DIGITAL CHALLENGES OF INDUSTRY 4.0 IN ENERGY SECTOR

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Abstract

The aim of the paper is to point out the advantages and possible problems in the introduction of Industry 4.0. Its implementation will be associated with the implementation of digitization, Internet of Things, Big Data as well as new marketing strategies, B2B or B2C. It creates a new approach to customers (Prosumer, Agregator), which are new economic categories due to the introduction of industry 4.0. We have used research methods from data collection from foreign and domestic sources, their sorting and paired methods of analysis and synthesis, induction and deduction. We simply illustrated the obtained and processed data in pictures.

Key words:
digitalization, market strategy B2B, B2C, new energy model, Industry 4.0.

JEL Classification: L10, L19, O31, O32

Introduction

Technology plays an important role in many areas of our lives, it has made it possible for information access to be faster and faster, producing a transformation in the way we consume and relate with data. Business environment is getting more involved in this constant technological evolution. The industrial sector has been incorporating gradually greater uses of automation and connectivity. The concept of Industry 4.0 refers to some aspects that you have surely heard: fourth industrial revolution, smart industry, interconnected industry or cyber industry. All these definitions refer to the use of technologies to make the manufacturing process more agile, flexible and noticeable to customers. But surely you are interested in knowing what a fourth industry revolution entails, what its benefits are and how you can implement it in your business.

Literature overview

The concept of industry 4.0 refers to the so-called fourth industrial revolution. This involves the digital transformation of the industry with the integration and digitalization of all the industrial processes that make up the value chain, characterized by its adaptability, flexibility and efficiency that allows to cover customer's needs in the current market. Industry 4.0 represents a qualitative leap in the organization and control of the whole value chain throughout the life-cycle of the production till to delivery of the product. These changes are applicable for almost all branches of industry. This paper is a free sequel of our article concerning Smart Grids, which are one of the forms already existing practical application of Industry 4. 0..

Industry 4.0 is based on the following principles:

Interoperability express ability in communication of all the elements from the providers of goods and services, using cyber - digitalisation systems, robots, Information and Communication Technologies (hereinafter IKT), smart products with their orientation on the people as customers, towns, regions, countries.

Decentralization means, that the capacity creates as the new design of autonomous sub-processes within IKT, elements with the capacity to make decisions autonomously.

Real-time analytics is the ability to collect and analyse large amounts of data (Big Data) that allow the monitoring, controlling and ensure optimisation of processes. New important feature is finding all the results and adopt decisions derived from the process immediately and at every moment.

Virtualization is part of process, which has the ability to generate a virtual copy and the

modelling industrial processes (physical), obtaining virtual models and simulation models and using 3D printer create real "goods". For example, in the automotive industry, the development of new car is realized through the so-called crowdsourcing - you only pay for the result. This 3D printers do this using rapid prototyping to minimize the time to market enter of a new type of car.

Service orientation: the ability to transfer the new value generated to the customer in the form of new services or improved services with the exploitation of new business models. This marketing strategy is shortly call B2C -business to customer.

Modularity and Scalability: the flexibility and elasticity to adapt to the needs of industry and business at all times, with the ability of these systems are in accordance with market demand.

Next table shows existing changes between traditional industry and its organization of work and Industry 4.0 and the new, possible improvements in its organization of work.

Table 1: Comparison of traditional industry with industry 4.0

Traditional industry	Industry 4.0
Mass production	Production according to customer requirements
Large factories oriented on big volumes of specific products and services	Smart design of factories with flexible production and competitive cost
Planning production based on standard demand	Dynamic production in accordance to customers demand
Physical buying goods and their storage	Product is used as service
Minimization costs	Maximalization of ratio: profit/used capital
Monotonous work	Flexibility in work organization

Source: own processing according website: https://www.what-is-industry-4-0-and-what-does-it-contribute/

Competition and drivers of innovation

Competition can be defined as the process in which the market forces operate freely to ensure that society's limited resources are used them as the most possible efficiently as possible to maximize the overall economic welfare. (KOLASKY, W. J. 2004) Competition is often adopted as rivalry between market participants. Famous economist M. Porter considers it not only between competitors on market, but also states it between companies and its customers, its suppliers, substitute products and potential entrants. (PORTER, M. E. 1998) The competition leads to achieving higher profits than other market rivalries, competitors in long time. Significant benefit is the definition of competition within the energy sector, which has a predominantly oligopolistic structure and is appropriate to perceive competition as an environment of intense changes, in which new, aggressive and innovative competitors move quickly in the markets and take advantages of large companies and established big players yet operate in the energy market not only in Slovakia but also in the EU.

The intensity and type of competition in the sectors has changed from stable oligopolies to intense and rapid competitive rivals use fast, unexpected and unconventional means of competition.(Magretta, J.2012) On the one hand, these positive changes caused the entry of new entities into the energy market thanks to the implementation of the 3rd liberalization package adopted in 2009 A positive change in the entry of new entrants into the energy market has ensured supplier choice and a decline of value of HHI index, which in practice this means reduction a degree of concentration in the energy sector and strengthened the rights of all consumers, mainly

households and small businesses, which are perceived as vulnerable customers. On the other hand, we meet various unfair and illegal practices of suppliers in this market, which often have to solve addressed by the Office for Regulation of Network Industries, which is the regulator in the Slovak energy market. Its role is to regulate the final prices of particularly vulnerable customers, which are still regulated. In addition, it "replaces" imperfect competition in this market.

Several researchers have found that new knowledge, views and innovate ideas rise more from outside of company and bring more innovations than from within companies. (Hillebrand and Biemans, 2004) The transfer of knowledge between companies, or companies and external deliveries, s cooperating subjects have the form of stream transfer, such as the transfer of knowledge between businesses and their customers (market strategy B2C). Another transfer refers to the transfer of knowledge between businesses and suppliers, universities, or other research organizations (market strategy B2B), which have an end-user who knows the value of a new, innovative product or service. The transfer of knowledge between an organization and outside agencies is a horizontal transfer—the transfer of knowledge between a business and its competitors for the purpose of new product development or innovative development, which ultimately leads to improved business performance and competitive advantage. Distanont (2018) discovered that outside factors that influence the innovation of SMEs can be classified into two groups: factors at the micro level, which are market-oriented (customers, suppliers, and the industry), and outside factors at the macro level, which can have an international context.(Geissbauer, R., Vedsø, J. a Schrauf, S. (2016) This study can we adopt, too for large companies, for big players in energy sector, and a another, specific feature for oligopoly structure of market is creating economies of scale and scope, too.

Table 2: Innovations according Valenta

	Degree	Name	Characteristic of innovation
	-1	Degeneration	Negative change
New variant	0	Regeneration	Simple change of company
	1	Change of quantity	Increasing(decreasing) of items of company
	2	Intensity	Increasing of intensity of company items
Incre-mental innova-tions	3	Reorganisation	Positive changes of time and enviroment in company
	4	Qualitative adaptation	Adaptation items of company
	5	Qualititation change	*Qualitative changes items of company
	6	New generation	Change of quality of company at all
Radical innova-tions	7	New kind	Change of concept of company
	8	New principles	Changes of principles of company
	9	New approach	Change approch to nature envirinment

Source: own processing according Bartes, F.: (2008) *Inovace v podniku*. Brno : Akademické nakladatelství CERM, s.r.o., 2008. ISBN 978-80-214-3634-3.

It is important for energy companies to know how customers use a product or service - supply of energy commodities (gas, electricity, heat, water) because it allows them to segment their customers into groups, into tariff groups according to the size of their consumption. Subsequently then they adjust the required product, service to customer requirements and set prices commensurate with the quantity of commodity provided or the quality of service provided. Smart and interconnected networks enable companies to develop closer relationships with customers. (PORTER, M. E. (2008) By using ICT, companies can also be informed about the volume of consumption in a short time and subsequently also customers about the price for the provided product or service. As mentioned above, after 2009, customers were able to choose their supplier of energy "products" - switching, which also made a positive contribution to lower prices in the European energy market. (European Commission (2017a)) As we mentioned in the Smart Grid article, smart products can increase customers' market power by reducing their dependence from producers, suppliers, distributors.

1. A smart product will require new design principles. It is not a matter of hardware design, but mainly of software that needs to be adapted. If predictive and remote operation is to be achieved, it must be integrated into the product.

2. If the product is to be repaired remotely in real time, this will require a new sales service proposal, too. It is no the delivery of a product repair component, but a software update and product information to be integrate and share across the company.

3. All of these new capabilities will require a new set of skills, such as Big Data Analysis, Software Development, and Systems Engineering.

4. If the product is to be intelligent and connected, require security management for verification and storage. As products become intelligent and connected, huge amounts of data will be available and the way of interact companies with customers will change. (Porter, M. E. A Heppelmann, J. E.: (2014))

These changes will lead to a change in the company's work, especially in product development, IT, production, logistics, marketing, sales and post-warranty service. Economists Porter & Heppelmann point out that new forms of cooperation in the company will emerge as well as its completely new functions. Data will become a significant source of competitive advantage, new techniques will need to emerge for their processing, Big Data, Internet of Things and so on.

New energy model

Based on the results of a cost - benefit analysis within the meaning of Directive No. 2009/72 / EC (dated 13 July 2009) and the Slovak Republic started in 2013 according to the conditions in the Decree of the Ministry of Economy of the Slovak Republic no. 358 with the installation of smart metering systems, which should be built to support decentralized production and ensure higher energy efficiency. On October 30, 2017, the World Meteorological Organization announced a new record for atmospheric carbon dioxide concentrations at its highest level in 800,000 years, when global average CO2 concentrations reached 403.3 ppm (parts per million) in 2017. Reversing developments so far requires a fundamental change.

Digitization, decentralization, digitization and decarbonisation have become paradigms for Europe's new energy model. The initiative is increasingly being taken over by active customers (so-called Prosumers), t. j. cities, industry, service providers or the general public who are most motivated to look for solutions to save energy and protect the environment. The need the most accurate information possible from all major appliances, be it buildings, public lighting or transport systems, as well as from

installations for the production and storage of electricity and heat is in these new economic models very important and urgent in real time.

Modern technologies from Industry 4.0, IoT or blockchain, which move the possibilities of implementing energy solutions closer and closer to real time, are very effective in this effort. Intelligent measuring systems (IMS) are also adapting to this trend, providing the possibility of connecting meters and other energy media (gas, heat ...) or other smart devices and enabling the sending of information on production and consumption in real time, thus providing data with analytical tools (so-called Big Data), whether with the form of personalized or so - called open data. IMS open up space for local prediction, control and modelling of complex energy management (so-called Microgrids) using integrated renewable sources, energy storages or charging stations for electric vehicles. All efforts should be aimed towards energy-efficient to self-sufficient communities and cities that are attractive to their people with a carbon-free and sustainable energy economy.

Clean energy package

Yet in November 30, 2016, the European Commission published a package of legislative proposals, the so-called "Winter package" or "Clean energy" package, in which she submitted proposals to change the organization of the electricity market, the so-called New market design. It includes a revised Directive on common rules in the internal market in electricity of 2009. However, it introduces some clarifications to the existing provisions on smart meters, published in particular Articles 19, 20, 21 and Annex III. It grants every consumer the right to request from smart meter a certain minimum set of functions. Adequate incentives and technologies are needed to exercise these consumer rights. Smart metering systems empower consumers by providing them with accurate real-time feedback on their consumption or production, which they can better manage; at the same time, they can participate in consumption management programs and other services and take advantage of them as a reduction in electricity bills. In addition, smart metering provides distribution system operators with a better report of their network, thereby reducing their operating and maintenance costs, and these savings can be reflected in distribution tariffs that are ultimately pay by the consumer.

When EU is deciding about the deployment of smart metering at national level, it should be possible for the deployment of smart metering systems to be based from their economic evaluation. In order to promote the active participation of consumers in the electricity market, smart metering systems introduced by Member States on their territory should be interoperable, should not hinder switching and should be equipped with efficient functions that allow consumers to access in near real time, to its consumption data, to adjust the energy consumption and, to the extent that the support infrastructure allows it, to offer the system its flexibility, to reward it and to achieve savings in electricity costs, too.

Microgrids

It is important question, do microgrids have a future in Slovakia? Electricity market is in process a revolution. Decarbonisation, decentralization and digitization (3-D) are shifting the orientation to the energy chain towards the end customer. These possibilities create opportunities for new business models in the electricity market. One of them is the concept of microgrids, which are based on intelligent technologies. This solution enables active management of its production from only renewable sources (green electricity) and electricity consumption among end customers. It includes the storage of electricity within the smart grid and their billing of supplied surplus electricity to small producers. Subsequently again

there is space for another technological trend so called Blockchain.

Quo Vadis EU energy sector?

Changes are also expected in the area of "big" energy. Several European countries plan to change their energy mix. Even traditional nuclear France plans wants to gradually reduce its coverage of nuclear consumption from the current about 72% to the expected about 50%. This should become the phasing out of nuclear power units and their replacement, in particular, with renewable energy sources. However, according to Enel, such market volatility is the new normal state and new opportunities need to be to accept through asset digitization through 3 steps:

• basic applications (IMS, AMM, remote ERP management);
• sensors network Internet of Things (IoT) software in equipment's connected to the Internet;
• Big Data - located in the cloud.

New technologies represent revolutionary changes in energy technologies and also in their use. Modern technologies shorten innovation cycles and this creates pressure on investment. It is expected to increase the interest of customers in managing their consumption, and it is also may be expected to shift the load off-peak.

It is expected that cross-border traffic will continue to increase and local distribution problems will spread across borders, too. The increase in capacity to cover the demands of increasing cross-border flows is still unresolved. At the same time, price volatility and pressure for greater flexibility in cross-border supply are expected to increase. New technologies will require significant processing of large amounts of data and information through the use of Big Data, which will require legislative protection of data against misuse. Representatives of Belgian, Italian and German network companies presented pilot solutions in the field of big data and data flow management and efforts to achieve standards for the use of data between Distribution System Operators (DSO) and Transmission System Operators (TSO). It is considered about the possibilities of creating one or more so-called Data Hubs, which should be a repository of an enormous amount of data, their proccessing into statistical forms and with access mechanisms. All players should contribute to such a system, and everyone should also have access, with the aim of access for all customers as well, as it will promote a competitive environment for suppliers.

New market players were also presented - an aggregator and prosumer, as little-known economic categories. The aggregator, is defined in the new market design, combines several customer loads for the purpose of selling, buying or auctioning electricity, while the independent aggregator is not connected to a traditional supplier. In essence, it should be the player who concentrates the virtual reserves of electricity with IT resources, thus increasing his flexibility and trading with them. Finally, it should also be able to provide support services.

Prosumer is actually a customer and a manufacturer in the one place and its energy management is not an energy business. Thus, it can also be a household with micro-cogeneration unit. Prosumers could work very effectively with the aggregator.

Information and Communication Technologies (ICT) will be a key prerequisite for the stated challenges of energy companies, in which most innovations will take place. The solution to the growing complexity of the market and the complexity of ICTs in businesses is the smart company. Cyber-physical systems (CPS) can build decentralized and autonomous networks that are organized independently and are optimized. The level of autonomy and decentralization is increasing with increasing complexity. To enable this development, the IT is undergoing a fundamental change from the traditional pyramid of monopolistic, unified systems to a service orientation called "everything as a service" (XaaS). It is a software deployment model where the application is hosted by the

service provider. The service is further offered to customers via the Internet. Eliminating the need to install and operate the application on their own devices SaaS has recently become a popular way to run the application. SaaS was created in response to the need to reduce costs by using SaaS, companies can also reduce the direct cost of purchasing software, as the cost of an on-demand license tends to be lower due a server license not required a payment. This paradigm shows that everything, whether physical or virtual, is offered as a service and comes from the three main layers of cloud computing services - software as a service (SaaS), platform as a service (PaaS), and infrastructure as a service (IaaS).

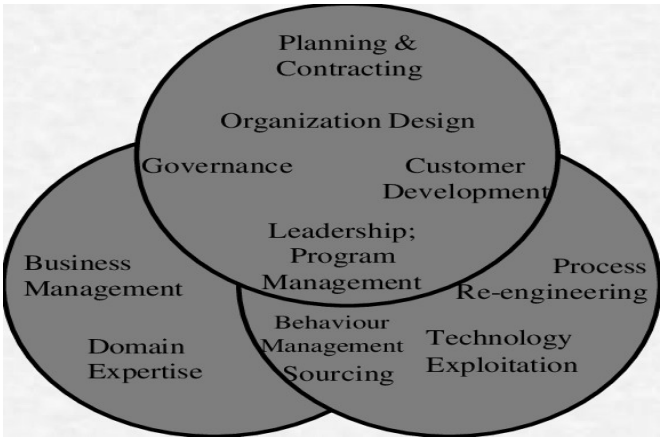
The SaaS model brings significant benefits to both the customer and the supplier. The main advantage for both parties is that they share risks and rewards. From the customer's point of view, these are mainly the following benefits:

1. Initial costs are significantly lower.
2. The costs are known in advance and without surprising increases.
3. The service includes continuous software improvement and support.
4. The customer is free to choose to switch to another supplier if the service does not meet the expected benefits. However, it should be noted that the transition can be complicated.
5. Reduce additional costs and focus on core business. John Hagel III and Marc Singer (1999), who define the basic types of business (infrastructure management, customer relationship management and product innovation).

(Michel Treacy and Fred Wiersema (1992)) came to the similar conclusion that in their work on value disciplines (operational excellence, customer support) intimacy and product management) show that there are three main different strategies, by which they mean focusing on cost, customer and product innovation. Perhaps the only difference between the two approaches is that the study of value disciplines shows that there are very few companies that are able to excel in more than one discipline, even though the recommendation focuses on only one (industry leaders focused on only one discipline). (Hagel, J. and Marc Singer, M.:(1999))While John Hagel III and Marc Singer argue that "range, speed and range cannot be optimized at the same time.

Build and manage facilities for high volume, repetitive operational tasks. High fixed costs make large volumes essential to achieve low unit costs. They stress standardization, predictability and efficiency.

Picture 1: Relations resulting from implementation digitalization

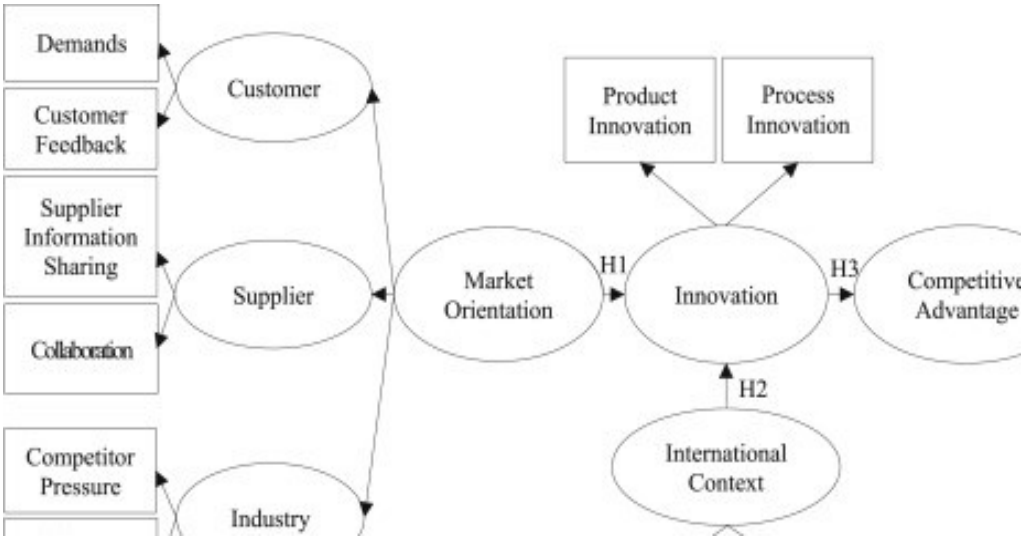


Source: Jensen, M. C. - Ruback, Richard S.:(1983: The Market for Corporate Control: The Scientific Evidence. [online]. Journal of Financial Economics, 1983, s.5-50 available on https://papers.ssrn.com/sol3/papers.cfm?abstract_id=244158inovácie

6. Customer Relationship Management (CRM): Identify, attract, and build relationships with customers. High cost of customer acquisition makes it imperative to gain large wallet share. Highly service oriented.

Product Innovation: Conceive of attractive new products and services and commercialize them. Early market entry enables charging premium prices and acquiring large market share.

Picture 2: Relations in new model in Industry 4.0



Source: https://www.sciencedirect.com/science/article/pii/S2452315118300080

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Conclusion

Benefits of Industry 4.0 include improved productivity and efficiency, better flexibility and agility, and increased profitability. Industry 4.0 also improves the customer experience. In Industry 4.0 any investment you make in technology, improved manufacturing processes, or enhanced systems should deliver a return. That means with Industry 4.0, the ROI opportunities are significant because of the benefits the technologies offer. This includes digital technologies that improve automation, communication between suppliers and customers, are the main benefits of Industry 4.0. Higher productivity concerned od Industry 4.0 technologies enable you to do more with less. In other words, you can produce more and faster while allocating your resources more cost-effectively and efficiently. Other examples of improved efficiency include faster batch changeovers, automatic track and transmission and distribution processes, and automated reporting.

Complying with regulations in industries like pharmaceutical and medical device manufacturing does not have to be a manual process. Instead, Industry 4.0 technologies make

it possible to automate compliance including track and trace, quality inspections, serialisation, data logging, and more.

Better Customer Experience

Industry 4.0 also presents opportunities to improve the service you offer to your customers and enhance the customer experience. For example, with automated track and trace capabilities, you can quickly resolve problems. In addition, you will have fewer issues with product availability, product quality will improve, and you can offer customers more choice of services. Next advantage is reduction of costs. To achieve it, you need to invest, so there are upfront costs. However, the cost of implementing innovations at your facilities will dramatically fall as a result of Industry 4.0 technologies, i.e. automation, systems integration, data management, and more. Industry 4.0 technologies give you greater knowledge of the manufacturing process, supply chains, distribution chains, business performance, and even the products you manufacture.

This creates opportunities to innovate, whether that is changing a business process, developing a new product, optimising a supply chain. Many of the above points can result in higher revenues for your companies. For example, by fully automating your production line and implementing other Industry 4.0 technologies, you could add a new shift with minimal staffing costs to meet an uptick in demand or compete for a new contract.

Shortly:

Better use of resources,

Faster production of goods and providing services,

Less machine and production line downtime,

Fewer quality issues with products,

Less resource, material, and product waste,

Lower overall operating costs,

Creates Innovation Opportunities.

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