oils. This way, the coal-derived chemical raw materials were successfully replaced with petrochemical ones.

That time, modern plants for production of poly(vinyl chloride) at Włocławek, dimethyl terephthalate and poly(ethylene terephthalate) at Toruń, caprolactam in Tarnów and Puławy, polyamide-6 in Gorzów and epoxy resins in Pustków have been also built[3]. The investments contributed to substantial increase in production of plastics (Table 1).

At the beginning of the eighties, the development of the chemical industry has been stopped because of political reasons. The Ministry of Chemical Industry was dissolved and changed to Ministry of Chemical and Light Industries, where chemistry was no more prominent. An economic slump in the chemical industry has been dawned and all investments were suspended.

Transformation of national economy

The transformation of Polish planned national economy to the free-market one started 1989 and was accompanied with formation of joint-stock companies with private shareholders. This way, many companies (also chemical ones) became politically (at least partly) independent and were concentrated on profits. The independence resulted in an investment boom. After 10 years long calm, the companies started with investment to build new production plants and revamp the old ones. It was very well visible on example of the Petrochemia Płock SA refinery (converted then into Polish Oil Company PKN Orlen SA). The investment boom in the Company was shown in Table 2. Unfortunately, privatization was soon stopped and many companies remained state-owned ones.

The privatization was necessary but was carried out very inefficiently and not transparently in many cases. The foreign capital had priority in the process. A friendly takeover of a state-owned factory by the company staff took place only in one case in the chemical industry. The company's facilities for production of dressings in Toruń passed along to employees with a great success. To-day, this company (TZMO) is a global player on the world market of dressings.

Many chemical companies went bankrupt because of lack of financing and know-how, wrong administration and animosity towards privatization. Zachem at Bydgoszcz, Carbochem at Gliwice, Blachownia at Kędzierzyn-Koźle, Hajduki at Chorzów, Zakłady Chemiczne at Tarnowskie Góry and Opol-Rapp at Lewin Brzeski are only few examples of crashed state-owned chemical companies. There were not any real causes for closing the factories in most cases. Only the problems of environmental pollution on the sites have remained unsolved up to now.

Many new chemical companies with Polish capital were advantageously formed that time. Atlas at Łódź (building materials), Impuls at Pruszcz Gdański (surfactants and disinfectants), Viwax at Plock (polyolefin waxes), Inwex at Kielce (brighteners for electroplating, fuel additives, cosmetics) and Kikgel at Ujazd (dressings) are only few examples of the new prospective companies.

The Polish chemical industry was, however, still very late and remained far away behind the developed countries at the turn of the twentieth and twentieth first centuries[9]. Production of sulfuric acid was then not a bench mark for the chemical industry any more. This role played production of ethylene which was on the very low level in Poland (Table 3). First in 2005, it was increased to 0.7 Tg/year.

Table 2. Investments in Polish Oil Company Orlen in 1980–2010[8]

Year of commissioning	Plant	Capacity, Gg/year	Remarks
1983	ethylene oxide and glycols	60	licenced by Shell and Uhde, intensified in 2009
1984	sulfur (Claus)	30	domestic licence
1991	methyl-tert-butylether	120	domestic licence
1993	sulfur (Claus)	60	licenced by Elf and Lurgi
1994	reforming	700	licenced by UOP
1994	hydrorefining gas oil	900	licenced by Mannesmann
1996	bitumen	960	licenced by Poerner
1996	polypropylene film	10	licenced by Brueckner
1997	hydrocracking	2600	licenced by Unocal and UOP
1997	hydrogen	144	licenced by SNAM and KTI
1999	bitumen	1800	licenced by Axens
1999	crude oil distillation	3700	licenced by SNAM
2000	reforming	873	licenced by UOP
2000	hydrorefining gas oil	1600	licenced by ABB Lummus
2000	C5 isomerization	600	licenced by UOP
2000	gas desulfurization	318	domestic licence
2002	crude oil distillation	up to 6700	licenced by Fluor Daniel
2005	olefins	700 (ethylene)	licenced by Lummus Global
2005	aromatics	500	licenced by Krupp and Uhde
2006	gasoline desulfurization	no data	licenced by Axens
2010	hydrorefining gas oil	2200	licenced by Technip
2010	p-xylene	400	licenced by UOP
2010	terephthalic acid	600	licensed by Mitsubishi

Current state

The economic transformation in Poland resulted in an enormous increase in demand on chemicals and related products (polymers, pharmaceuticals, agrochemicals, fuels). The domestic chemical industry was not strong enough to meet the demand. It was done by imports of respective chemicals and chemical products. Therefore, the foreign trade balance became negative. A dramatic situation was observed in pharmaceuticals: in 1991 the balance was a surplus 63 mil $ and in 1966 was a deficit 758 mil $! The foreign trade balance in chemical products has been remaining negative up to day (Fig. 1) although the production value grew permanently (Fig. 2).

Table 3. Production of ethylene[9], Tg/year

Country	1983	1996
USA	13.0	25.5
Japan	3.7	7.5
Germany	3.2	4.6
[…]		
Turkey	0.1	0.4
Bulgaria	0.2	0.4
Poland	0.2	0.4
Portugal	0.1	0.3

Fig. 1. Polish foreign trade balance in chemicals and chemical products in 2006–2017[10], million €

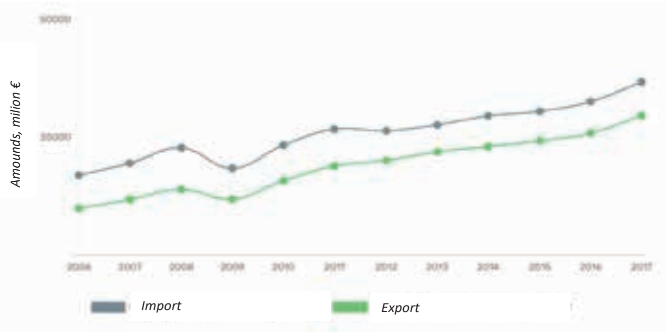
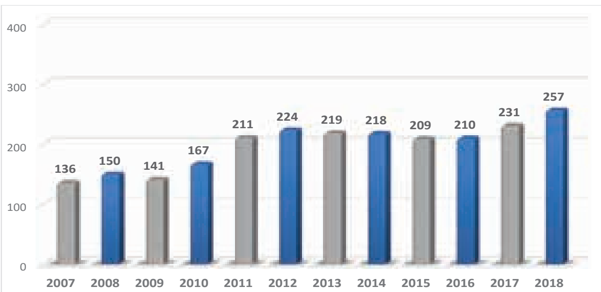


Fig. 2. Growth of the chemical production value in Poland in 2007–2018[11], million zlotys



The situation changed, however, significantly last years. The export of Polish cosmetics reached 1.3 billion euro in 2017 and was by 50% higher than their import. The cosmetics exported are not only products of Beiersdorf, Avon and l'Oreal but also of Polish Ziaja, Dr. Irene Eris and Inglot[10]. The export of Polish pharmaceuticals was substantially increased and reached 3 billion euro in 2017. The exported pharmaceuticals are not only produced in Poland by famous Western companies (Novartis, Sanofi, GlaxoSmithKline) but also by Polish companies (Polpharma, Adamed). Unfortunately, the import of pharmaceuticals remained still higher by 1 billion euro.

The situation in plastics can be hardly evaluated. The balance in foreign trade in plastics is highly negative according to the official data. But the imported plastics are mostly processed in Poland to plastic parts of machines, cars and household equipment or to packages and then exported as goods (not as plastics!). The plastics processing became even a Polish specialty. There are more than 10 Thousand companies active in this branch. Many private enterprises are equipped with modern machines and are competitive on the European market. Plast-Box and Gamrat are only 2 examples of the companies.

All the exported value-added chemical products (pharmaceuticals, cosmetics, plastic goods) came from enterprises with a private capital.

The main players in the chemical industry in Poland are shown on Fig. 3. Some of them are still state-owned companies. Liquid fuels, fertilizers, plastics (including rubbers) and basic chemicals are the main chemical products manufactured in Poland. The most important constructions in Polish chemical industry are shown in Table 4. Unfortunately, they fall short to meet the demand on chemical products by the national economy.

Fig. 3. Basic data on Polish chemical industry in 2017[13]

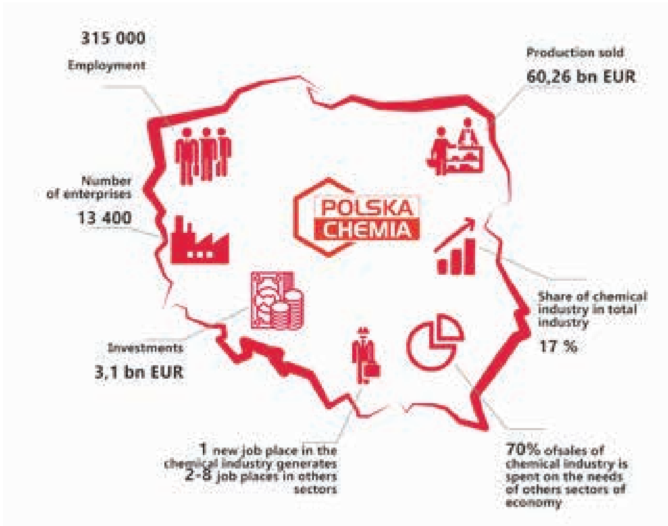


Table 4. The most important capital constructions in Polish chemical industry in 2015–2019[13]

Year	Company	Subject	Capacity, Gg/year	Expenditures, million zloty
2015	Synthos, Oświęcim	SBBR rubber	90	568
2015	Grupa Azoty, Puławy	urea/ammonium sulfate fertilizer	160	138
2015	Grupa Azoty, Kędzierzyn-Koźle	Oxoviflex plasticizer	50	40
2016	Ciech, Inowrocław	soda	200	318
2017	Grupa Azoty, Tarnów	polyamide	80	320
2018	PCC Rokita, Brzeg Dolny	monochloroacetic acid	42	293
2018	Grupa Lotos, Gdańsk	efficient refining EFRA	900*	2300
2019*	PKN Orlen, Płock	propylene	100	400
2019**	Grupa Azoty, Puławy	ammonium nitrate granules	360	365

The development of particular branches of the Polish chemical industry in XXI century was very accurately forecasted by A. Szyprowski[20]. Many of his forecasts were well-aimed (methanol, synthetic fibers) but some of them were to pessimistic (fertilizers, plant protection agents, pharmaceuticals, rubber). Bankruptcy of the company producing epichlorohydrin, isocyanates and polyurethanes (Zachem) was indeed hard to forecast!

Vision of the development of Polish chemical industry given by J. Kijeński[21] was also remarkable. Shortage of investment capital, low production capacities, false political decisions and unsatisfying innovativeness are the basic constraints in the development.

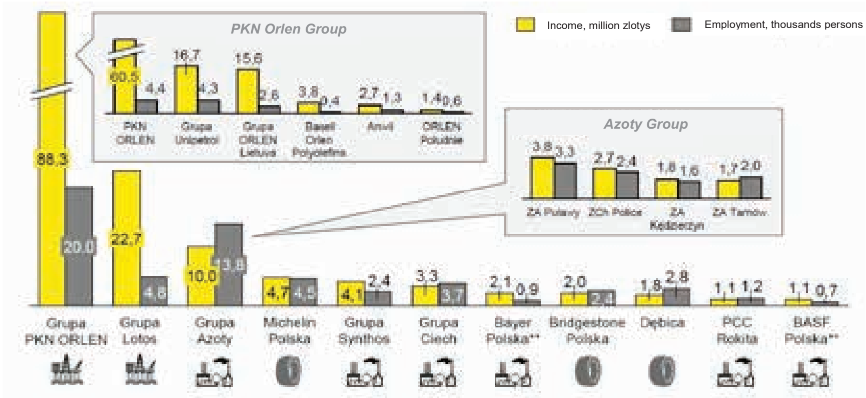
The chemical industry has no economic priority in to-day Poland. Nevertheless, the share of the value of sold chemical products (without fuels) in permanently growing value of total industrial production in Poland was increased from 10.4% in 2005 to 12.2% in 2016[13].

The non-governmental Polish Chamber of Chemical Industry plays a very important role in consolidation of the whole branch, stimulation of its activity, protection of its economic interests and assistance in implementation of EU regulations in the area of process safety, environmental policy and quality issues (both chemical raw materials and products).

Raw materials

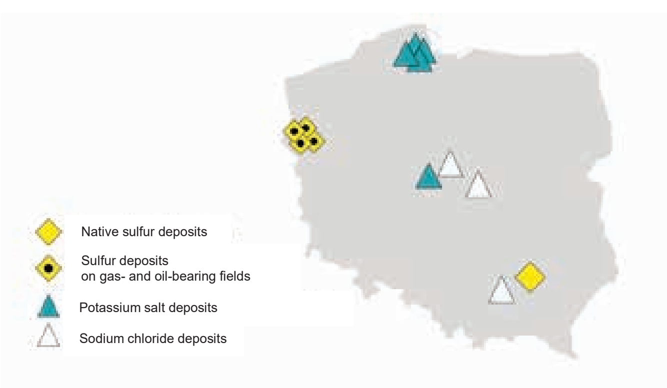
Unfortunately, the country of Poland is rather resourceless and chemical industry has to import most of the raw materials needed. The location of domestic mineral resources in Poland is shown on Fig. 4. There are admittedly big reserves of coal in Poland but its applicability for chemical processing decreased substantially last time. Additionally, the undercapitalization of coal mines and overexploitation of coal deposits resulted in their exhaustion and the coal yield decreased dramatically in last years. A lot of low-quality coal is now even imported to meet the energy production needs. Therefore, the coal gasification to synthesis gas can be hardly considered as the efficient way to replace natural gas in the chemical industry. Coal can be however coked to clean solid fuels ("blue coal") according an original Polish technology (Zabrze). The Polish society has a great liking for coal, called as a "black gold" in the past, and is hopeful about its comeback to the list of chemical feedstocks in the not too distant future.

Fig. 4. Main players on Polish chemical market[13)]



Prospecting the oil and gas-bearing fields is a great challenge for the future but the Polish chemical industry is now import-dependent in this respect. Resources of native sulfur and halite are quite large but they do not play any crucial role for chemical industry (except for potassium and magnesium-containing halites) (Fig. 5). The availability of metallic raw materials is much better. There are big copper, zinc, lead and silver ore deposits under exploitation in Poland. Biomass is also easily available in Polish agriculture and forestry.

Fig. 5. Location of some Polish mineral resources[13)]



Among raw materials, the special role was played by hydrogen, a crucial feedstock for many productions (ammonia, fuels, organic intermediates). Nowadays, the hydrogen is also taken into consideration as a clean fuel for automotive purposes[22)]. The hydrogen is not available in free form on the Earth, but can be produced by conversion of water and/or hydrocarbons (gasification of coal or biomass, reforming of natural gas or other hydrocarbons, as well as electrolysis or thermolysis of water). The emission-free production of hydrogen is still waiting for an economic decision.

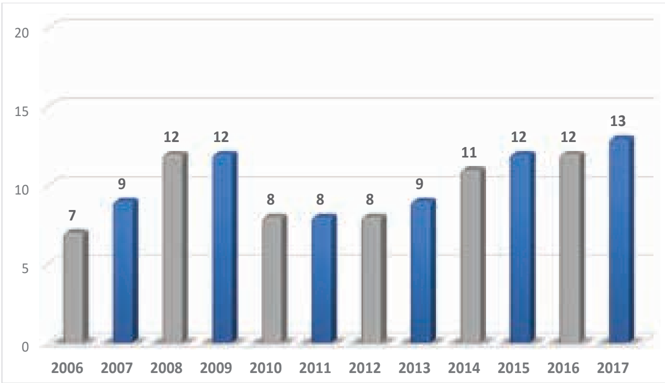
The raw materials can be therefore treated as the key factor limiting the development of the chemical industry in Poland. It has to strive for a high degree of raw material utilization and to bring only value-added products on the market. This principle is applied in Switzerland where the mineral resources are much poorer then in Poland but imported raw materials are converted to expensive pharmaceuticals, dyestuffs and plant protection agents[9)].

The structure of Polish chemical industry does not allow for a rapid transformation from cheap fertilizers, basic chemicals and commodity plastics to value-added specialty chemicals. There are however some projects within easy reach. The crude oil has to be deeply processed to petrochemicals (and not exported as heating oil in any case!) and the biomass waste has to be biotechnologically gasified to biogas. The rate of raw material utilization can be also substantially increased either by circular economy or by using efficient processes for carrying out the chemical reactions (flow chemistry, biotechnology).

Innovativeness

Polish chemical researchers and engineers have made a big contribution to the development of industrial chemistry. The alumina-supported copper-zinc oxide catalyst for low-temperature methanol synthesis developed by E. Błasiak was used for industrial methanol production in Poland (Oświęcim) in 1979 and is still used over the world practically in all new production plants[14)]. The ion exchange resins-catalyzed process for synthesis of bisphenol A developed by E. Grzywa was also used in an industrial plant in Poland (Kędzierzyn-Koźle) in 1982 and in many foreign chemical factories[15, 16)]. An original remedy for arterial hypertension (todralazine hydrochloride, binazine) developed by S. Biniecki (Warsaw) was produced and used in Poland and in Japan. The process for catalytic oxidation of cyclohexane to cyclohexanone, a key intermediate in production of caprolactam developed by S. Ciborowski (Warsaw) and A. Krzysztoforski (Tarnów) was implemented in Poland (Tarnów and Puławy) in 1979 and sold for many foreign companies[17)]. A process for synthesis of methyl (or ethyl)-tert-butyl ether developed by S. Grzeczkowski from the K. Frączek team (Płock) was implemented in Płock refinery in 1991. The process for production of epichlorhydrin by hydrochlorination of glycerol was developed by M. Spadło (Kędzierzyn-Koźle) and sold for abroad. A new phthalate-free plasticizer was developed by B. Tkacz from the A. Krueger team (Kędzierzyn-Koźle) and implemented under commercial scale in Kędzierzyn-Koźle. Finally, a process for production of liquid silicon rubber developed by J. Maciejewski (Warsaw) was implemented in Poland (Kańczuga). There were only some examples of the Polish achievements in industrial chemistry. Fates of the developments were mostly less optimistic. The productions of methanol, bisphenol A, binazine and liquid silicone rubber in Poland were stopped many years ago. Some of the products are imported. The plant for production of epichlorhydrin was constructed (Bydgoszcz) but never started up. Only the plants for manufacturing cyclohexanone, alkyl-tert-butyl ethers and the plasticizer are still under operation in Poland.

Fig. 6. Capital investment in Polish chemical industry in 2006–2017[13], billion zlotys



Many Polish strategic chemical inventions have been never commercialized and were charged off. Graphene, gallium nitride and perovskite are examples of value-added chemical products developed in Poland and thrown away.

Poland occupies only 22nd position (21st in 2018) on the ranking list of Bloomberg Innovation Index 2019. U.K., Australia, Canada and Italy are directly before Poland. Iceland, New Zealand, Czech Republic, Malaysia and Russia are directly after Poland on the ranking list (Table 5). It is far below expectations of the Polish society and Polish chemical industry!

Table 5. Bloomberg 2019 innovation index (an excerpt)[18]

Rank	Economy	Total score
1	South Korea	87.38
2	Germany	87.30
3	Finland	85.57
4	Switzerland	85.49
5	Israel	84.78
	[…]	
19	Australia	75.38
20	Canada	73.65
21	Italy	72.85
22	Poland	69.10
23	Iceland	68.41
24	New Zealand	68.12
25	Czech Republic	68.09

Conclusions and recommendations

Polish chemical industry is closely dependent on the global economy. The energy prices, the availability of raw materials, the human resources of highly skilled personal, the process and product safety, the legal regulation (especially in area of environmental policy) and permanent inflow of knowledge are the main factors determining the future of the chemical industry in Poland.

To be competitive, the Polish chemical industry has to modernize the existing facilities under operation, to construct new production plants and to commercialize processes for manufacturing value-added chemical products according to the market demand. The implementation both domestic or imported know-how and acquisition of respective foreign companies is strongly recommended. In this respect, a close cooperation between chemical industry, research institutes, academia, governmental administration and non-governmental organizations (like Polish Chamber of Chemical Industry or Association of Chemical Engineers) has a substantial importance[19].

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OPERATING COSTS IN NON-LITTER CATTLE BARNS OF HIGH LEVEL OF AUTOMATISATION IN POLAND

KOSZTY EKSPLOATACJI W OBORACH BEZŚCIÓŁKOWYCH W POLSCE O WYSOKIM POZIOMIE AUTOMATYZACJI

Summary: *Recently non-litter dairy cattle barns have become more and more popular in Poland. It is reasonable because of higher costs of littered system. As a result of it, multi criterial approach was applied to assess technical, technological and economic indicators. The following factors were tested: technical, technological and economic. Technical assessment included the areas: constructional, production and utility as well as cubage. Within the frame of technological assessment, all technological treatments were considered (milking and milk cooling, feeding and natural manure removing). Energy, labour and investments cost were used to calculate operating costs of machinery and equipment according to own elaborated methodology. In cattle barn with „fish bone" milking parlor there were the lowest operating costs and in building with 1 milking robot the mentioned costs were the highest.*

Keywords: *energy inputs, milking robots, non-littered housing, operating costs*

Streszczenie: *W ostatnich czasach w Polsce staje się coraz bardziej popularny bezściółkowy system utrzymania bydła mlecznego. Jest to uzasadnione coraz wyższymi kosztami ściółkowego systemu utrzymania. W związku z tym, przeprowadzono wielokryterialną ocenę obór w systemie bezściółkowym. Zbadano czynniki: techniczne, technologiczne i ekonomiczne. Charakterystyka techniczna obejmowała kubaturę oraz powierzchnię: zabudowy, produkcyjną i użytkową. W ramach oceny technologicznej uwzględniono wszystkie zabiegi technologiczne (doju i wstępnej obróbki mleka, przygotowanie i zadawanie pasz, usuwania i magazynowania nawozów naturalnych). Nakłady energetyczne, robocizny oraz inwestycyjne posłużyły do obliczenia kosztów eksploatacji wyposażenia oraz maszyn i urządzeń wg opracowanej metodyki własnej. Najniższe koszty eksploatacji były w oborze wyposażonej w halę udojową „rybia ość" a najwyższe w oborze z jednym robotem udojowym i najniższą obsadą zwierząt.*

Słowa kluczowe: *nakłady energii, roboty udojowe, obory bezściółkowe, koszty eksploatacji*

Introduction

Adapting of buildings barns and their equipment to the requirements of animal welfare, environmental protection, with ensuring of the profitability of production is a necessary condition for sustainable development in view of the intensification of production. The overview of literature leads to the conclusion that there are no studies, which are completely describing the problem of influence of the solutions applied on costs of milk production in non-littered cattle barns, concerning buildings and their equipment with machinery. The analysis contained the human labour inputs, electrical and mechanical energy inputs, what was the basis for calculation of operating costs.

Till now, operating costs in agricultural production were the objectives of the studies of many researchers (Szulc, 2008; Kowalik, Grześ, 2006; Sonnenberg, Graef, 1999).

Objective and scope of research

The main aim of research performed was to analyze the influence of technological solutions in non-littered cattle barns on labour, energy inputs and costs of milk production.

The fragmentary aims included, *inter alia*:

- determination of investment costs of buildings;
- equipment and machinery for technological treatment in milk production such as: milking and milk cooling, preparation of feed and feeding, manure removing, its storage and other work;
- determination of labour inputs and mechanization level in treatments in milk production, in particular cattle barns;
- determination of electric and mechanical energy inputs;
- determination of operating costs of buildings and equipment for mechanization of all technological treatments.

Among many solutions of tied-up and free-stall cattle barns three free-stall cattle barns were chosen in view of the possibility of mechanization and automation of all technological treatments. The scope of research covered three cattle barns.

In particular, the scope of research consisted of the following elements:

- *technical*: description of buildings, construction, mechanization of technological treatments in milk production – machinery and equipment, including three robots for milking, feed scraping and cleaning of slatted floor;
- *technological*: labour inputs, electric and mechanical energy inputs;
- *economical*: investment costs, electric energy costs, mechanical energy costs, labour costs, operating costs.

Methodology

The field tests were conducted by a direct moderated interview method and photography of working day was made, as well as timing scheme. Unitary operating costs of buildings and equipment with machinery taking part in mechanization of four treatments constituted the sum of unitary maintenance and use costs (Kapela et al., 2017; Kowalik, Grześ, 2006). The equations (1) to (9) shows the way of these costs' calculation.

$$c_e = \frac{C_m + C_{us}}{N} \quad [\text{PLN} \cdot \text{LU}^{-1}\ \text{year}^{-1}] \qquad (1)$$

c_e – unitary operating costs [PLN • year^{-1}]
C_m – costs of maintenance [PLN • year^{-1}]
C_{us} – costs of use [PLN • year^{-1}]
N – number of Large Units

Costs of maintenance:

Costs of maintenance (C_m) were the sum of amortization costs of buildings, machinery and their insurance (eq.2)

$$C_m = \frac{C_b}{T_b} + \Sigma \frac{C_{im}}{T_m} + C^b_{ins} + C_{ui} \quad [\text{PLN} \cdot \text{year}^{-1}] \qquad (2)$$

C_{ib} – investments costs of buildings [PLN]
T_b – the assumed stability of the building [number of years]
C^b_{ins} – insurance costs of building [PLN • year^{-1}]
C_{im} – price (value) replacement of machinery or equipment [PLN]
C_m – the assumed stability of the machinery [number of years]
C_{ui} – costs of insurance of machinery and equipment [PLN • year^{-1}]

Costs of usage:

$$C_u = C^b_{ee} + C^b_r + C^m_{ee} + C_{me} + C^m_r + C_L \quad [\text{PLN} \cdot \text{year}^{-1}] \qquad (3)$$

C_u – costs of usage [PLN • year^{-1}]
C^b_{ee} – costs of electrical energy of buildings [PLN • year^{-1}]
C^b_r – costs of repairs in buildings [PLN • year^{-1}]
C^m_{ee} – costs of electrical energy of machinery and equipment for mechanization [PLN • year^{-1}]
C_{me} – costs of mechanical energy [PLN • year^{-1}]
C^m_r – costs of repair of machinery and equipment [PLN • year^{-1}]
C_L – costs of labour inputs [PLN • year^{-1}]

Results

The tested farms were located in the podlaskie (1 cattle barn) and mazovian voivodships (2 cattle barns). The area of farms was from 65 ha to 802 ha of agricultural land and the size of herds was between 83 and 170 LU [Livestock Units]. The milk yield was from 8500 to 9600 l of milk in extra class. These cattle barns were characterized by at least fourth level of mechanization, i.e. diurnal human labour inputs below 10 working minutes per LU. In two cattle barns milking is performed by milking robots (Automatic Milking System or Voluntary Milking System), in one there was a traditional dairy room. The milk cooling was conducted in milk tanks, which were situated in milk rooms.

The cattle barns had a separated feeding corridor, on which feed was discharged by mixer wagons with tractors, the forage was supplied in PMR system (Partly Mixed Ratio). Supplementary dose of concentrates was fed in milking robots (2 barns) or in feeding station (1 barn). The slurry was stored in deep channels under slatted floor, which was situated in manure-walking alleys, whence was periodically pumped out. In all objects tested the cows were in non-littered area. The characteristic of farms and barns tested concerning the ways of mechanization of particular production treatments was shown in table 1.

Table 1. Characteristic of cattle barns tested

No. of barn	**LU milk yield [dm3]**	**Mechanization of treatments: I- milking and milk cooling, II- feeding, III – r moving and storaging of natural manure**			
		I type of dairy unit capacity of milk cooler [dm3]	II feeding waggon, company, capacity/power of engine/the technological line for concentrates feeding	III type of manure, power of tractors's engine + capacity of slurry spreader	IV hoof knife power/swinging brushes power
1	**109 9600**	„fishbone" 2x5(10) 7000	Siloking 12 m³/150 KM/ 2 feeding stations, spiral transporter, silos 12,5 m³	slurry, deep channels, tractor 77,2 KM + slurry spreader 10m³	electrical 0,25kW
2	**170 8500**	2 robots Astronaut A4 10000	RMH 14m³/95 KM/ feeding in two milking robots, spiral transporter, silos 14 m3 and 15 m3	slurry, deep channels, tractor 160 KM + slurry spreader 14,2 m³	electrical 0,25kW/, 3 electrical swinging cow brushes 0,12 kW
3	**83 9500**	robot VMS 5000	SEKO 11 m³/110 KM/ feeding in milking robot and 1 feeding station, spiral transporter, silos 8 m³ and 10 m³	slurry, deep channels, tractor 123 KM + slurry spreader 12,7 m³	electrical 0,25kW/ 2 electrical swinging cow brushes 0,12 kW

Table 2 shows the characteristic of buildings, regarding the area of building, using, resting areas, cubage, kind of roof construction and ventilation system, size of slatted floor and capacities of slurry channels.

Two barns had the construction of roof founded on columns, the remaining building had non-columned construction i.e. steel frames. The steel frames although more expensive, are recommended for objects with width up to 30 meters. Thanks to it there are possibilities for future adaptation of building in case of development. The lack of internal partitions in one-room spaced cattle barns makes the ventilation more effective, because there are not partitions which disturb in gravitational movement of air, making worse the quality of air exchange

Table 2. Building characteristic of cattle barns, using, production and resting areas, slatted floor and capacities of channels for liquid manure.

No of barn	Construction of buildings	Cubage [$m^3 \cdot DJP^{-1}$]	Ventilation/ air inflow/ air outflow	Areas					Unitary capacities of slurry channels
				building [$m^2 \cdot LU^{-1}$]	using [$m^2 \cdot LU^{-1}$]	production [$m^2 \cdot LU^{-1}$]	resting [m2]/ [$m^2 \cdot LU^{-1}$]	slatted floor [m^2]	[$m^3 \cdot LU^{-1}$]
1	one - room spaced non-columned, steel frames	39,74	gravitational /windows roof ridge gap	9,38	9,01	7,85	120/1,10	361,4	3,95
2	three-room spaced, columned	70,64	gravitational/ adjustable curtains/ roof ridge gap	12,44	11,64	10,98	363,5/3,3	1094,8	33,9
3	three-room spaced, columned	74,43	gravitational /windows roof ridge gap	14,86	14,35	11,73	82,8/0,99	461,72	10,43

Tables 3–6 contain the set of machinery and equipment in barns tested, prices and costs of cattle barns buildings

Table 3. Machinery, equipment and prices set for mechanization of technological treatments, costs of cattle barn no 1.

Treatment	Machinery or equipment	Price Cm [PLN•pcs.$^{-1}$]	Number of pieces	Price total [PLN]
I	„fish bone" 2x5(10) DeLaval	110 000	1	110 000
	milk cooler 7000 dm^3	49 000	1	49 000
	heater	500	1	500
II	mixing wagon Siloking 12m^3	76 000	1	76 000
	tractor for mixing wagon Ursus 1614 150 KM	199 348	1	199 348
	telescopic, self-going loader MLT 627 20 Zoll 101KM	158 600	1	158 600
	the technological line for concentrates feeding: spiral transporter, 2 feeding stations, silo	45 000	compl.	45 000
	self-locking feed ladder Meprozet Koscian	17 300	compl.	17 300
	drinking bowls with two chambers, with constant water's level Arntjen	700	2	1400
	drinking pots with one chamber with constant water's level Arntjen	520	2	1040
III	slurry mixer (own production)	4500		4500
	tractor for slurry mixer MF 255 48 KM	87 200	1	87 200
	slurry spreader with pump Meprozet Koscian 10 000 dm^3	59 778	1	59 778
	tractor for slurry spreader	215 000	1	215 000
IV	hoof knife	350	1	350
	electrical aggregate	6 500	1	6 500
			Total outfit [PLN]	**1 031 546**
			Investments costs of building (barn no. 2) [PLN]	**824 236**
			Costs of machinery, equipment and cattle barn building [PLN•LU^{-1}]	**17 025,52**

Table 4. Machinery, equipment and prices set for mechanization of technological treatments, costs of cattle barn no 2.

Treatment	Machinery or equipment	Price Cm [PLN•pcs.$^{-1}$]	Number of pieces	Price total [PLN]
I	milking robot LELY Astronaut A4	350 000	2	700 000
	milk cooler LELY 10000 dm3	140 000	1	140 000
	heater	14 000	1	14 000
II	mixing wagon RMH 14 m^3	98 400	1	98 400
	tractor for mixing wagon SAME 95KM	105 000	1	105 000
	telescopic, self-going loader	221 400	1	221 400
	silage cutter	8 100	1	8 100
	the technological line for concentrates feeding (spiral transporter, silos 14 m^3 and 15 m^3)	40 000	compl.	40 000
	feed pusher (robot) LELY JUNO 150 NN765	65 700	1	65 700
	chambered drinking bowls	2 500	4	10 000
	drinking bowls	80	7	560
III	slurry mixer	16 000	1	16 000
	tractor for slurry mixer 130 KM	172 200	1	172 200
	slurry spreader with pump for slurry 14 200 dm^3	120 000	1	120 000
	tractor for slurry spreader 160 KM	466 000	1	466 000
	robot for cleaning of slatted floor	52 200	1	52 200
IV	hoof knife	350	1	350
	swinging cow brush LELY	6 000	3	18 000
			Total outfit [PLN]	**2 247 910**
			Investments costs of building (barn no. 3) [PLN]	**1 500 000**
			Costs of machinery, equipment and cattle barn building no 3 [PLN•LU^{-1}]	**22 046,52**

Table 5. Machinery, equipment and prices set for mechanization of technological treatments, costs of cattle barn no 3.

Treatment	Machinery or equipment	Price Cm [PLN•pcs.$^{-1}$]	Number of pieces	Price total [PLN]
I	milking robot VMS	400 000	1	400 000
	milk cooler DeLaval 5000 dm^3	55 000	1	55 000
	heater (with heat recovery)	850	1	850
II	mixing wagon SEKO 11 m^3	70 000	1	70 000
	tractor for mixing vagon SAME Roller 450 110 KM	120 000	1	120 000
	tractor SAME 123 KM	200 000	1	200 000
	the technological line for concentrates feeding (spiral transporter, 2 feeding stations, silos PRO AGRO)	40 000	1	40 000
	head- loader TUR -6	25 000	1	25 000
	feed pusher (robot) LELY JUNO	50 000	1	50 000
	chambered drinking bowls	1 000	2	2 000
	drinking bowls	80	4	320
III	slurry mixer (own production)	4 000	1	4 000
	tractor for slurry mixing SAME 90 KM	-	-	-
	slurry spreader 12 600 dm3	67 000	1	67 000
	tractor for slurry spreader SAME 123 KM	the same for mixing vagon	-	-
	robot for slatted floor cleaning	64 500	1	64 500
IV	hoof knife	350	1	350
	swinging cow brush DeLaval	6 250	2	12 500
			Total outfit [PLN]	**111 520**
			Investments costs of building (barn no. 4) [PLN]	**100 525**
			Costs of machinery, equipment and cattle barn building no 4 [PLN•LU^{-1}]	**26 651,14**

Tables 6-8 shows labour and energetic inputs in cattle barns tested.

Table 6. Labour, electrical and mechanical energy inputs set in cattle barn no 1.

Treat-ment	Activity/process	Process time	Process time	Labour inputs	Power of ener-gy source	Energy inputs on process
		[h·LU⁻¹·year⁻¹]	[h·year⁻¹]	[working minutes· year⁻¹]	[kW]	[kWh·year⁻¹]
I	milking + dairy unit washing	12,24	1334,667	85775	2,2 ;0,55; 1,5 heater	4953,05
	milk cooling+ milk tank washing	174,128	18980	1825	4,0+0,75+0,12	9909,75
II	feed loading	1,834	200	12000	74,2	14840
	feed mixing and discharge	2,752	300	18000	110,3	33090
III	slurry mixing	0,183	20	1200	35,3	706
	slurry pumping out	0,825	90	5400	77,2	6948
IV	decornization	2,0	218	13 080	0,25	54,5
	ordering activities, cleaning the walls /ceiling	0,11	12	720	1,75	21,828
	lighting	-	-	not appl.	-	2640,094
Total labour per year				**138000**	**-**	**73163,22**
Daily labour inputs per LU				**3,468**	**-**	**1,838**

Table 7. Labour, electrical and mechanical energy inputs set in cattle barn no 2.

Treat-ment	Activity/process	Process time	Process time	Labour inputs	Power of energy source	Energy inputs on process
		[h·LU⁻¹·year⁻¹]	[h·year⁻¹]	[working minutes· year⁻¹]	[kW]	[kWh·year⁻¹]
I	milking -2 milking robots+ washing	89,75	8200	21717,5	2,2 ;0,55	22 550
	milk cooling +washing of milk tank	27,058	4200	1930,4,4	5,0;2x0,22+2x0,07	22 932,65
II	feed loading	1,17	200	12000	58,8	11760
	feed mixing and discharge	2,35	400	18000	69,8	27920
	feed pushing	2,47	420	not appl.	55 Ah (3,67kW)	4964
III	slurry mixing	0,729	124	7440	95,6	11854,4
	slurry pumping out	0,729	124	7440	110,3	13677,2
	slatted floor cleaning	10,735	1825	not appl.	0,165	310,25
IV	decornization	1,66	283	16980	0,25	70,75
	ordering, cleaning the walls/ceiling	0,08	14,57	874,2	1,75	25,5
	lighting	not appl.	not appl.	not appl.		6105,89
	swinging cow brushes	18,81	not appl	not appl.	3x0,12=0,36	799,45
Total labour per year				**84451,7**	**-**	**122 970**
Daily labour inputs per LU				**1,361**	**-**	**1,981**

Table 8. Labour, electrical and mechanical energy inputs set in cattle barn no 3.

Treat-ment	Activity/process	Process time	Process time	Labour inputs	Power of energy source	Energy inputs on process
		[h•LU⁻¹·year⁻¹]	[h•year⁻¹]	[working minutes· year⁻¹]	[kW]	[kWh·year⁻¹]
I	milking + 1 milking robot, washing (water heating)	89,759	7450	29200	2,2; 0,55; 2,0	12309,295
	milk cooling (aggregate, mixer; ventilator), water heater)	53,012	4400	3650	6,0; 0,78; 0,13; 2,0	11351,1
II	feed loading	1,20	100	6000	74	7400
	feed mixing and discharge	3,01	250	15000	66	16500
	feed pushing	5,18	430	not appl.	55Ah	1578,1
III	slurry mixing	0,05	4	240	66	264
	slurry pumping out	0,96	80	4800	74	5920
	slatted floor cleaning	13,19	1095	not appl.	0,165	180,675
IV	decornization	1,66	138	8280	0,25	34,58
	ordering, cleaning the walls/ceiling	0,175	14,57	874,2	1,75	25,5
	lighting	-	-	not appl.	-	3004,829
	swinging cow brushes	24,09	2000	not appl.	0,12	240
Total labour per year				**68044,2**	**-**	**58808,079**
Daily labour inputs per LU				**2,246**	**-**	**1,941**

On table 9 operating costs were presented, when in table 10 total labour and mechanical and electrical energy, as well as operating costs of buildings and machinery and equipment were given.

Table 9. Costs of operating of buildings, machinery and equipment for mechanization of production treatments.

No. of cattle barn	Costs of maintenance (machinery) C^m_m	Costs of maintenance (building) C^b_m	Costs of using (machinery C^m_u	Costs of using (building) C^b_u	Operating costs (machinery) Ce^m	Operating costs (building) Ce^b	Total operating costs C_e		Investment costs C_i
	PLN•year-1	PLN•year-1	PLN•year-1	PLN•year-1	PLN•year-1	PLN•year-1	PLN•year-1	PLN•year-1•LU-1	PLN•LU-1
1	84894,92	16 744,72	124462,84	6 286,94	209357,7	23 031,66	232389,42	2132,01	17025,52
2	178166,85	30 400,00	207200,43	11 831,7	385367,3	42 231,77	427599,05	2515,28	22 046,52
3	89188,46	22 410,50	101826,73	8 238,28	191015,19	30 648,79	221663,98	2670,65	26651,14

Table 10. Energetic and electric indicators set of cattle barns tested.

No. of cattle barn	Unitary investment costs	Unitary daily labour inputs	Mechanization level	Unitary daily energy inputs	Unitary operating costs
	PLN•LU-1	working minutes•day-1•LU-1		kWh•day-1•LU-1	PLN• year-1• LU-1
1	17 025,52	3,47	V	1,838	2 132,01
2	22 046,52	1,36	V	1,981	2 515,28
3	26 651,14	2,24	V	1,941	2 670,65

Conclusions

- Significantly higher investments costs for buildings and their equipment and machinery for mechanization as well as exploitation costs were noted in cattle barns with robots, wherein the lowest was in cattle barn with more livestock (170 LU).
- The energetical energy inputs calculating for 1 LU per day were the highest in cattle barn with one milking robot.
- The lowest daily labour inputs were in two barns with robots for milking, feed pushing and cleaning of slotted floor. The highest labour inputs were in cattle barn with milking unit “fishbone” 2x5 (10) and amounted 3,47 working minutes per day and per LU - fifth level of mechanization was ensured.
- The highest exploitation costs of the buildings were in farm with the highest herd size and with two milking robots. The highest total exploitation costs (regarding buildings and their equipment with machineries) were in cattle barns with milking robots. Higher exploitation costs in robotized cattle barns resulted, inter alia, from high investment costs, but also higher, comparing with other buildings- electric energy inputs.

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NORMALIZATION PROCEDURES AS A PATTERN FOR DIFFICULT CONTEMPORARY TIME

POSTĘPOWANIE NORMALIZACYJNE JAKO WZÓR NA TRUDNE CZASY WSPÓŁCZESNE

Summary: *The problems of contemporary civilization included climatic changes, armed conflicts, destruction of ecological resources of the Earth and, also, threats coming from Cosmos, interior of the earth and artificial intelligence. The normalization procedure which allows recognizing the reasons and finding the methods for counteracting or preventing the threats may be suitable for the solution of the mentioned problems.*

Keywords*: threats, civilization, normalization*

Streszczenie: *Problemami współczesnej cywilizacji są zmiany klimatyczne, konflikty zbrojne, niszczenie zasobów ekologicznych Ziemi, a także zagrożenia z kosmosu, wnętrza ziemi oraz sztuczna inteligencja. Do Rozwiązania tych problemów może być przydatne postępowanie normalizacyjne, które pozwala poznać przyczyny i wynaleźć sposoby przeciwdziałania lub zapobiegania zagrożeniom.*

Słowa kluczowe: *zagrożenia, cywilizacja, normalizacja*

Potential threats

We all perceive the increasing problems of the contemporary stage of civilization development and the most important of them are as follows:

- Climate changes, causing various consequences (migrations, increase in the number of catastrophic phenomena with growing costs, the accelerated death of the species, etc.) which may, in consequence, bring about to serious troubles and even to destruction of the contemporary civilization;
- Growth of various conflicts, and especially the increase in the number and effectiveness of the contemporary combat assets, the total application of which may lead to a violent self-destruction of civilization;
- Excessive and growing utilization of ecological and non-renewable resources of the planet, exceeding the possibilities of their reproduction, what – in the light of the growing population and increase of consumerism may result in serious global conflicts;
- There are also the threats with the unknown probability of occurrence to which we are not prepared as to counteract them affectively. The major ones include:
  - Threats coming from cosmos (near explosion of Supernova, ejection of solar plasma towards earth, impact with asteroid or small black hole etc.),
  - Threats coming from the interior of the Earth in a form of explosion of super-volcano or hyper-volcano, earth quacking which may radically change the conditions of vegetation on big areas and even on the whole Globe,
  - Difficult-to be -assessed threats, coming from development of artificial intelligence, the power of which may exceed the sum of the intelligence of the people as soon as after a few decades.
  - The above list may be considerably prolonged by specification of other threats such as epidemics, degenerations, particularisms and other ones, leading to crisis and conflicts having a local, regional or global range.

The preventive measures

It is obvious that there is an urgent need to prepare to the anticipated threats and undertaking the counteracting measures against the already existing problems. There are many examples of such activity in a local or regional scale. Generally, they may be classified into three groups:

1. The measures having an organizational-social nature;
2. The measures having an organizational-technical nature;
3. The measures having a scientific-technical nature.

The first type of the activities could be most effective if the universal awareness of global threats and the need of cooperating of the politicians, entrepreneurs and consumers had been shaped. We may observe many initiatives and undertakings but they have a limited range and their results are not promising for the solution of the global problems.

The second type of the activities has also a local or regional extent and to a various, better or worse degree; it creates the conditions enabling the development of ecology-promoting awareness and the conditions favourable for perspective solution of the important cognitive and utilitarian problems concerning gaining the necessary resources and improvement of life conditions.

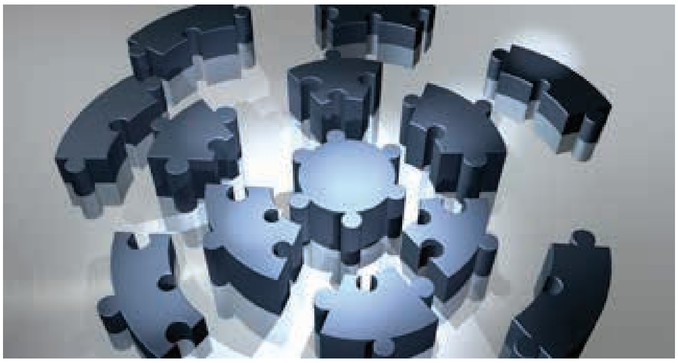
The perspectives for the solution of important contemporary local and global solutions are supported by the following examples:

- The advanced work on the control of the controlled reaction of nuclear synthesis, the positive result of which might solve the energy problems (ITER project);
- The planned development of Swiss accelerator of hadrons LHC from 20 km to 100 km what would facilitate the understanding the construction of matter (costs equal to ca. 40 billion EUR),
- The advanced work on start up of exploration of near cosmos and construction of cosmic laboratories (inter alia, for studies on gravitation waves what would facilitate the recognition of the nature of gravitation),

- The local initiatives include the preliminary plans for constructing the bridge between Gibraltar and Africa when the necessary materials reach the required resistance (probably in few years).

The rate of the implementation of the mentioned and similar undertakings and projects is limited by the accessible financial, material and personal resources.

On the other hand, a high potential of the possibilities of preventing the existing and anticipated threats is found in the third type of activities consisting in utilization of the possessed knowledge and familiarization with a new one which may radically change the present possibilities of corrective and preventive action. To utilize effectively the mentioned possibilities, it is necessary to fulfil few fundamental conditions:



- Creation of the common conditions, enabling early detection and recognition of especially and creatively talented persons and establishing the conditions for their development and creative utilization of their capacities in favour of creating a new knowledge. The discussed system could be partially based on the model of finding and developing the outstanding sportsmen, with consideration of the specificity of a given domain. Creation of such global system may be difficult due to differences in civilization, culture and income and due to the competing religious, terroristic, crime systems with the particular aims. Some people state that the epoch of genius units has passed but it lasts still and the genius unitary persons are less perceivable in the light of big teams, undertaking difficult tasks;
- The second indispensable condition is to create the material-infrastructure conditions for conducting the necessary basic, applied and developmental studies. It requires greater and greater outlays due to complexity of the undertaken problems in respect of matter, energy, cosmos, artificial intelligence, biotechnology, neurotechnology etc. Due to the limitation of the possessed means, it is necessary to distribute them and assign them to the particular tasks. It brings the specified danger that certain areas may be omitted, just those ones where the crucial necessary solutions might appear as we do not know what may be especially suitable /useful and where it may be discovered. As not to lose the mentioned potential profits, it is necessary to finance not only the domains being recognised as priorities but also some other ones which do not promise radical achievements, being possible for universal application.

The choice of criteria

All areas of social activity include the important problem, i.e. the choice of criteria for distribution of the possessed resources for satisfaction of the particular needs, and especially those ones recognised as priorities, i.e. removal of the results of catastrophes and natural disasters, ensuring the possibilities of survival, health and safety of the citizens, liquidation of the effects of earlier destructive activities. From among the mentioned tasks, shaping of the ecological awareness of the societies and levelling of the differences resulting from different opinions, orientations, origin and, wealth etc., seems to become especially relevant. It would support a gradual liquidation of the sources of conflicts and lowering of high costs of safety assurance in favour of increasing the means for education, material protection and science and technology development, what could effectively protect from the existing and potential hazards.

The mentioned above needs are satisfied in a different degree by various social-political and economic systems according to therein established criteria. They prefer usually one group and marginalize the other ones what generates a hotbed for conflicts and usually excludes the possibilities of common cooperation for ensuring the total prosperity. The existing differences in approach to satisfying the needs are caused by the opinions, mentality, traditions, and situations affecting the behaviour of groups which administrate the societies on different levels of development. The discussed groups are very much differentiated and often prefer their own aims over the aims of the groups which they are controlling. Under such situation, it seems purposeful to indicate the advantages and principles which were elaborated in the past century in respect of shaping the aware normalization activity. A series of such principles and their gradual shaping may be also found in unaware evolutionary processes of biological systems where they occurred to be useful in practical applications. The adoption of the discussed, practically proven principles and methods as a suitable supplementation of the developed methods of management of resources and other aspects would be advantageous for levelling of the differences, conflicts, barriers and viewpoints and would also favour the global terrestrial cooperation.

The normalization procedures

The principles and rules of procedures as being developed in the previous century have been gradually improved with the aim to betterment of the quality of the developed standardization documents, destined for universal and voluntary application. The mentioned documents in a form of standards, specifications, reports, memoranda etc. contain the recommended guidelines for proceeding in the situation of manufacture of the products, implementation of processes, management of various aspects (e.g. quality, environment, safety, design, innovations, risk, and conflicts). The discussed guidelines and the recommendation destined for voluntary use contain the arrangements and rules with the practically proven suitability under different conditions. They consider the current state of the knowledge and technique (they are periodically updated (amended) gradually with the extent of the knowledge and technical solutions) and they are so established that they should satisfy all the interested and gain their approval (what often requires a considerable time period). The major aspects and principles when developing standards are as follows:

- Undertaking the collaborative development of the subjects which are a point of interest of a wide range of producers and consumers. Such teams consist of the representatives of the producers, consumers, experts and stakeholders of social organizations. Such team may be participated by any interested person (at his own cost) and the projects of documents under development are subjected to common survey (each stakeholder may express his opinion). Final edition of such document requires higher consensus of the team which developed it and avoiding decisive contras;
- Guidelines, requirements and rules, as contained in the discussed standardization documents are free from pressure of lobbyist groups and administration organs (the exceptions may occur as far as safety, defences matters or important social aspects in concerned). The development of the discussed documents takes place on a full public of the mentioned process and with a wide exchange of information between the particular states and standardization organizations (to avoid doubling of work). There is also a possibility to participate in their development for all stakeholders. Apart from the overriding standardization system, there are commercial organizations elaborating similar documents, which compete with the systemic ones in respect of the quality of development of the document of similar nature (they sell their standards to the users, being interested in quality and utility of the discussed elaborations);

- A wide applicability of the developed standardization documents, containing the best and practically tested solutions brings the profits to the producers (reduction in design work, the possibility of increasing production scale, avoiding quality claims) as well as to the consumers (better quality, lower prices, better reliability, safety guarantees);
- International cooperation in respect of standardization includes practically all regions of the earth. General guidelines concerning new standardization needs are formulated in the respective Economic Commissions of the Organization of the United Nations (UN) and then, they are developed by the international standardization organizations, possessing UN accreditation (ISO – International Standardization Organization, IEC – International Electrotechnical Commission and ITU – International Telecommunication Union). Their corresponding bodies in the European Union are CEN, CENELEC and ETSI and in other regions (Nordic, Arabian, Pan-American) there are also organizations having a similar nature. There also international branch organizations which – based upon the specified needs – elaborate guidelines helpful in the solution of the existing problems (e.g. IATF – motorization, CAC – food, WHO – health, WTO – trade, IGU – gas, IATA – aircraft). In each EU country, there is one leading institution which has accreditation of the government for conducting, supervising and coordinating the standardization activity in a given country. It is anticipated that in all the EU countries in the future, the consolidated European standards will be obligatory (they are often adopted international standards).

Biological evolution

The correctness and suitability of the developed standardisation system is indirectly reflected in certain characteristic rules, developed in an unaware way during the evolutionary development of biological systems. The following facts of evolution process indicate certain analogies:

- Common application of uniform, universal genetic code which regulates various life functions in all biological organisms. Well developed standards also will find common application among the users owing to globalization of production and trade;
- Similar popularization was also recorded in case of other discoveries of evolution which occurred to be especially suitable in adaptation of organisms to the specified conditions and survival in them in spite of various potential threats (chlorophyll utilizing solar energy, typical organs of senses, reproduction problems, care of progeny, utilization of environment constituents as food);
- In biological systems, we may easily observe the utilization of typical standardization methods, employed in standardization activity; it may include as follows:
  - simplification, consisting in multiple utilization of usable elements in various organisms and applications (photosynthesis, typical organs, tissues),
  - type classification, consisting in utilization of typical elements by various species (tree trunks, horns, claws, leaves, flowers, feathers),
  - modularization, consisting in utilization of typical systems in various configurations (wings, fins, heart, excretion).

Duration and development of particular species is an evidence of their functionality and a specified effectiveness, and the similarity of major systems is a proof of the optimality of their solutions (homeostasis, immunological systems, regeneration, and reproduction). It is an effect, confirming the suitability of evolutionary shaping of organisms, with the utilization of the specified standardization principles. The evolutionary process, to a certain degree, resembles the process of developing a standard: when a usable mutation, facilitating the survival appears, due to incidental, or environment-activated reason, it is replicated and becomes spread, and with the time being, it is gradually improved. The standard becomes to be developed when the discovered solution reveals its suitability and its applicability increases. Owing to periodical amendments it is constantly improved.

The contemporary knowledge shows that development of organisms has been improved owing to better and better energy utilization, avoiding threats, recognition of the environment etc. Similarly, the extended applicability of good standardization elaborations facilitates saving of the resources, is applied in various configurations and is adopted by a wide circle of the users.

Conclusions

1. The existing knowledge on the possible threats to civilization on the Earth should be favourable for shaping the awareness of the necessity to discard the quarrels and conflicts, and focus on the cooperation, on the agreed principles, with the aim to prevent the threats or minimize the damages, resulting from the mentioned threats;
2. The obtained level of science and technique has already liberated a huge developmental potential, enabling to solve many problems which should be identified, their reasons recognized and the methods for counteracting or preventing discovered. In spite of the discussed possibilities, global destructive factors still prevail and require global initiatives and a wide cooperation;
3. Diversity of viewpoints, interests and cultural and historical conditions make the elaboration of the effective cooperation systems difficult. In such situation, the experiences obtained during the period of improving the aware standardization activity, dating back to the end of 19th century and the whole 20th century, may occur to be useful; it is evidenced by the successes of standardization and its results;
4. The indirect proof of the usefulness of the standardization procedure rules may be well perceived in the recognized principles and effects of evolutionary development of organisms and biological systems, during which the optimality of many structural and developmental rules, similar to those ones, employed in standardization.

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PIOTR DRZEWIECKI – ENGINEER, MECHANICAL TECHNICIAN, INDUSTRIALIST, PRESIDENT OF WARSAW

PIOTR DRZEWIECKI - INŻYNIER, TECHNIK, PRZEMYSŁOWIEC, PREZYDENT WARSZAWY

Summary: *Piotr Drzewiecki (born on May 29, 1865 in Warsaw, died 8th December 1943 in Spandau camp near Berlin) was Polish engineer, industrialist, social activist, President of Warsaw (1918 – 1921), organizer of the civil defense of Warsaw in August 1920 against the invasion of the Red Army - deputy chairman of the Defense Council of the Capital. He graduated Mechanical Department of Petersburg Technological University in Petersburg with a gold medal for project of steam mill (1988). In 1889, he commenced vocational work in Poland and began to write articles to "Technical Review". In 1899, he became the President of the Warsaw Technicians Association; owing to his efforts, Warsaw House of Technician was erected. His engagement in development of Polish technology, industry and social activity was appreciated by the National Council of Federation of Engineering Associations of Poland - Polish Chief Technical Organization (NOT) which, in 2008, established the Piotr S. Drzewiecki Medal. The mentioned Medal is the highest distinction, granted to the members of engineering associations of the Federation by the mentioned Organization.*

Keywords*: Piotr Drzewiecki, engineer, entrepreneur*

Streszczenie: *Piotr Drzewiecki (ur. 29 maja 1865 w Warszawie, zm. 8 grudnia 1943 w obozie Spandau pod Berlinem) był polskim inżynierem, przemysłowcem, działaczem społecznym, Prezydentem Warszawy (1918-1921), organizatorem cywilnej obrony Warszawy w sierpniu 1920 r. przed najazdem Armii Czerwonej – wiceprzewodniczącym Rady Obrony Stolicy. Ukończył w 1888 r. Wydział Mechaniczny Petersburskiego Instytutu Technologicznego w Petersburgu ze złotym medalem za projekt młyna parowego. W 1889 roku zaczął pracę zawodową w Polsce i zaczął pisać artykuły do „Przeglądu Technicznego". W 1899 r. został prezesem Warszawskiego Stowarzyszenia Techników i to jego staraniami został zbudowany Warszawski Dom Technika. Jego zaangażowanie w rozwój polskiej techniki, przemysłu i działalność społeczną została doceniona Radę Krajową Federacji Stowarzyszeń Naukowo-Technicznych Naczelnej Organizacji Technicznej, która w 2008 r. ustanowiła Medal im. Piotra S. Drzewickiego. Medal jest najwyższym odznaczeniem nadawanym przez NOT członkom stowarzyszeń naukowo-technicznych tworzącym Federację.*

Słowa kluczowe: *Piotr Drzewiecki, inżynier, przedsiębiorca*

Engineer, technologist, mechanical technician

Engineering was beloved and performed profession of Piotr Drzewiecki. He commenced his technological adventure by the project of stem mill for which he received a gold medal of the Technological Institute in Petersburg. After come back to Poland in 1889, as an assistant of director of Hulczyński Pipe Factory, and later on, of Sosnowiec Association of Pipe Factory as a young specialist in pipes' production, he promoted their manufacture without seams, by oblique rolling method [1].

Engineer Drzewiecki followed the novelties occurring in his domain of interest on the World Exposition in 1890 in Paris. After coming back, he tried to utilize them in the Kamiński-Grosman Enterprise for Construction of Roads and Technical Equipment and first of all, in his own company, established in 1893 together with Jan Jeziorański and Czesław Klarner. Production of the mentioned company was integrated with its construction-technical office which developed technological processes for construction of urban pipelines and sewage systems, factories and houses, pomp stations, containers, filters, water towers, fire-protecting equipment and central heating systems. The company was also specialized in production of dryers, washing rooms, steam kitchens, baths and water-therapeutic devices [2].

Piotr Drzewiecki was faced with new technical challenges in 1894 when he founded "Factory of Iron Casts and Mechanical Workshops by Piotr Drzewiecki et Co., which was transformed into "Joint Stock Company "Syrena". It was liquidated after Japanese-Russian war [3].

Piotr S. Drzewiecki, foto: audiovis.nac.gov.pl

As being an active entrepreneur, he utilized his competences, acquired at the Technological Institute in Petersburg and in 1896, together with Jan Jeziorański and Stanislaw Małyszycki, he established the office for construction of mills "S. Małyszycki et Co.", it exerted a significant influence on industrialization of Polish agriculture in Polish Kingdom where the consumption of flour was increasing [3].

A visit to the International Economic Exposition in St. Louis in 1904 played a significant role in modernisation of technological processes in his "Society for Construction of Sanitary Machines and Equipment", being conducted together with Jan Jeziorański. He paid there a special attention to American machines. He commented his impressions from the mentioned show in a following way: "Steam machine, as being a motor, dominates universally in the United States. It is a result of the fact that the industry is big and requires big machines; then, the steam machine - if the returning steam has any application, and finally, the coal is cheap and the manufacturer does not pay much attention to economic aspect of motor's operation but looks for savings in costs of labour which is expensive" [4]. Warsaw conditions in 1904 were somewhat different. Labour costs were relative low and the prices of electricity were relatively high, especially of the current produced by generators in big industrial enterprises. The building of the seat of the company, situated at 85, Jerozolimskie Alleys., was finished before the dramatic Warsaw strikes in 1905 – 1906 which disturbed normal functioning of the "Society for Construction of Sanitary Machines and Equipment Drzewiecki and Jeziorański". The discussed building having a rectangular shape (ca 30 m wide alongside the street and ca. 58 m depth), was constructed according to the project of architect Bronislaw Rogóski. Its construction lasted for 5 years (1898 – 1903). The building consisted of dwelling house, office and also industrial-factory parts; there was the newest heating-ventilation technology employed, as designed by Piotr Drzewiecki. According to information of "Technical Review", we read: "The buildings of the total property are centrally heated. The first half of the building and factory premises – by low pressure steam and the second half of the building by water whereas the steam and water boilers are situated in the basement near the main stair case. The stoves in the rooms – smooth radiators – were situated under the windows. Ventilation was assured owing to supply of a fresh air by the crates under the windows, oriented to the stoves and by the extraction channel in the walls. Each room has its own, separate ventilation channel, going out on the roof. Ventilation of the rooms of the company's office was performed owing to electric ventilators situated in special wall channels. Bath stoves in the flats were heated by gas and vapour from the central steam boiler. The kitchens were furnished with steam samovars; they were heated from the central fire. The houses possessed its own electric station; it was connected with the workshops of the company, situated in the depth of the property" [4]. The building of Drzewiecki was the example of construction with the application of modern ventilation-heating and energetic equipment.

PRZEGLĄD TECHNICZNY

CZASOPISMO POŚWIĘCONE SPRAWOM TECHNIKI I PRZEMYSŁU

Na 50-lecie pracy Piotra Drzewieckiego

Talent of engineer, technologist and manager, P. Drzewiecki was appreciated by great companies of metallurgical industry. "Joint Stock Company of Boilers and Mechanics Factory Fiztner W. & Gamper K., as founded in 1880, employing up to 2200 workers, offered him the membership in its board, the president of which was Ernst Borsig. Drzewiecki was also the member of the board of "Joint Stock Company of Mirkowska Paper Factory", beside Stanisław and Edward Natanson, Henryk Dynowski and Stefan Dziewulski [5].

His talents of mechanical engineer were revealed in 1907 when P. Drzewiecki, together with Karol Rose, living in Berlin, founded the all-European company, employing American system for temperature control, according to Johnson patent. Due to the war, the discussed company was sold to engineer Schellhase and functioned for the whole inter-war period.

When utilizing the economic-investment situation before the First World War, P. Drzewiecki together with Jan Jeziorański, Karol Rose and Czesław Klarner established the enterprise "Fire-protecting Devices for Easily Flammable Liquids by Martini Hunecke system", serving the receptive Russian market. It was liquidated by bolsheviks [6] with great losses for the owners.

The First World War devastated Warsaw industry. The engineering talents of Piotr Drzewiecki, the President of the Association of Technicians since 1899, were utilized in the activity of the Society of Technical Courses, in development of Polish School Educational Organization (in Polish: Polska Macierz Szkolna), the Society of Scientific Courses and reconstruction of higher education in Warsaw, including Warsaw University of Technology, managed by the outstanding mechanical engineer, Prof. Zygmunt Straszewicz (1860-1927), who was a friend of Piotr Drzewiecki and editor of "Technical Review".

Function of the President of the Association of Technicians, having the ambitious program of civil activity in respect of education, charity aid, and, first of all, activity in Civil Committee of the Capital City of Warsaw, in management of the city as the first major and President opened the new areas of social activities for P. Drzewiecki; his profession played a significant role. In 1920, together with Leopold Wellisz and Władysław Jechalski, with the support of the Commercial Bank in Warsaw, they established the joint stock company, the first Factory of Locomotives in Chrzanów. In 1920, together with engineer Andrzej Wierzbicki, he mobilized metallurgical industry of Poland and of Warsaw to direct service for Polish army, fighting with bolsheviks. In 1921, P. Drzewiecki took the lead in French-Polish Society for Construction of Automobiles and Airplanes which was initially overtaken by the Czech capital "Skoda" and then, by the Ministry of Military Affairs.

In 1922, P. Drzewiecki, as constructor-mechanical engineer participated in the establishment of Polish Electricity Society, the first factory of electric machines in Poland, with the participation of Swedish capital. From 1928 to 1939, he played a function of the president of the greatest Polish consortium of machine industry "Consolidated Factories of Machines, Boilers and Wagons Zieleniewski, Fitzner and Gamper S.A.". The mentioned consortium employed ca. 5 thousand workers. Since 1933, Piotr Drzewiecki played a function of the President of Polish Union of Metallurgical Industry, founded in 1920. In 1938, 360 factories, employing more than 70 thousand workers, were enrolled in the mentioned organization.

The place of P. Drzewiecki in economic history of Poland was determined not by his new technological constructions, but by his role as the outstanding, modern industrialist. Czesław Klarner when writing a biography of P. Drzewiecki stressed; "As early as in the mentioned period...there was shaped a nature of industrial activity of Piotr Drzewiecki, as a pioneer of progress at the territory of Poland. He will be carefully observing and transferring the most beautiful principles from the experiences of American and West European life to Polish ground, and the mentioned work will open newer and newer economic and social horizons for him" [6]. His friends from the Society of Technicians and Technologists (1928) evaluated Piotr Drzewiecki in a following way: "Owing to his unusual energy, organizational and financial capabilities and popularity among his colleagues, the building of the Association of Technologists at 3/5 Czackiego street in Warsaw could be erected; it contributed – in the greatest degree – to communication between Polish technicians and development of the Association [3].

Piotr S. Drzewiecki Medal, foto: editorial office

After the Second World War, his merits as engineer-constructor-industrialist were resembled by "Peoples' Newspaper" (in Polish: "Gazeta Ludowa"); it has been also presented for many years by "Technical Review" and, first of all, by the Chief Technical Organization (NOT). It is worthy to mention the article "Piotr Drzewiecki – why we remember?" by the President of NOT, Ewa Mankiewicz-Cudny: "When appreciating the merits of Piotr Drzewiecki for development of engineering associations and, also, his determination in social and educational activity, the National Council of Federation of Engineering Associations NOT (the supreme authority in technical organization, being the inheritor of the Association of Technicians in Warsaw and its legal successors) established, in 2008, the Piotr S. Drzewiecki Medal. The discussed medal is the highest distinction, which may be granted to the members of the associations that constitute the Federation" [3].

Industrialist – propagator of scientific organization of work and management

Piotr Drzewiecki belongs to the most talented Polish industrialists of the end of the 19th and the 20th century. His success in relation to the companies under his management comes; inter alia, from:

- Good knowledge of the needs of national market, and also, of the Russian market in the domain of iron casts and, first of all, sanitary machines and equipment. The demand on the former devices resulted from the development of water pipeline and sewage systems;
- Understanding the meaning of starting up the electrical engineering industry in Poland, with the utilization, inter alia, of Swedish capital;
- Stressing a special meaning of metallurgical industry and craftsmanship – under his guidance since 1933 - for all sectors of national economy, and first of all, for defence of the country;
- Utilization of modern technological processes, acquired from the United States of America, Germany, Great Britain, France and Sweden.

When writing about the role of export in development of Polish industry, he asked a difficult question: "how will our economic independence look like in comparison to our neighbour who has the surpassing merits, i.e. diligence, effectiveness, regularity, caution, and unheard perseverance. I am afraid that the products, manufactured in the regions of Poland will be not so cheap as to compete on the international markets and will be sold only in the own country" [7]. In his struggle for economic effectiveness of Polish industry and trade, P. Drzewiecki established (on 2, February, 1923) Polish Standardization Committee as an advisory body to the Ministry of Industry and Trade. He became the President of the Committee which published periodical "News of Polish Standardization Committee". The Committee published technical and material standards of industrial products, generally in agreement with the International Standardization Organization [8].

The establishment of the Insurance Association of Polish Industrialists on February, 16, 1920 had a significant meaning for Polish industrialists. "The mentioned association, as based upon the principles of mutuality was aimed at insurance from fire, theft of transports, civil responsibility, damage of machines etc. P. Drzewiecki was a founder of the Association, apart from de Alfred Biedermann, baron Juliusz Heinzl, duke Andrzej Lubomirski, Maurycy Poznański, Leopold Wellisz and other industrialists. Piotr Skarga, expert and practitioner in insurance matters was the managing director of the Association [9]. On the same day, there was established the Society of Mutual Insurances in Warsaw with Supervisory Board in the composition of which Piotr Drzewiecki and majority of the mentioned above founders of the Insurance Association of Polish Industrialists were found. The management of the Society included: engineer Stanisław Szymański, Stefan Laurysiewicz, dr Józef Berlinerblau, engineer Tadeusz Sułowski, engineer Stanisław Surzycki and Leopold Wellisz [9]. Piotr Skarga was also the managing director of the Society. The Society had, owing to the State, the appropriate reinsurance cover; it commenced the activity in fire sector and insured all types of realties and movables for insuring. In the country where the most of the dwelling houses and farm buildings had a wooden construction, remote from public water sources, the insurance from fire played an important role.

Activity of P. Drzewiecki in respect of scientific organization of work and management had the universal meaning, including also that one for the industry. On 26, February, 1919, P. Drzewiecki - together with Prof. Karol Adamiecki, Henryk Karpiński, Stanislaw Okolski and Prof. Zygmunt Straszewicz - founded the League of Labour. The aim of the organization which involved the people of science and economic life was to increase the effectiveness of work and rate of reconstruction at the territory of the whole country, deprived of capitals, raw materials, outlet markets and mentality of industrial community [8]. The activists of the League struggled for a reasonable utilization of working day, decrease of the number of free days and adaptation of the work time in Poland to the European countries, especially Germany, being involved since 1924, in a quick reconstruction of their industry, with the help of, inter alia, American capitals. In 1925 when the Germany declared customs war against Poland, Karol Adamiecki, Piotr Drzewiecki and Ignacy Radziszewski established Institute of Scientific Organization of Work. They addressed the following appeal to the industrialists: "The mentioned Institute should be vocational-scientific institution, independent in respect of work and become a centre for activity in the area of correct organization of Polish system of work. It should give assistance to each producer in his work and efforts aiming at improvement of work, in order to increase production, based on minimal consumption of energy, material and efforts. It would contribute undoubtedly to general improvement of life of working people [10]. It is difficult to answer the question: what was the number of the industrialists in Poland who implemented the postulates of the Institute. It was performed by the greater enterprises, working for the needs of internal market and for export, which were successful in the competition with German, Czech, French, Italian and English companies. Their percentage was low. They occurred first of all in coal mining, metallurgy and consortia of machine industry. The recommendations of the Institute were popularized in editorial series of the League of Labour which included several dozen of popular items, developed by P. Drzewiecki, usually without scientific, statistical and iconographic aspects. P. Drzewiecki tried to popularize – in an understandable way – modern methods of economic education, material savings in construction industry, harmonize the architectonic solutions with climate conditions of Poland and utilize reasonably work time in manufacturing processes.

P. Drzewiecki, as being industrialist, was able to transfer the manufacturing experience, exposed during industrial-construction exhibitions in St. Louis, Paris, Prague and Berlin into Polish ground. He was open to technical novelties what was manifested in his engagement in establishment of the cradle of Polish broadcasting "Polskie Radio Ltd." (1924) and then, presentation of the first TV programme during the exhibition of machine and electro-engineering industry in 1936 which he organized as the President of Polish Union of Metallurgical Industry.

A very small number of Polish historians have perceived the achievements of P. Drzewiecki until now. They were" Zbigniew Landau and Jerzy Tomaszewski, creators of synthesis "Economy of the inter-war Poland, Volume I – III" (Warsaw, 1967-1989) and Zbigniew Pustuła, author of problem entries in "Encyclopaedia of the History of the Second Republic of Poland" (Warsaw, 1999). The merits of P. Drzewiecki for Polish industry were highly appreciated by Czesław Klarner: "Having integrated so many economic problems from the territory of Poland in one hand, Piotr Drzewiecki is one of the leading and extremely active representatives of the Society of Industrialists of the Polish Kingdom, and then, the Central Union of Polish Craftsmanship, Mining, Trade and Finances (1920 – 1932) and finally, the Central Union of Polish Industry, unifying the industry of the whole Republic of Poland since 1932 where – representing the Polish Union of Metallurgical Industrialists – he participates in almost all most important activities of the mentioned organization in the name of welfare of the whole national economy. As the President of the discussed Union, Piotr Drzewiecki organizes the first exhibition of metallurgical industry, electro-engineering and radio broadcasting and becomes the chairman of the board of the exhibition" [7].

After the September destruction in 1939, P. Drzewiecki tried to reconstruct Warsaw industry, taking an advantage of the activities of the President Starzyński in October 1939, being tolerated by the occupant and later on, of various forms of activity of the Warsaw Committee of Social Self-Assistance. In agreement with the Polish-government-in-exile, he prepared information for gen. Sikorski, concerning German industrial policy on the occupied territories. It was the reason for his arresting and tragic death in the campus in Spandau, near Berlin.

The industrial activity of Piotr Drzewiecki waits still for a documented source monograph. The matter of participation of P. Drzewiecki in Polish banking system requires also detailed studies.

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SCIENCE AND INDUSTRY IN A COUNTRY OF CHANGES

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A GOLDEN ENGINEER IN THE PRESIDENTIAL PALACE

ZŁOTY INŻYNIER W PAŁACU PREZYDENCKIM

With the participation of the President of the Republic of Poland, Mr. Andrzej Duda, a solemn Gala summarizing the XXV plebiscite for the title of Golden Engineer run by "Technical Review" Magazine took place at the Presidential Palace in Warsaw on February 27, 2019.

"There is no modern state without modern technical thinking, no modern industry, no modern production, no inventiveness, no production of goods, which we call highly processed goods. This is all the merit of technical thinking, said the president, greeting the participants of the ceremony. He reminded that two of his predecessors, Gabriel Narutowicz and Ignacy Mościcki, were "not only engineers, but they were great engineers, great inventors who greatly contributed to the development of this reborn and reborn homeland".

The most important participants of the Gala were 22 winners - engineers: young, silver, gold, diamond and Honor, as well as three 25th Anniversary Golden Engineers.

The ceremony was attended by the Chief of the Cabinet of the President of the Republic of Poland Halina Szymańska, secretaries of state Andrzej Dera, Adam Kwiatkowski and Błażej Spychalski and the Minister of Investments and Development Jerzy Kwieciński, PhD who received the title of Honorary Golden Engineer 2018. Sebastian Skuza - Deputy Minister of Science and Higher Education, Tomasz Szweitzer - President of the Polish Committee for Standardization and Małgorzata Oleszczuk - President of the Polish Agency for Enterprise Development were also present.

The final of the plebiscite for the title of "Golden Engineer" was a celebration of the technical community and the anniversary time made it extra special. On the pages of the 153-year-old "Technical Review" the successes of Polish engineers have been described many times over various periods of history, not forgetting the conditions in which they were to act. The careers of the laureates of all editions of the plebiscite have progressed during difficult time of transformation and a learning process of the principles of the free market economy. They have had to pass economics and law courses quickly. Those lessons were often painful but also the successes were very satisfying. Many of them already have various awards, distinctions and titles that reflect their enormous professional achievements.

Each year, when awarding diplomas and statuettes to the winners, chosen by the readers from among the candidates presented in the "Technical Review" throughout the year, it can be seen that Polish engineers are very good at keeping up with revolutionary changes in science, technology and economy.

Statuettes and diplomas were presented to the laureates jointly by the President of the Republic of Poland Andrzej Duda and the President of FSNT-NOT Ewa Mańkiewicz-Cudny.

For many years, Polish engineers regardless of their

specialization have attached great importance to ecology and sustainable development. It is worth mentioning that at a time when the natural environment was losing to technology it was engineers who started looking for ecological solutions. The idea of sustainable development, the EUROPA 2030 program confirms in many aspects that without engineers it is impossible to implement a development program that takes into account human, cultural, economic and technical factors.

The winners of the "Technical Review" plebiscite prove that engineers realize that technical creation is currently beyond the area of pure technology. The title of "Honorary Golden Engineer" proves that technical knowledge and engineering pragmatism are of the great value in achieving success in other professions. Honorary Golden Engineers emphasize that the way of thinking, gained during their technical studies has been often helpful in their careers. Being an engineer you can be a famous opera singer, an outstanding doctor, a satirist, a journalist, a banker and even a politician.

The title of 25th Anniversary Golden Engineer which was specially created for this year jubilee was awarded to Prof. Michał Kleiber, PhD, Prof. Zbigniew Śmieszek, PhD, and Andrzej Sajnaga, MSc, absent at the ceremony due to illness.

The 25th Plebiscite of the Golden Engineer was held under the media patronage of Polskie Radio SA

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