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ECONOMY 4.0

Time of change for business

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ECONOMY 4.0

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This report was prepared by the Strategy and Project Management Department and the Corporate Communication Department at PKN ORLEN S.A., with the other business areas contributing to its contents.

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What is Economy 4.0?

Trend observatory

Watching and analysing changes in the business landscape is a routine task of any respectable company's strategy team. Oil companies are obviously focused on the oil market, which can be looked at from many perspectives. Until recently, we concentrated mainly on oil price developments, while changes in the supply and demand were seen primarily as factors driving the prices of final products. In 2010 it was still believed that oil reserves would run out one day, the question was only when exactly that would happen. The shale revolution in the US and new discoveries of oil deposits in other parts of the world proved the theory wrong and showed that oil was abundant. Since mid-2014, the market has been driven by the supply side. Oil prices have gone down, the short-cycle production sources have quickly adapted to the low price environment, and stocks have accumulated. For large oil companies, long-time prices and the future and significance of crude oil as a resource rather than a fuel have become more important than current prices.

Therefore, a central feature of publications and scenarios envisaging shrinking oil demand is not the prices but demand and negative demand drivers. Electric mobility is obviously to the fore, but looming in the background is a much more powerful force – **the progressing digital revolution, which has been called as the Fourth Industrial Revolution**. Its impacts reach far beyond traditional industry and are strongly shaped by demographic and social changes. In one of its reports, The Boston Consulting Group presents the following nine technologies that will transform industrial production[1]:

- big data and analytics,
- augmented reality,
- additive manufacturing (3-D printing),
- the cloud,
- cybersecurity,
- autonomous robots,
- simulation,
- horizontal and vertical system integration,
- the industrial Internet of Things.

Importantly, all the technologies overlap and will logically interact, and in the long run the interactions will probably not be controlled by humans any more but by artificial intelligence. What all the technologies have in common is their '**digitality**'.

[1] The Boston Consulting Group, Przemysł 4.0 PL. *Szansa czy zagrożenie dla rozwoju innowacyjnej gospodarki?* (Industry 4.0 PL. A threat or opportunity for innovation-driven economic development?) [online], on: bcg.com [accessed on October 7th 2017], <http://image-src.bcg. com/Images/BCG-Przemysl-4-PL_tcm78-123996.pdf>.

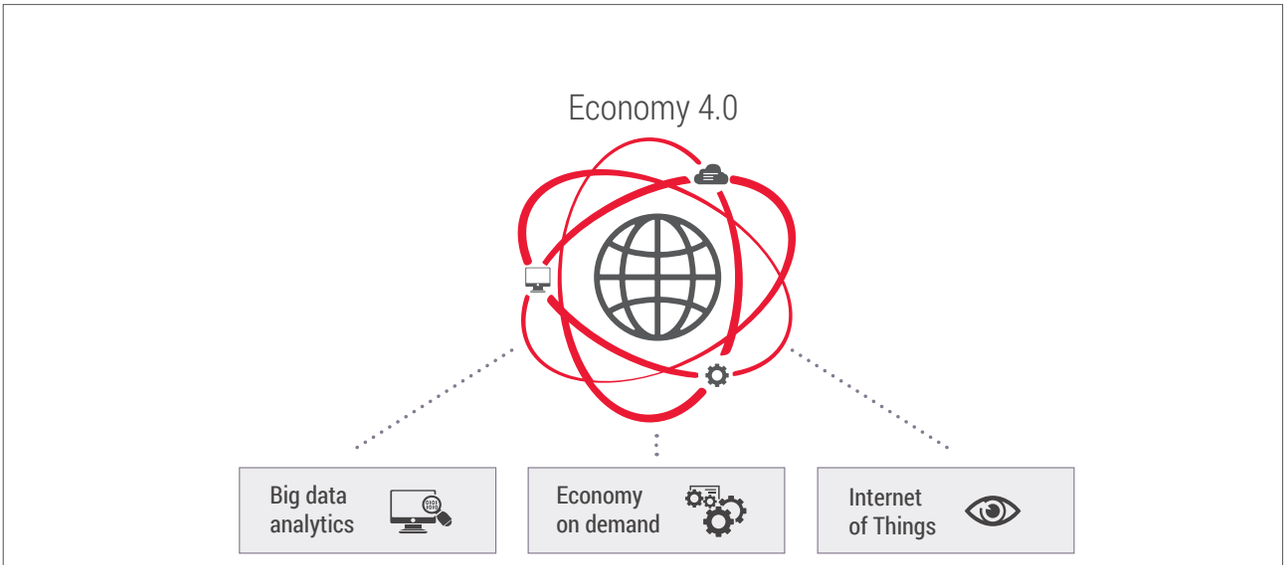
Since anything digital is also electric, the Fourth Industrial Revolution is an electric revolution as well, with far-reaching implications for the energy and transport sectors. Therefore, observation and interpretation of trends by strategy departments of oil and energy companies is now more important than ever before, especially in the light of the increasingly faster changes, driven to a large extent by end users. The revolution is also having an impact on the demand side of the market, determining which primary energy sources we choose and how we use energy. A good example here is Google, whose data centres consume 5 TWh of electricity per year (as much as one million people living in San Francisco), with more than 80% of the energy coming from renewable sources.

Predictability and stability of energy prices, which are offered by renewable sources, greatly help to run businesses where electricity is the largest cost item. The use of renewables is driven by business rationale – the cost of energy is easy to predict and, consisting mainly of depreciation charges, it is insensitive to cyclical fluctuations.

A closer look at these trends and underlying factors leads to the conclusion that something big and inevitable is going on. Digitalisation, i.e. technology, is the basis of it, but its driving force are people who reject the *status quo* and invent new services and products. All this can happen because of the power of the Internet and the disappearance of communication barriers. The "network" itself has taken on a double meaning. In the narrow sense, it means the Internet. No social networks, mobile applications or the related new business models would have ever emerged without it. From this broad meaning of 'network' comes the term **network revolution**, emphasising the role of networks in the Fourth Industrial Revolution.

The rate of technological changes varies and depends on the life cycle of equipment. In the energy sector, where the life cycle lasts decades, they are slower than in the services sector, but they are also all-pervasive, because so are the Internet and social networks of our customers, competitors and suppliers. The risk is that slow changes are not that easy to spot, and once they are visible to the naked eye, it may be too late or too painful to adapt accordingly. An illustrative example is the use of innovative technologies to extract oil from unconventional fields. Because large oil companies failed to see the potential of hydraulic fracturing for more than a decade, oil prices slumped deeply and persistently, forcing many oil-exporting countries to make hard economic and social changes. In order to see the potential effects of new technologies in the energy sector, both on the production and consumption side, the time horizon of the analysis needs to be expanded to at least three decades. Only then can the scale of the upcoming changes in transport and energy mix be visible. In the shorter term, the forecast share of electric cars in the global vehicle fleet is not particularly impressive.

We have long thought that our knowledge of the subject, built on observation and analysis of research findings and reports available in the public domain, is no longer revealing whatsoever, so sharing it in a report would be of little interest. However, a text published recently could make most strategic managers or economists change their minds.



Source: In-house analysis based on: K. Werbach, *How to regulate innovation – without killing it* [online], on: Knowledge@Wharton.

Figure 1. Economy 4.0 integrates cyber-physical systems into one 'internet of the world'

In an interview for Knowledge@ Wharton, prof. Kevin Werbach, University of Pennsylvania, said:

"There's something big going on, and it's a bigger trend than most people realize. There are three trends, and each in and of themselves is significant. One is what we often call the sharing economy — it's really more the on-demand economy. It's not just about sharing resources, but services like Uber and Airbnb, which give on-demand access to resources. The second piece is the Internet of Things — all kinds of devices, billions of devices getting networked. And the third is big data and analytics — the ability to understand and manipulate trends coming out of all those devices. What those three things together mean is that all of the world, potentially, is networked. It's not just that you go somewhere to a computer or you go to your phone to get access to information. It's that potentially everything is a generator of data, and all that data can be integrated and analysed and processed and manipulated. What that means is the kinds of trends and the kinds of developments that we saw online are now happening offline. They're happening to things and physical objects in the world, as well"[2].

Since we can see that something big is going on and we are among those who realise how powerful the trends are, it is our duty not only to take this knowledge into account in our work on strategy and in future decision-making processes, but also to share our observations with wide audiences. That is why this report has been written.

Our conclusions

Despite the great uncertainty as to the future of the energy sector, one thing is sure: continuation scenarios are going into oblivion. There is no escape from changes. Lagging behind may lead to a business disaster and the future belongs to those who spearhead the change. We can see how powerful social media are. Those who ignore them lose customers, lose elections, and land on the outskirts of history. Equally powerful are digital platforms used to provide services – ignore them and you will lose to your rivals. Industry and the energy sector are in for inevitable digitisation and, therefore, their business models must be adapted accordingly to meet customers' needs. Consumers' side will rule also in the energy sector, thanks to innovative technologies, developed and scaled up by industry. It would be useful to think what we should do to start setting new development paths in some areas.

In the era of revolutionary changes, when continuity is out of question, the future is becoming extremely uncertain. The uncertainty is about how – rather that if – the world is going to change. No one can say for sure what the world will look like in 30 years. However, we must not stick to the belief that since we do not know what it will be like, we'd better not do anything and wait until things clarify. The upcoming changes are a real challenge to the traditional industry, as they are rather slow in the beginning and appear to be of a niche nature. Research into these processes at the business level shows that many of the world's giants, such as Boeing or General Electric, are changing their business models to capture the opportunities and avoid the threats posed by Industrial Revolution 4.0. Digital companies are taking it all and growing rapidly, widening the gap between their efficiency and earnings and those of analogue businesses.

Waiting for a change is not a good strategy to follow – you will only lag behind, weaken your competitive position, be marginalised, moved to the periphery or even excluded from the business community. A better solution is to use the changes as a driving force and – where possible – to influence them through innovative ventures.

We wondered how to convince our readers that now is the time to start preparing for the change, although it is difficult to show exactly what it will involve. So, we have decided to refer to cases that are already known, and seek analogies. Case study is a proven research method used for many years, e.g. by the World Bank to prepare reports on economic and social changes which are not covered by general theories yet. It simply confronts examples of what works with what does not work and draws conclusions, for example, on which way not to go. It is worth recalling here the reports on Poland as the pioneer of transformation taking place in the early 1990s. Reports on successive economies in transformation referred to the cases seen in the Polish economy. The examples we have chosen are to show the situation from the perspective of three groups of entities:

- **Individual consumers and their needs**
  How to identify and satisfy those needs? How is the on-demand economy changing consumer behaviour? To what extent will consumers' preferences affect the demand for energy and energy carriers?

- **Flexible businesses that make and deliver personalised products and services**
  Do businesses, by offering new solutions, give consumers the opportunity to customise their products and services, or do the consumers and their behaviour, discovered through big data and analytics, play the leading part? How does business deal with digitisation?
  How do the new business models based on digital platforms and integrating with real business affect competition? In the past, a company from country A competed with a company from country B; today 'digital companies' compete with 'analogue companies'.

- **Market moderators**
  How to regulate markets so as not to distort development? How to accelerate the transformation of business models? What challenges does digitisation pose to regulators with respect to safety and consumer protection against unfair competition?

[2] K. Werbach, *How to regulate innovation – without killing it* [online], on: Knowledge@Wharton [accessed on October 7th 2017], <http://knowledge.wharton.upenn.edu/article/how-to- regulate-innovation-without-killing-it />.

We view this report as material for consideration and discussion. It is based on the reasoning underlying the strategy of PKN ORLEN. Did we read the future trends correctly? Have your say.

Introductory example: Uber

Some of us in Poland still remember the time when people would queue for a taxi at a taxi stop, and catching a cab in the street bordered on the miraculous. It was hard to believe that there were cities in the world where taxis were constantly in move, looking for clients. Apparently in London you only had to shout "Taxi!" and raise your hand, while in New York, whistling with your fingers did the job. Eventually, the situation in Poland changed and it was the taxi drivers that needed to look for passengers. Each taxi had a small CB radio transceiver to allow the driver to talk to the taxi dispatcher receiving phone calls from clients. The dispatcher had to be told exactly where the taxi was supposed to arrive, which sometimes was quite a challenge even for the locals. When the passenger was finally located and boarded the taxi, the time of the trip was filled with hisses and crackles from the radio station left on and with the driver shouting his responses to the calls from the dispatcher. Replacing the radios with small tablets did not change much in the taxi business.

And then Uber appeared. To those of our readers who do not know how Uber works, let us explain that after installing the Uber app on your smartphone and signing up as a passenger, you can hail a taxi (or actually a private car with an Uber driver, to be more precise) by entering your destination address and pressing the right button on your smartphone. A moment later a map appears showing a car moving in your direction and displaying the estimated time of arrival. You also see a photo of the driver, his average rating, his name, and the car's make, model and registration number. The driver takes the shortest or the fastest route to your destination, and you can follow it on your screen. Soon after you get off and close the door behind you, you get an electronic confirmation of your travel, specifying the fare and asking you to leave a rating for the driver (if the rating is low, you will not be offered to ride with the driver again). Standard elements of the service are handled automatically through the Uber digital platform, which:

- accepts trip requests,
- identifies your location and destination,
- launches the location system and passes the trip request to the driver that is closest to you,
- gives the driver turn-by-turn directions along the fastest route to the pick-up location and then the destination,
- produces and sends to you an electronic sales document (e-invoice), which includes the route map, travel time, fare, and request to leave a rating of the service quality,
- settles the transaction by dividing the fare into the driver's pay and the company's margin.

With the Uber app, which stands in for the CEO, the accountant and dispatching centre, you can move from point A to point B faster and – most importantly – at a lower cost. That makes Uber so popular, especially with young people who are not traditional taxi clients.

Taxi corporations accuse Uber of unfair competition, saying that Uber lowers the costs by violating the law. Of course, the law does not prohibit anyone from giving strangers a lift or even taking money for the ride, provided that this is not gainful employment (which is regulated by law)[3]. There are disputes in many countries between the regulators and Uber about whether the drivers are workers and therefore should be registered as employees and pay social insurance and taxes, or – as the company claims – they are Uber partners and customers, not employees. The dispute resolutions differ from one country to another. In some, Uber is banned or its operations are severely limited[4]. In others, Uber's success has led to the emergence of followers, such as Lyft, Arro and Way2Ride in the US, Grab in South Asia, or Ola in India, competing with Uber for the benefit of the customers[5].

We have started our report with taxis and Uber for a few reasons.

- Uber is widely known and provokes strong emotions (taxi drivers strikes, driver intimidation, license cancellations).
- Uber is more than just another company competing with taxis. It represents a completely new approach to latent demand that remained untapped by the previous business models. The benefits it offers to the consumers are obvious.
- Because its operations are not legal everywhere, Uber is a serious challenge and a trial field for regulators. How to regulate innovative business models so as not to throw the baby out with the bathwater? Any commercially used innovation is illegal at first as it goes beyond the current legal framework. However, many Uber-like initiatives are beneficial to the consumers, and it is the consumers' interests that regulators should be guided by in the first place. Therefore, it is only natural that the passenger transport regulations should be adjusted to account for the presence of digital platforms.

[3] The Labour Code, laws regulating business activity, insurance and taxes. BlaBlaCar, a carpooling platform connecting people who need to travel longer distances, does not cause such controversy. The passengers cover only a part of the fuel costs, so the driver does not earn a profit. Sharing of travel costs does not affect the validity of driver's insurance. To learn more, go to: www.blablacar.pl

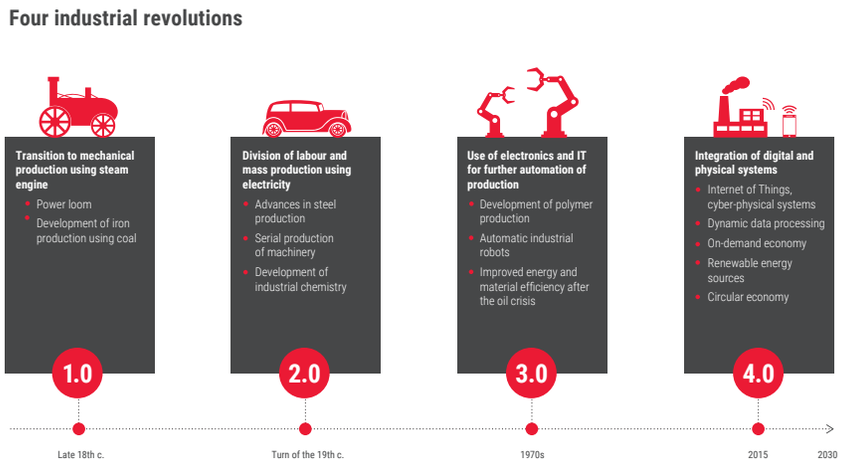
[4] A. Rhodes, *Uber: Which countries have banned the controversial taxi app* [online], on: Independent [accessed on October 7th 2017], <http://www.independent.co.uk/travel/news-and-advice/ uber-ban-countries-where-world-taxi-app-europe-taxi-us-states-china-asia-legal-a7707436.html>.

[5] A. Łopusiewicz, *Uber ma sporo do zrobienia. Poznajcie jego 10 największych rywali* (Uber has a lot to do. Meet its top 10 rivals) [online], on: mamstartup.pl [accessed on October 7th 2017], <http://mamstartup.pl/sukces/10135/ube- r-ma-sporo-do-zrobienia-poznajcie-jego-10-najwiekszych-rywali>.

- The Uber business model, based on digital platforms, networks and social relations (trusting strangers), is replicable and can be emulated in other digital platforms. All you have to do is use your imagination and substitute the driver and the passenger with communicating devices and replace the transport algorithm with another algorithm.
- The economic and social effects that Uber has produced clearly indicate what we can expect of digitisation and automation in other sectors.

Source: In-house analysis.

Figure 2. Uberisation is an effect of further growth of the sharing economy



Source: In-house analysis based on The Boston Consulting Group, *Przemysł 4.0 PL. Szansa czy zagrożenie dla rozwoju innowacyjnej gospodarki?* (Industry 4.0 PL. A threat or opportunity for innovation-driven economic development?) [online], on: bcg.com.

Figure 3. The time gap between successive industrial revolutions is getting shorter

Uber is an embodiment of a new powerful force (megatrend), which changes the way we live, namely:

- how we find work and how we work (occasionally, when we have free time, without being formally employed anywhere),
- how we earn money (using our free assets, such as time, skills, tools, unused car, apartment),
- who we trust (the app helps build up trust of strangers and is its guarantee),
- how we communicate (directly with service providers),
- how we use services (research shows that we use more services not only because of lower cost but also because of their greater accessibility).

Everybody is a consumer of goods and services that they have to pay for, so they have to earn money. Companies like Uber are generally thought to deprive people of work. However, the facts are different. Not all taxi drivers have lost their jobs to Uber drivers. In the cities where Uber operates, the number of active drivers providing passenger transport services has increased. The number of rides completed has also grown, as Uber is used by people who did not use taxi services before. Some (flexible) traditional taxi drivers switched to Uber, while some others (preferring fixed employment terms) have lost their jobs. What is the net effect for the labour market? Automated handling of the process has facilitated access to the service, reduced its price, stimulated demand for the rides, and – as a consequence – increased the number of people making their living on passenger transport.

We deliberately avoid such terms as 'employed' or 'working', as they are officially defined in the Labour Code. If we want to have access to network platforms such as Uber, Airbnb or TaskRabbit, we need to amend the Labour Code and other industry regulations to take into account the benefits that these platforms bring to consumers. Banning a service on the grounds of current laws is a journey down a dead-end street.

This grand wave driving social and economic changes will bypass us and leave us far behind the others, provided it does not flood us completely[6]. Those processes may have many names, but they have one feature in common[7] – the growing presence of digital technology in the real world, connected with departure from mass services and mass production to tailored services and production on demand.

This is possible thanks to automation and robotics, sensors, collection and analysis of data streams and the internet of everything. That is how Industry 4.0 is being born.

Industry 4.0: history and definition

The First Industrial Revolution took place at the end of the 18th century in Great

6 PKN ORLEN, *Jak regulować innowacje?* (How to regulate innovation?) [online], on: napedzamyprzyszlosc.pl [accessed on October 7th 2017], <http://napedzamyprzyszlosc.pl/blog/jak-regulowac-innowacje>.

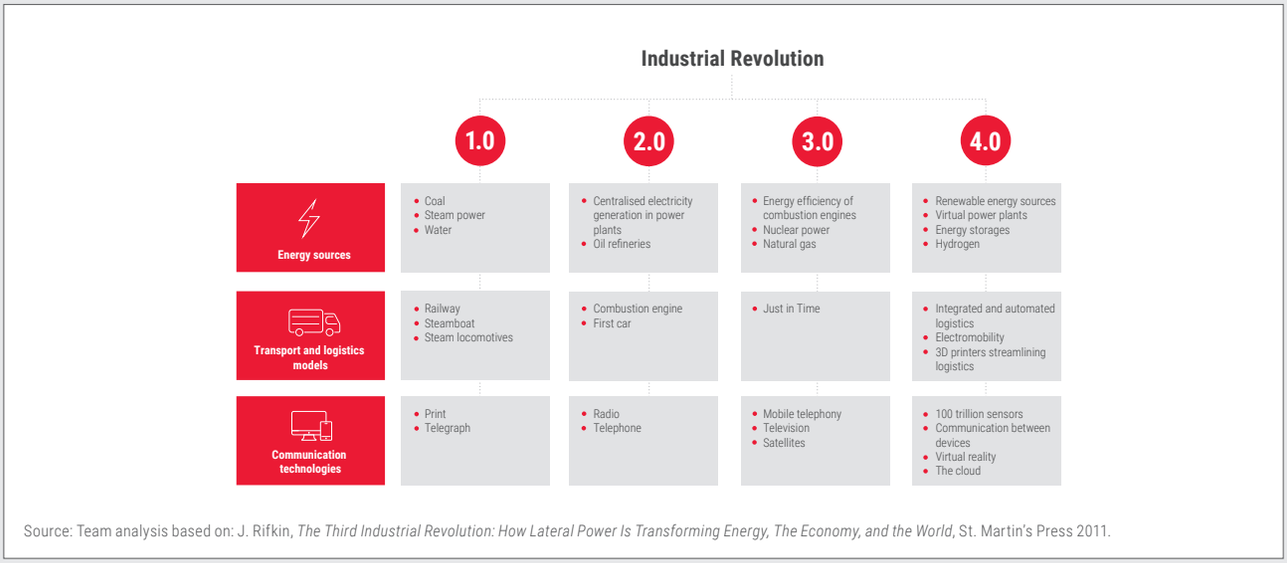
7 Scientific and research circles call the force the Fourth Industrial Revolution (or Network Revolution), highlighting the processes and their potential impact on the business, society and environment which is being analysed. Business, on the other hand, prefers names that relate to the future vision and objectives that they intend to accomplish. The most familiar are the German terms Industrie 4.0 and Industrial Internet propagated by General Electric. Other names are: Integrated Industry, Smart Industry and Smart Manufacturing. The Polish Ministry of Development uses the term 'Fourth Industrial Revolution'.

Britain and involved mechanisation to the textile industry. Tasks previously performed manually by hundreds of spinners and weavers in their homes were moved to a single textile plant, a prototype of modern factory. **The Second Industrial Revolution** occurred at the turn of the 19th and 20th century, and one of its spectacular successes was the launch of Henry Ford's production line, which started a century of mass production of cars. The first two industrial revolutions led to increased prosperity and urbanisation. **The Third Industrial Revolution** took place in the 1970s and resulted in increased automation of production processes with the use of computers. **The Fourth Industrial Revolution** is what we have seen for the last 5–6 years – the integration of digital and physical systems.

So far, when referring to the future, we have spoken of digitisation as a megatrend, a force bringing profound changes in all aspects of our lives. Today, we can name the changes. Digitisation supports the emergence of on-demand economy, which develops and delivers products and services as and when needed by the customers. The change is led by consumers, who are increasingly willing to share resources against consideration rather than own them. The second element is the Internet of Things – devices equipped with sensors to communicate with each other faster and more efficiently than through humans. These include automated factories using artificial intelligence to anticipate customer needs, or autonomous cars carrying us safely wherever we want. Last but not least, there is big data and analytics which feed data to

In the 19th century, printing, telegraph and rail (relying on large coal reserves) paved the way for the First Industrial Revolution. In the 20th century, centralised electricity generation, radio, development of the automotive industry (combustion engine running on cheap oil) were the foundations of the Second Industrial Revolution.

After 1970, new means of communication (mobile telephony, television), lean manufacturing, just-in-time logistics and efficient combustion engines contributed to the emergence of the Third Industrial Revolution. After the oil crisis, energy efficiency was treated as a new energy resource. Today, we are witnessing the birth of another revolution in industry. The accumulation of developments like Internet-based communications, digital energy infrastructure relying on renewable energy sources, and automated digital transport systems, create unique conditions for the emergence of a qualitatively new effect – spilling of the digital revolution into other sectors of the economy. By 2030, more than 100 trillion sensors will be placed in devices that we use every day in our homes, cars, roads, power grids, and offices. As a result, we will have the Internet of Communications, Internet of Energy and Internet of Logistics, all part of the Internet of Things. For the first time in the history of mankind, individuals will be able to communicate, trade and exchange goods and services directly – without system, communication, logistic, or language barriers – on such a large scale.



Source: Team analysis based on: J. Rifkin, *The Third Industrial Revolution: How Lateral Power Is Transforming Energy, The Economy, and the World*, St. Martin's Press 2011.

Figure 4. Every industrial revolution requires changes in three areas of the economy: energy, transport, and communication

artificial intelligence, explore our consumer, communication, nutrition and health behaviours and habits, identify our needs, suggest solutions, and control production lines so that we can get what we need when we need it.

The internet of the world is emerging to interconnect everything. However, all fundamental phenomena begin to exist in our consciousness only after we name them. The name is usually derived from diagnosis and interpretation of a phenomenon, i.e. from its context. And when it emerges, it creates its own context, in many cases different from the original.

Yet, the 'Fourth Industrial Revolution', popularised by Klaus Schwab and the World Economic Forum, is a broader term. In the Forum materials, the Fourth Industrial Revolution is defined as the emergence of "cyber-physical systems" offering a completely new set of functionalities for people and machines. While the functionalities depend on the technologies and infrastructure developed in the Third Industrial Revolution (IT revolution), the Fourth Industrial Revolution is about new solutions, with technology embedded in societies and even in the human body. Examples include: genome editing, new forms of machine intelligence, groundbreaking materials and approach to management relying on cryptographic methods such as blockchain.

The now commonly known phrase Industry 4.0 (Germ. *Industrie 4.0*) first appeared in the public domain in 2011 at the Hannover Trade Fair and meant a joint initiative of the business, political and scientific milieus to promote the idea of strengthening the competitiveness of the German industry. The idea was welcomed by the German federal government, which decided to make Industrie 4.0 an integral part of its 'High-Tech Strategy 2020 for Germany', looking to promote Germany as a global leader in technological innovation. Industrie 4.0, which was at the heart of the government's strategy for the German economy, took on a life of its own and only then plenty of publications appeared on what Industrie 4.0 was about.

Researchers at the Technical University of Dortmund examined 51 online publications and published their review in early 2015[8]. It was found that the concepts shown in Figure 5 were the most frequently named core components of Industrie 4.0.

For some time, the term Industrie 4.0 was only known in German-speaking countries. In other parts of the world, similar concepts emerged, such as Industrial Internet, promoted by General Electric, defined as "combining complex physical machinery with networked sensors and software; it is used in predicting, controlling, and planning to improve business and social products." The US government supports the Industrial Internet Consortium formed in 2013 with the Advanced Manufacturing Fund (worth USD 2bn). Other concepts covering similar ideas are Integrated Industry, Smart Industry, or Smart Manufacturing.

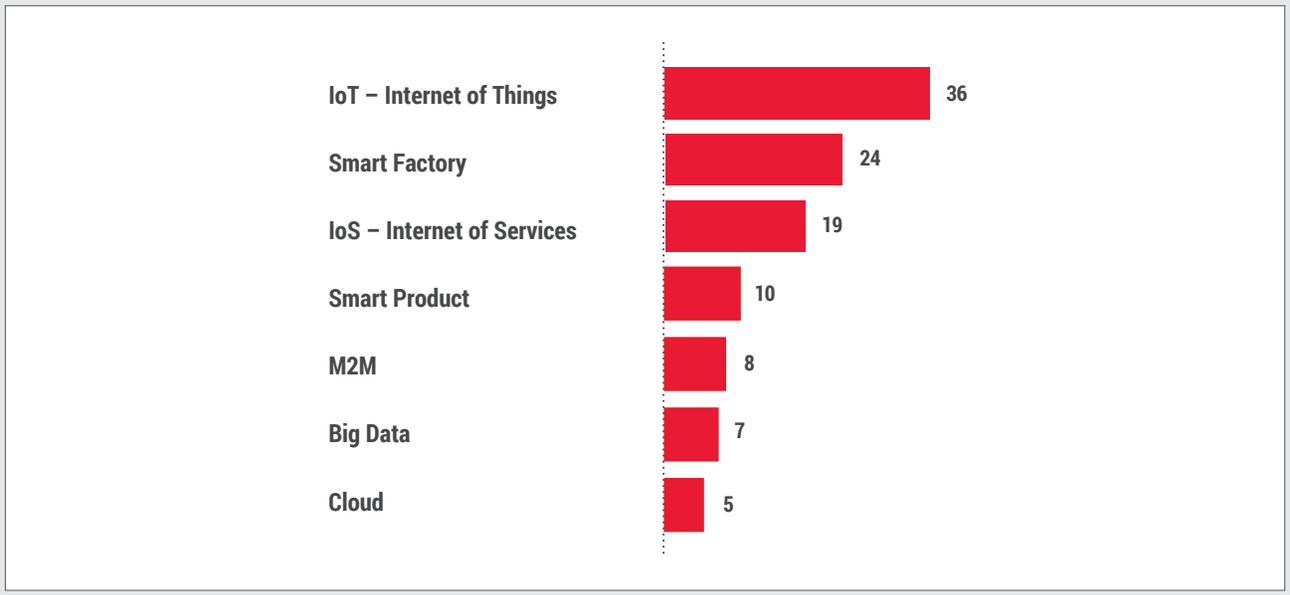


Figure 5. Core components of the Fourth Industrial Revolution most frequently named in 51 publications reviewed

[8] M. Hermann, T. Pentek, B. Otto, *Design Principles for Industrie 4.0 Scenarios: A Literature Review* [online], Technische Universitat Dortmund 2015 [accessed on October 7th 2017], <http: // www.snom.mb.tu-dortmund.de/cms/de/forschung/Arbeitsberichte/Design-Principles-for-Industrie-4_0-Scenarios.pdf>.

Klaus Schwab's book has not been published in Poland yet, but a Polish review is available[9]. The foreword to the book, published in the Polish language, reads:

"Of the myriad challenges the world faces today, perhaps the most overwhelming is how to shape the coming Industrial Revolution that began at the turn of the century. [...] The Fourth Industrial Revolution has the potential to empower individuals and communities, as it creates new opportunities for economic, social, and personal development. But it also could lead to the marginalisation of some groups, exacerbate inequality, create new security risks, and undermine human relationships. If we are to seize the opportunities, and avoid the pitfalls, of the Fourth Industrial Revolution, we must consider carefully the questions that it raises"[10].

Earlier, the term 'Fourth Industrial Revolution' appeared in the title of the document proclaiming Industrie 4.0. The authors said that the revolution was rooted in the integration of the Internet of Things and Internet of Services in the processing industry.

The Polish Ministry of Development also speaks about the Fourth Industrial Revolution:

"The Fourth Industrial Revolution, also known as the digital industrial revolution, is changing the operating models of businesses and entire industries. The transformation of the production base assumes that state-of-the-art intelligent IT and automation technologies need to be used at every stage of the production chain, from the design to production, to maintenance and recycling. [...] Key technologies conducive to the transformation will be implemented in the following technological areas:

- systems and devices managing the networks of power operators and integrating the networks with end-user infrastructure,
- technical infrastructure systems and devices in energy-efficient and passive buildings,
- reliable production systems,
- sensor technologies (data-collecting sensors),
- Internet of Things (IoT), enabling communication between devices,
- storage of large data sets,
- cloud computing, offering easy access to data and the possibility to process data collected in one place,
- telecommunication technologies supporting fast data transfer"[11].

The changes brought about by the Fourth Industrial Revolution go far beyond industry and in fact affect the entire economy. When writing about them further in this report, we will be using what we believe to be a more appropriate term: Economy 4.0.

[9] MA.C. Kondratowicz [online], for: Association of Polish Economists [accessed on October 7th 2017], <https://drive.google.com/file/d/0B6z6Svs4V1C9MkQza09jcHpQMEU/view?ct-=t(NEWSLETTER_1_20173_14_2017)>.

[10] K. Schwab, *Dokąd zaprowadzi nas czwarta rewolucja przemysłowa* (Where does the fourth industrial revolution take us?) [online], on: wszystko`conajwazniejsze.pl [accessed on October 7th 2017], <https://wszystkoconajwazniejsze.pl/klau=s schwab-dokad-zaprowadzi-nas-czwarta-rewolucja-przemyslowa/>.

[11] Ministry of Development, *Czwarta rewolucja przemysłowa* (Fourth Industrial Revolution) [online], on: www.mr.gov.pl [acessed on October 7th 2017], <https://www.mr.gov.pl/strony/zadania/reindustrializacja-gospodarki/ czwarta-rewolucja-przemyslowa/>.

What is the business potential of Economy 4.0?

A presence in new innovative industries and services is the essence of the business potential of Economy 4.0. Many corporations have overlooked the opportunities that digital business models give.

The European Union attaches much importance to development of Economy 4.0. Through the Digital Europe project, it seeks to create an advanced, intelligent economy of the 21st century, making Europe the most innovative, productive and green economic power in the world. However, the European digitisation agenda requires more than just wide access to free broadband wireless Internet and removal of roaming charges. Digitisation of the European economy, if successful, will revolutionise almost every sector of the economy and bring unprecedented new business opportunities. Robotics and automation of the production of parts and components, offered by 3D printing even today, will encourage industry to move from low-cost countries (peripheries of value chains) to Europe, with its value chain centres offering high-performance jobs.

For energy companies, Economy 4.0 is a challenge and an opportunity at the same time. Every industrial revolution needs three elements to succeed:

- new communication technologies to effectively manage business processes,
- new transport models to ensure efficient flow of goods,
- new energy sources to ensure effective production costs[12].

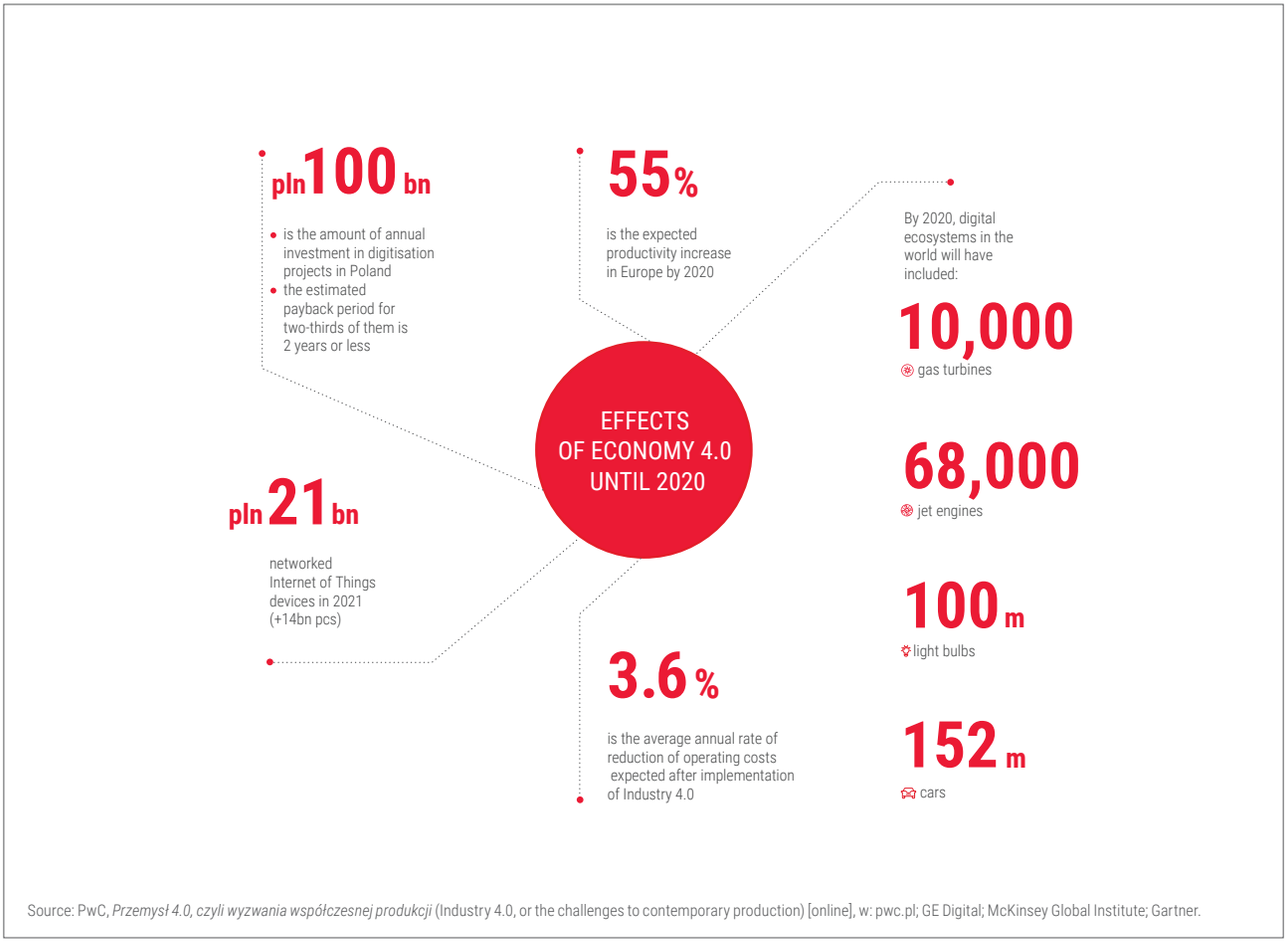
Like with the previous revolutions, the power industry is again at the very centre of the change.

Economy 4.0 would have never emerged but for groundbreaking technologies offering new value to consumers.

To succeed, companies must be effective in three dimensions.

- **Consumer perspective**
  What do the increasingly demanding customers need here and now, and – importantly – how to reach the customers just in time?
- **Trader perspective**
  How to build an effective production system that allows millions of prosumers to work together to create products and services in the consumer-to-consumer model?
- **Regulatory aspect**
  How to make regulations to meet the needs of Economy 4.0, or how to ensure safe and socially beneficial long-term growth in the times of change? How to develop dynamic and forward-looking regulations that would allow the new business models to be scaled up?

[12] J. Rifkin, *The Third Industrial Revolution: How Lateral Power Is Transforming Energy, the Economy, and the World*, St. Martin's Press 2011.



Source: PwC, *Przemysł 4.0, czyli wyzwania współczesnej produkcji* (Industry 4.0, or the challenges to contemporary production) [online], w: pwc.pl; GE Digital; McKinsey Global Institute; Gartner.

Figure 6. Diverse effects of Economy 4.0

Consumer perspective

With growth of the global economy, people in most parts of the world get richer. Although distribution of wealth is unequal, and some economists believe that the inequalities have in fact increased in recent years, the poverty ratio is undoubtedly declining and the middle class is growing. According to the World Bank data, the percentage of the world's population living in poverty (for less than USD 1.9 per day) fell from 42% in 1981 to 11% in 2013.[13] Using the World Bank data, Homi Kharas, Deputy Director for the Global Economy and Development programme at the Brookings Institution, estimates that the size of the global middle class rose from 1 billion in 1985 to 3 billion in 2015.[14]

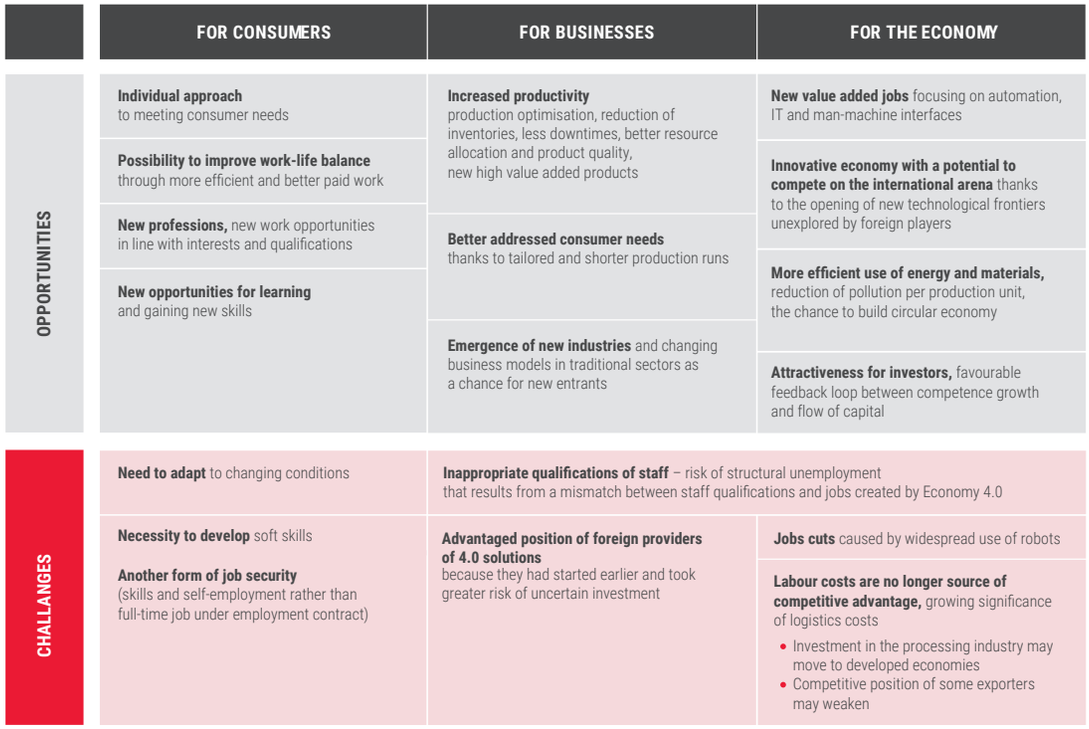
For the market, this translates into an exponential increase in the number of consumers with growing financial resources to satisfy their needs. According to consultancy firm McKinsey, consumers in developing countries will move from the periphery to the centre of the global economy within the next 15 years. The company calls the phenomenon the greatest growth opportunity in the history of capitalism[15] and predicts that by 2025 consumption in these countries will almost double relative to 2010.

Consumers' needs and how they are satisfied are changing rapidly now, mainly

[13] World Bank, *Development Research Group, Poverty headcount ratio at $1.90 a day (2011 PPP) (% of population)* [online], on: worldbank.org [accessed on October 7th 2017], <https://data. worldbank.org/indicator/SI.POV.DDAY?view=chart>.

[14] H. Kharas, *The unprecedented expansion of global middle class. An update* [online], on: brookings.edu [accessed on October 7th 2017], <https://www.brookings.edu/wp-content/uplo- ads/2017/02/global_20170228_global-middle-class.pdf>.

[15] P. Desai, A. Potia, B. Salsberg, *Retail 4.0: The Future of Retail Grocery in a Digital World* [online], on: sipotra.it [accessed on October 7th 2017], <http://www.sipotra.it/wp-content/uplo- ads/2017/06/The-future-of-retail-grocery-in-a-digital-world.pdf>.



	FOR CONSUMERS	FOR BUSINESSES	FOR THE ECONOMY
OPPORTUNITIES	**Individual approach** to meeting consumer needs	**Increased productivity** production optimisation, reduction of inventories, less downtimes, better resource allocation and product quality, new high value added products	**New value added jobs** focusing on automation, IT and man-machine interfaces
	Possibility to improve work-life balance through more efficient and better paid work		**Innovative economy with a potential to compete on the international arena** thanks to the opening of new technological frontiers unexplored by foreign players
	New professions, new work opportunities in line with interests and qualifications	**Better addressed consumer needs** thanks to tailored and shorter production runs	**More efficient use of energy and materials,** reduction of pollution per production unit, the chance to build circular economy
	New opportunities for learning and gaining new skills	**Emergence of new industries** and changing business models in traditional sectors as a chance for new entrants	**Attractiveness for investors,** favourable feedback loop between competence growth and flow of capital
CHALLANGES	**Need to adapt** to changing conditions	**Inappropriate qualifications of staff** – risk of structural unemployment that results from a mismatch between staff qualifications and jobs created by Economy 4.0	
	Necessity to develop soft skills **Another form of job security** (skills and self-employment rather than full-time job under employment contract)	**Advantaged position of foreign providers of 4.0 solutions** because they had started earlier and took greater risk of uncertain investment	**Jobs cuts** caused by widespread use of robots
			Labour costs are no longer source of competitive advantage, growing significance of logistics costs • Investment in the processing industry may move to developed economies • Competitive position of some exporters may weaken

Source: In-house analysis based on: The Boston Consulting Group, Przemysł 4.0 PL. Szansa czy zagrożenie dla rozwoju innowacyjnej gospodarki? (Industry 4.0 PL. A threat or opportunity for innovation-driven economic development?) [online], on: bcg.com; team analysis.

Figure 7. Opportunities and threats presented by Economy 4.0 to Poland and Polish businesses

because of the progressive digitisation which helps customers to make better choices from among the increasingly wider (also because of the technological revolution) array of goods and services offered by manufacturers and providers.

At present, the demand side is shaped by the following phenomena: customers expecting personalised offers to meet their individual needs, profound change in the buyer profile resulting primarily from demographics (ageing society), and a new generation of consumers with specific expectations entering the market.

PERSONALISATION: MASS OFFER REPLACED BY INDIVIDUAL OFFER

The era of mass consumption is ending. The same product or service offered to all customers, with only slight differences in the service model, no longer appeals to buyers. Confronted with the mass of information, potential customers are increasingly likely to ignore messages addressed to everybody. They rather look for the most suitable deals and make their own buying decisions. If they expect some kind of suggestion, it should be personalised and should address their needs.

Profiling of customer needs based on regional or national preferences is becoming a thing of the past. Nowadays, consumers are less spontaneous in their purchasing decisions. Before they decide to spend money, they make research on the Internet, looking for the right product or service, checking the prices, comparing products of other sellers, and reading users' opinions. And even when they finally make the decision to buy and choose to order the product online, they would first

go to a traditional brick-and-mortar store to see the product in reality.

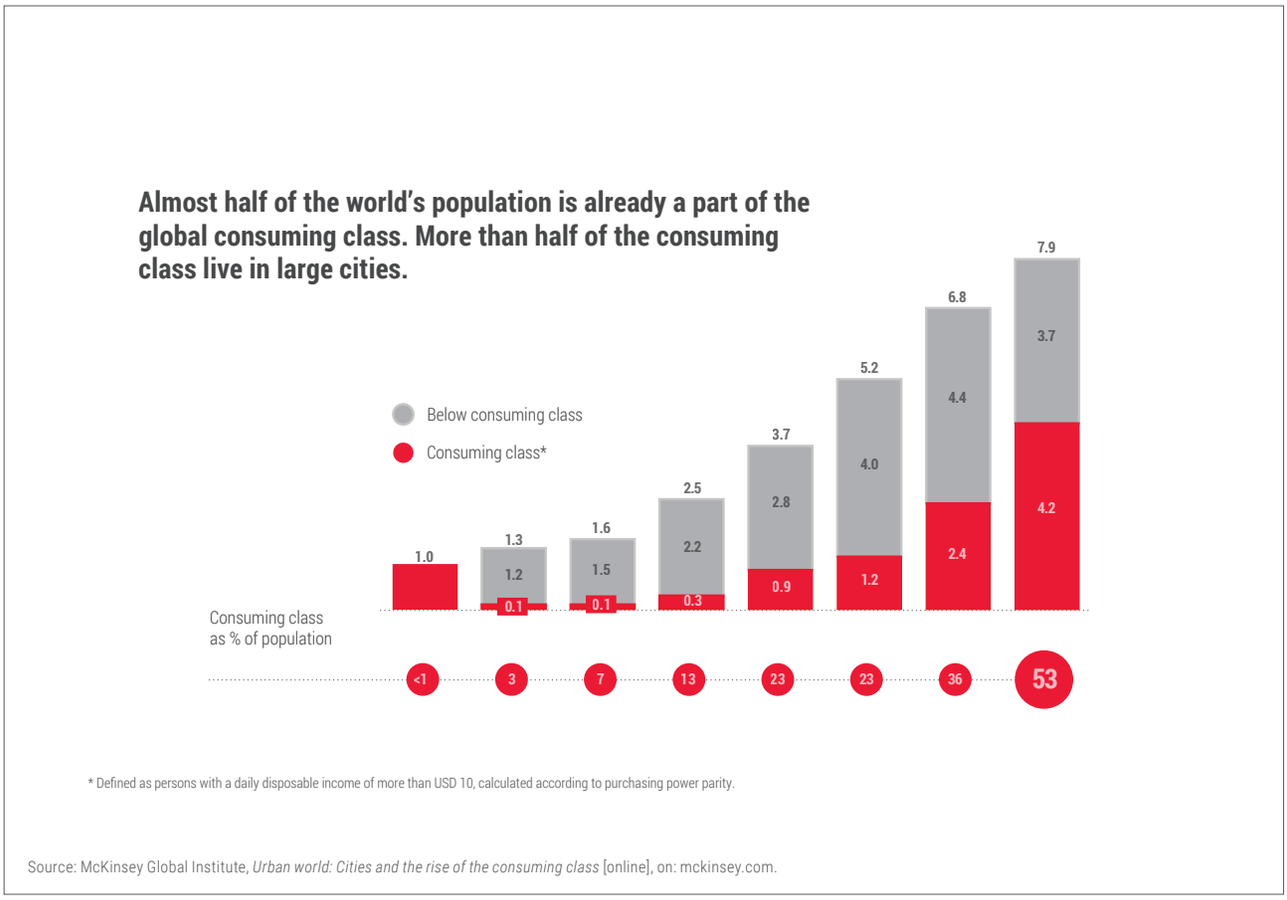
Only several years ago, information on products was mainly sought on websites. Now more and more people are using Facebook or other social networking sites for this purpose. Furthermore, because of the growing popularity of smartphones and mobile applications, the buying process in e-commerce has changed as well. The survey 'E-commerce in Poland 2016. Gemius for e-Commerce Poland' shows that more than 40% of e-customers use the smartphone to buy online[16]. The first step in the personalisation process is to analyse consumer behaviour.

Being active in the Internet helps you find out who your customers are and what they need, and thus helps you to better match your offer. There are tools available to facilitate the task, many of which collect a lot of data (e.g. IP address, location, cookies) automatically to later use it to prepare an individualised offer tailored to the client's preferences.

Acquisition of customer data is relatively the easiest for businesses offering products and services online, as they encourage users to create accounts on their sites. Traditional stores, on the other hand, promote loyalty cards. Analysis of purchase history (including complaints record), phrases typed in search engines, and opinions posted does more than only help to target ads or suggest products to buy. Online store Zalando uses self-learning algorithms to analyse the profile of purchases made by a customer and then prepare offers of clothes for the new season that he or she may be interested in. The company's financial results show that the idea works.

OLDER POPULATION AS AN INCREASINGLY IMPORTANT MARKET SEGMENT

When speaking of changing customer needs, we tend to think about young consumers, ready to quickly seize the opportunities that come with new tech-



Source: McKinsey Global Institute, *Urban world: Cities and the rise of the consuming class* [online], on: mckinsey.com.

Figure 8. Over 3 billion people will enter the global consuming class by 2025, most of them large city dwellers in developing countries

[16] Gemius, *E-commerce w Polsce 2016. Gemius dla e-Commerce Polska* (E-commerce in Poland 2016. Gemius for e-Commerce Polska) [online], on: ecommercepolska.pl [accessed on October 7th 2017], <https://ecommercepolska.pl/files/9414/6718/9485/E--commerce_w_polsce_2016.pdf>.

nologies. But they are just one segment of the market and not very likely to expand, considering the prevailing demographic trends. On the other hand, the innovations of Economy 4.0 are likely to be more and more widely used by the elderly.

With life expectancy rising and fertility rates falling in developed countries, their populations will age rapidly in the coming years. Also, this and next generations of seniors will increasingly defy the stereotype of sickly and penny-pinching old people. Many of them have accumulated considerable wealth over their working life, some pursue a professional career until late in life, and most of them remain active consumers thanks to leading healthy lifestyles.

In the US, baby boomers, born from the mid-1940s to the mid-1960s, began to move into retirement a few years ago, with the over-50s already representing half of the country's adult population and controlling 70% of total disposable income. By 2050, there will be 161 million 50+ consumers in the US, representing 63% growth over 2010, according to Nielsen. The same trend is being seen in other geographies as well. In China the number of people over 60 will double by 2053 and in Japan people over 65 will account for a staggering 40% of the country's population by 2060.

In Poland, the share of population post working age is about 19%, with the figure projected to surge to 33% by 2050. According to GfK, consumers aged 60+ now account for 29.9% of total household purchases, and their share is expected to increase to 36.9% by 2035. People aged 60+ represent 21% of the total purchasing power of Poland's population. The aggregate annual value of household purchases in this age group is PLN 48.2bn.

Against this backdrop, can we still refer to the silver population as a 'market niche', particularly considering the resources at their disposal? According to estimates, the UK's over-50s hold 80% of the nation's wealth, and in Poland as many as 65% of people over 65 years of age are real estate owners[17]. Seniors already control over two-thirds of the world's disposable income. Globally, the spending power of consumers aged 60 and older will hit USD 15 trillion

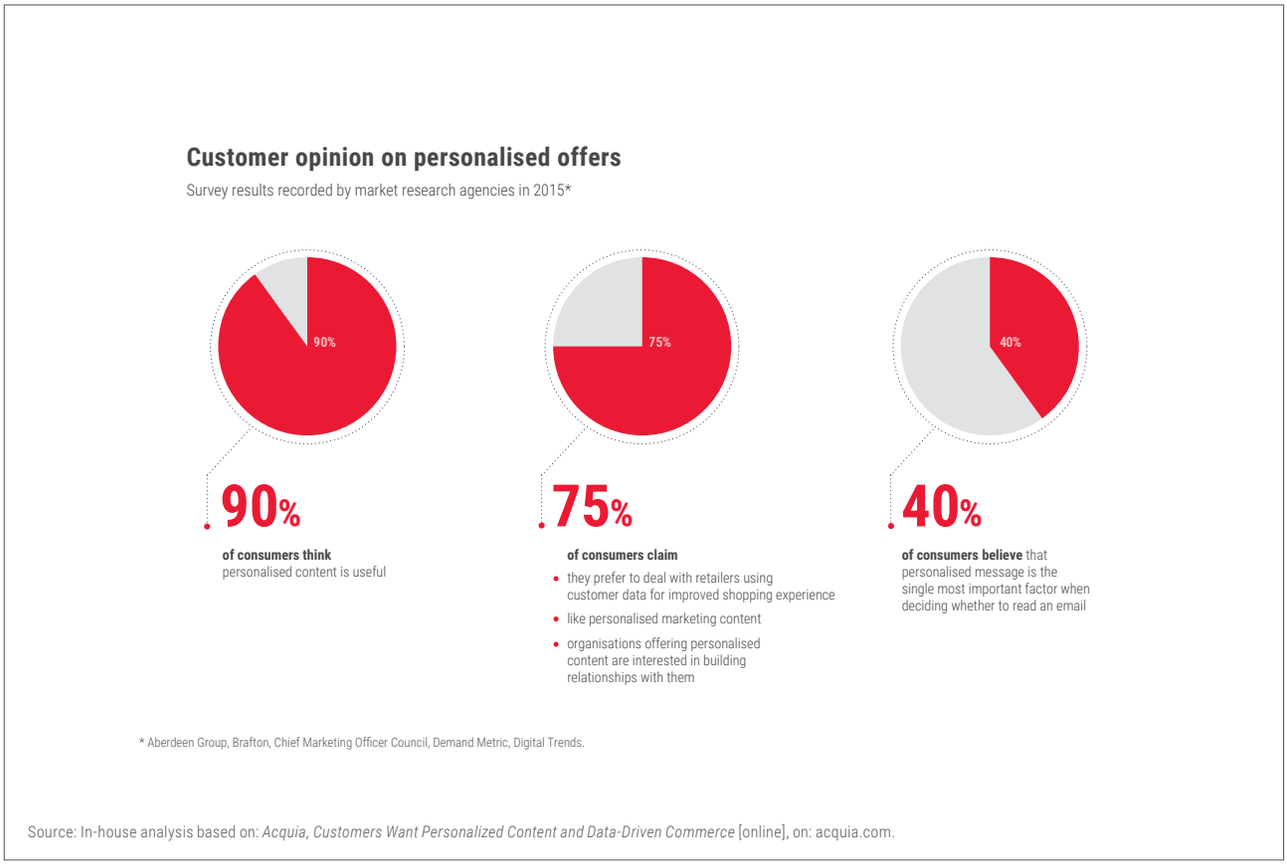
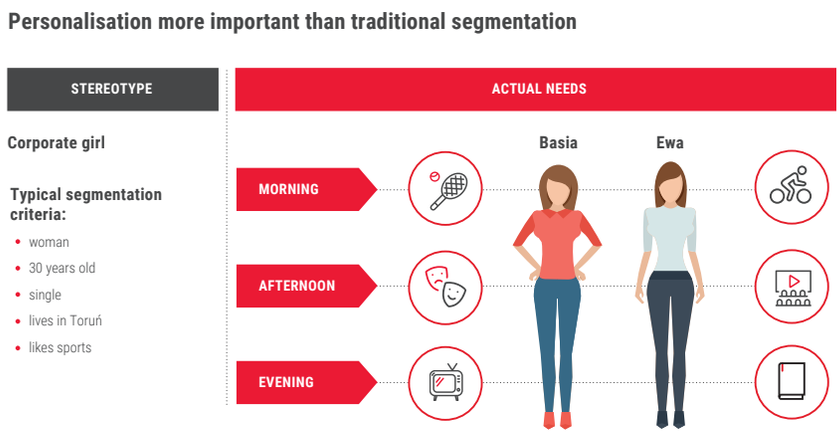


Figure 9. Consumers expect greater personalisation from digital marketing channels

[17] S. Badowska, A. Rogala, *Przełamywanie stereotypizacji konsumentów-seniorów a implikacje dla marketingu* (Breaking the stereotype of senior consumers and the implications for marketing) in: Scientific Journal of the University of Szczecin 2015, No. 875, vol. 1.

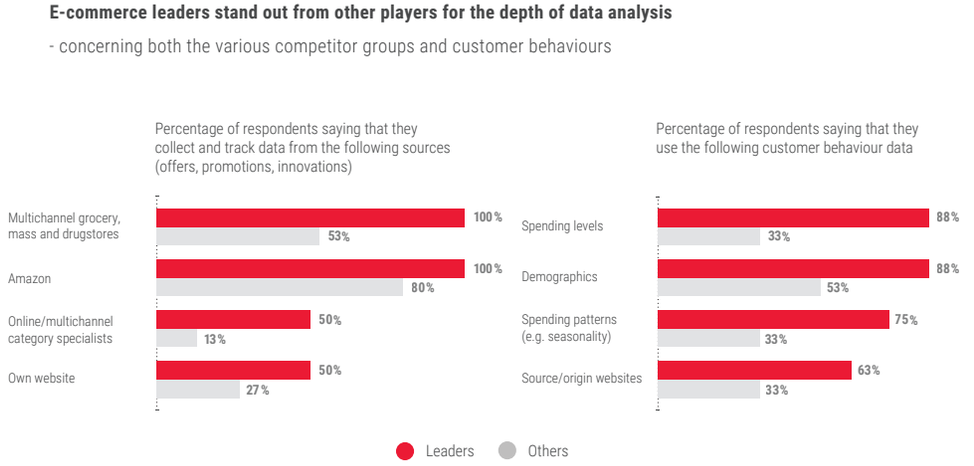


Source: In-house analysis based on The Boston Consulting Group, *Identifying the Sources of Demand to Fuel Growth* [online], on: bcg.com.

Figure 10. Marketing personalisation is about focusing on consumer needs rather than customer segmentation

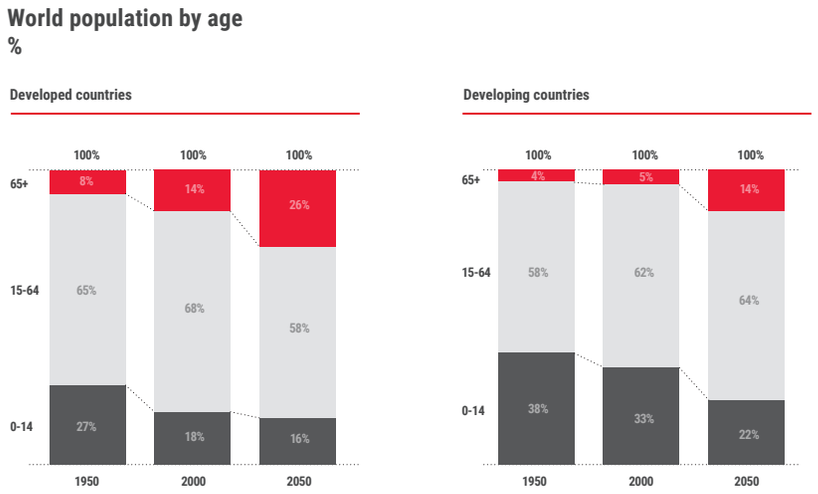
by the end of this decade, up from USD 8 trillion in 2010, according to Euromonitor.

Given the size and importance of older adults as a consumer group, it is surprising that in the United States a tepid 15% of ad spend is targeted at older people. This could be explained by the fact that older people feel younger than their years. According to a survey carried out among UK consumers, some feel as much as 20 years younger than their actual age. Interestingly, the older the person the less likely they are to feel their age and the lower the felt age declared by them.



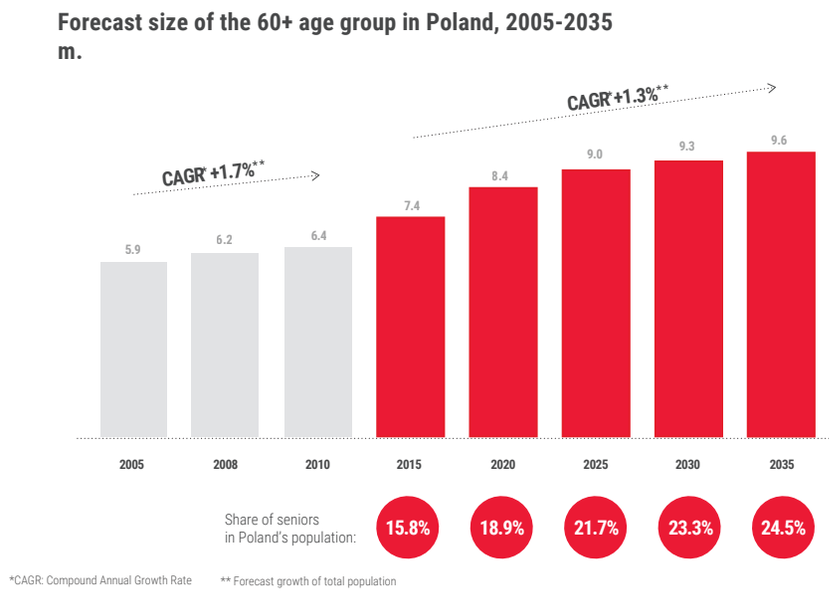
Source: McKinsey Global Institute https: // www.mckinsey.com/industries/consumer-packaged-goods/our-insights/winning-in-consumer-packaged-goods-through-data-and-analytics.

Figure 11. E-commerce stores tap into broad range of consumer data to tailor their offer



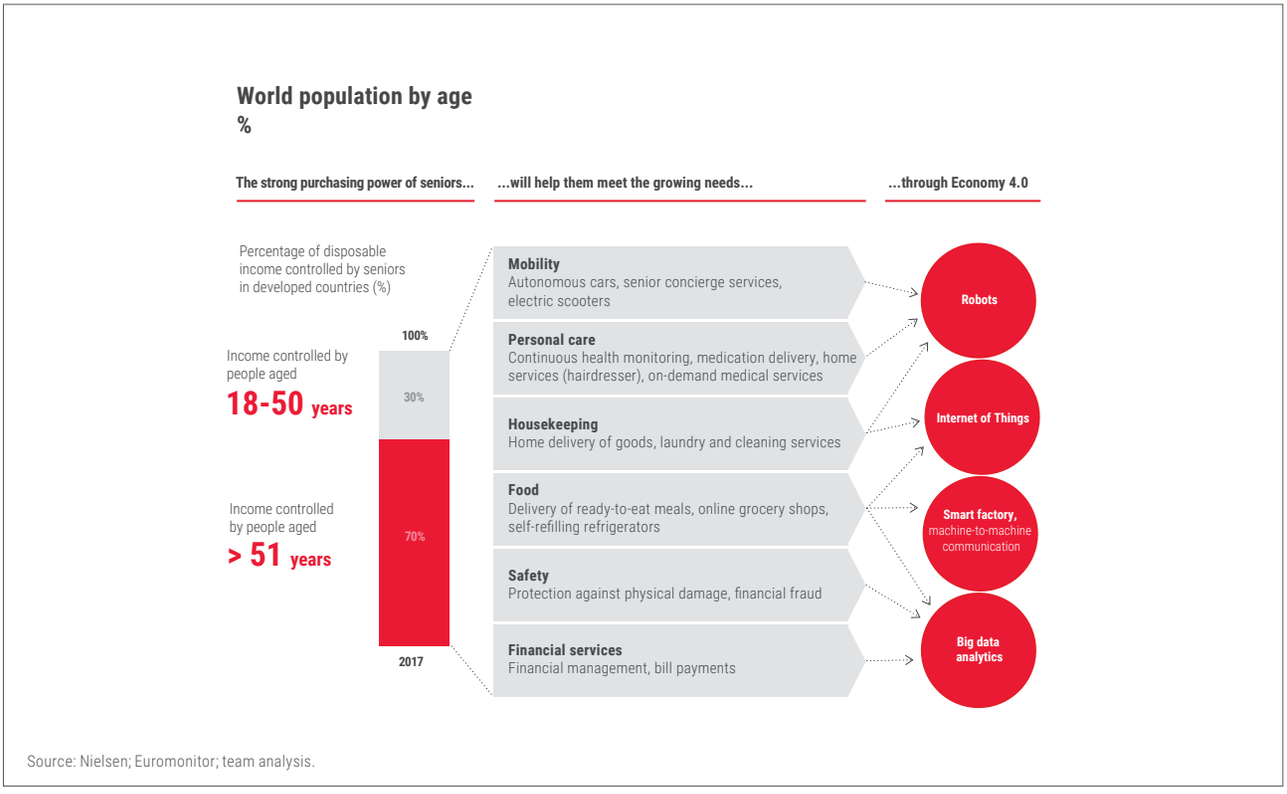
Source: McKinsey Global Institute, team analysis.https: //www.mckinsey.com/global- themes/urbanization/urban-world-cities-and- the-rise-of-the-consuming-class.

Figure 12. The world's population is ageing



Source: team analysis based on GUS data.

Figure 13. Demographic projections: the over-60 population is growing, as is its share of Poland's total population



Source: Nielsen; Euromonitor; team analysis.

Figure 14. The ageing population have ever-higher incomes

The demographic group referred to as the elderly should not be viewed as homogeneous given the wide age range of the group members and their varying needs that depend on their health and well-being. In fact, this age cohort is many consumer groups, which should not all be seen as customers for medication and staples. Niche markets should be sought among them and targeted with personalised offers.

Undoubtedly, the specific needs stemming from the physical limitations of seniors create new opportunities for manufacturers and service providers. Oxo is a kitchen utensils manufacturer founded in 1990 by the then 55-year-old New Yorker Sam Faber. His inspiration was the sight of his wife, who had arthritis, struggling to peel an apple. Farber saw an opportunity to introduce kitchen gadgets that were both functional and easy-to-use. The Good Grips range was soon sold in 78 countries and in 2004 Oxo was acquired for USD 275m[18].

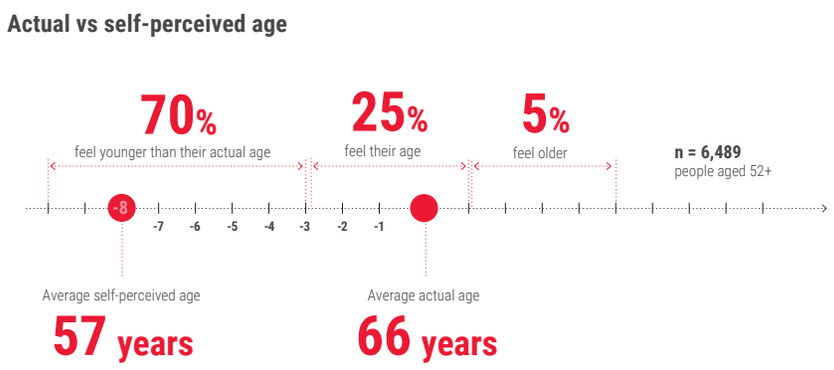
The Australian-based start-up Kisa has been successful with their easy-to-use smartphone featuring a screen tailored to the needs of the elderly. The phone was invented by Dmitry Levin, who saw his grandparents struggle to use a regular smartphone. Large icons appear on the screen (a sizeable photo can be assigned to a contact), which you hit to make a call. An SOS button can be used to contact rescue services, enabling them to identify the caller's identity and location. In 2014, Kisa was included in Startup Daily's list of '10 Entrepreneurs Creating Next Generation Hardware Products' and won numerous business awards.

THE SECRETS OF GENERATION Y

A further challenge is the expanding share of another distinct group of consumers called Generation Y or Millennials, who are people born in the 1980s and 1990s. According to GUS forecasts, in ten years' time people who were born after 1980, a group with a growing purchasing power, will make up more than half of Poland's population. McKinsey estimates that over the next five years today's 15- to 34-year-olds will see their income grow by 63%[19].

[18] M. Boyle, *Aging Boomers Stump Marketers Eyeing $ 15 Trillion Prize* [online], on: Bloomberg [accessed on September 7th 2017], <https: // www.bloomberg.com/news/articles 2013-09-17 / aging-boomers-befuddle-marketers-eying-15-trillion-prize>.

[19] Digital / McKinsey, *Cyfrowi Polacy. Konsumenci w czasach e-rewolucji* (Digital Poles.Consumers in a time of e-revolution) [online], on: mckinsey.pl [accessed on October 7th 2017], < http://mckinsey.pl/wp-content/uploads/2016/09/Rapor- t-DIGITAL-Polacy.pdf>.



Source: In-house analysis based on: I. Rippon, A. Steptoe, *Feeling Old vs. Being Old: Associations between Self-Perception and Mortality* [online], on: The JAMA Network.

Figure 15. Seniors feel younger than their chronologic age

Millennials are people who have lived with technology since childhood, who played with computers as their first toy and for whom the Internet has been a fact of life since forever. They are able to navigate the world of information overload, have a wealth of knowledge about the latest products and market trends, and are conscious consumers knowing exactly what they need. They do not want to overpay for products and services and know where to find what they need. They buy products, not brands, which means companies cannot count on them to be loyal customers. Millennials are impatient and want their product or service here and now.

For Generation Y, everything, even consumption, should carry a deeper meaning and be conducive to accomplishment of a mission. When making purchasing decisions, Millennials opt for fair trade, eco-friendly products delivered in biodegradable packaging. When spending money, they want to feel it will not end up in the pockets of greedy capitalists, but instead it will serve a worthy cause, for instance help other Millennials to spread their wings. This explains the success of Polish fashion startups like Mustache or Showroom, which sell online clothes and accessories of young local designers.

These examples demonstrate that the consumer community, which until recently was a complex bunch that differed in financial status and the ability to satisfy needs, is metamorphosing into an increasingly atomised collection of individual consumers with very distinct needs. In order to satisfy those needs, the starting point is to understand them, to properly design a marketing message and to effectively get it across to the target audience. It is also about latent needs, which cannot be discovered through simple focus groups. Firms capable of collecting sufficiently large amounts of customer behaviour data, analysing it properly and drawing the right conclusions will gain a competitive advantage. The advances in digital technology made over that past few years have created tools that can be used for that purpose.

INCREASING URBANISATION

The rising incomes of city dwellers create new opportunities for companies. By 2030, spending by urban population will hit USD 30 trillion, almost double the GDP of the EU-29. This is the reason why global corporations move their manufacturing operations close to major cities, to be able to quickly address the needs of their inhabitants.

The urban growth will increase costs for cities, creating opportunities for exploiting the solutions of Economy 4.0.

- Rising water demand in large cities will require more than USD 480bn in investment by 2025. The urban freshwater demand will increase the fastest in China and the Middle East. Combined, developing countries will account for 80% of growth in global water demand. The efficiency of municipal water management may be improved with the help of groundbreaking technologies such as smart cameras and sensors for water quality management.

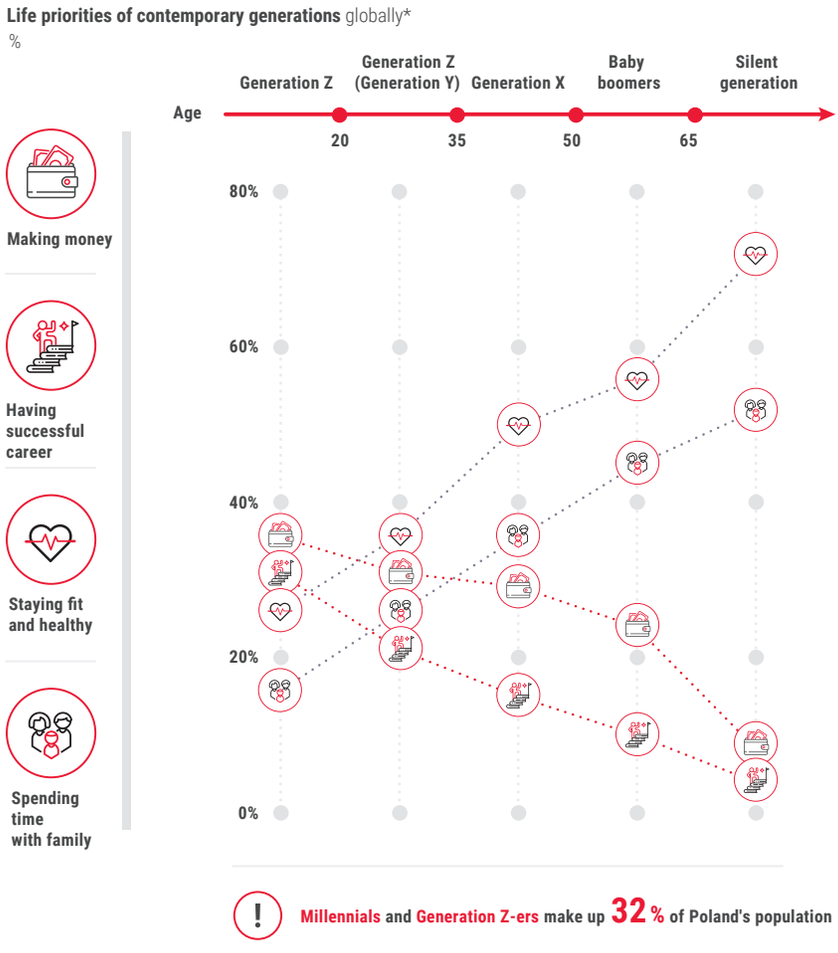
- Cities generate huge electricity costs, and municipal demand for electricity will only grow, estimated to double between 2015 and 2035. In some US cities, particularly those with high sum-

mer temperatures, an average electricity bill can be a whopping USD 160 per month, or PLN 580. High electricity prices are already driving people into energy poverty, which is also the case in the relatively rich Western countries – 10% of families in the EU struggle to pay their energy bills. The systems helping to lower the bills include the widespread smart meters, but also distributed energy and, in the future, vehicle-to-grid schemes.

Business perspective

Manufacturers and service providers realise that key to success is the ability to accurately identify consumer needs, quickly respond to emerging trends and use new tools to deliver what customers want in the most efficient way. Mass production remains the mainstay of big business, but mass product customisation and mass personalisation are increasingly the response to individualisation of demand. The widespread use of high-speed mobile broadband enables improved interaction with customers and big data analytics provides a tool to uncover their specific needs and to offer targeted products.

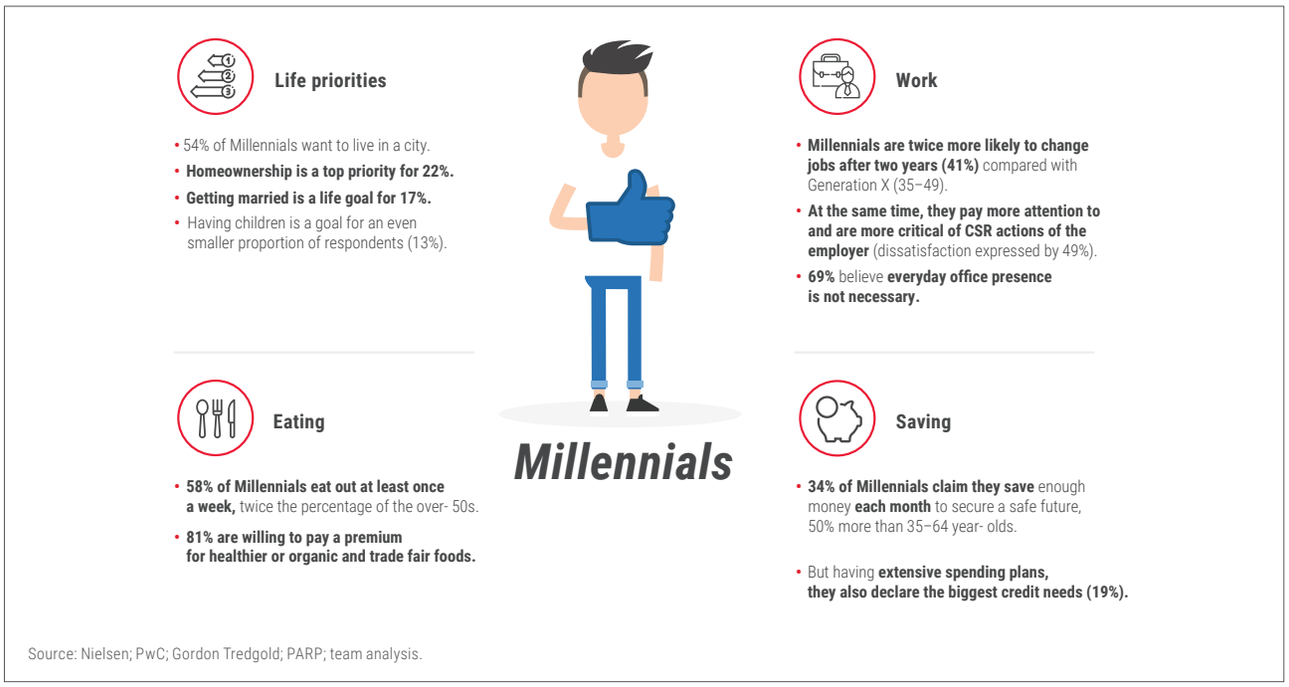
Personalisation of manufacturing is a challenge but also a tremendous opportunity for businesses. We have already men-



* Percentage who selected an option as one of their top three priorities.

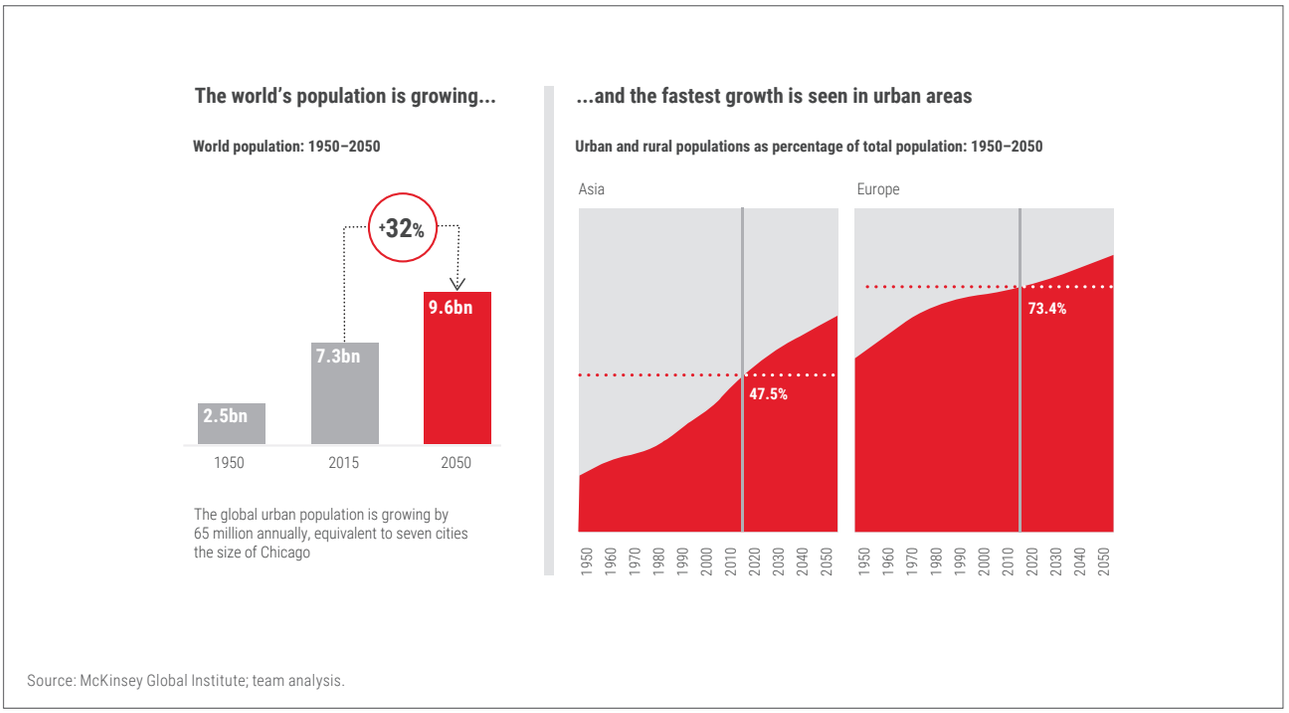
Source: Nielsen; team analysis. http://www.nielsen.com/us/en/insights.html.

Figure 16. Millennials have a slightly different set of needs and priorities than previous generations



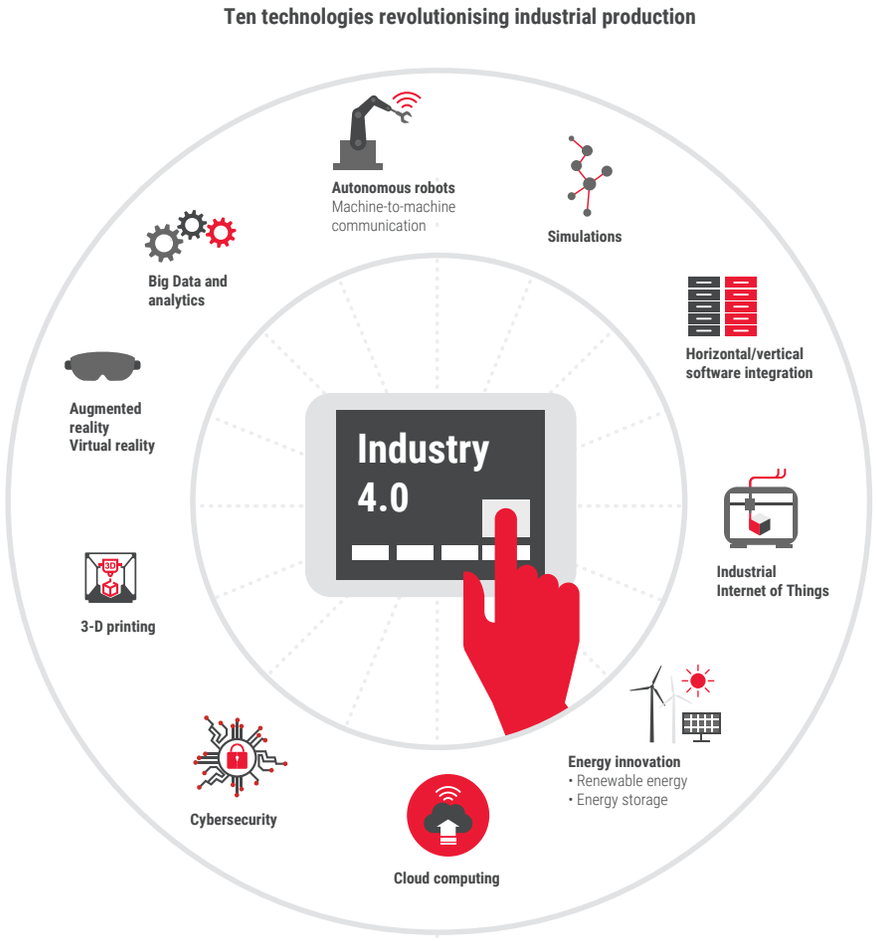
Source: Nielsen; PwC; Gordon Tredgold; PARP; team analysis.

Figure 17. Flexibility and new business models are needed to meet the needs of Millennials. Millennials are less willing to make long-term commitments, but at the same time want to be more conscious consumers



Source: McKinsey Global Institute; team analysis.

Figure 18. The world's population is growing, and the fastest growth is seen in urban areas



Source: In-house analysis based on The Boston Consulting Group, *Przemysł 4.0 PL. Szansa czy zagrożenie dla rozwoju innowacyjnej gospodarki?* (Industry 4.0 PL. A threat or opportunity for innovation-driven economic development?) [online], on: bcg.com.

Figure 19. Economy 4.0 enables manufacturers to hyperpersonalise the offer and gain an efficiency premium

tioned the online store Zalando, which uses machine learning algorithms to recommend new season fashion items to customers. Personalisation is the most conspicuous in the fashion industry. The popular H&M chain designs entire collections based on data about customer preferences and behaviours stored on cloud. By analysing individual orders, it is possible to predict with a high degree of accuracy what colours, patterns and styles will be popular in the coming season.

According to Professor Dominik Walcher of Salzburg University of Applied Sciences, mass customisation and mass personalisation are incorporated into about 50% of all business models entered in business plan competitions in recent years[20].

An example of a successful startup using this model is the Polish-based owner of the furniture customisation app tylko.com (now enabling customers to order shelves, sideboards and tables). It easily raised USD 1.6m from US angel investors.

[20] After: T. Pilewicz, *Masowa personalizacja – recepta na sukces?* (Mass personalisation – a recipe for success?) [online], on: Innpoland [accessed on October 7th 2017].

US electric car maker Tesla has also implemented a model largely based on mass customisation. Tesla does not have a large dealer network, and the entire buying process happens online. The customer orders a personalised car by clicking the preferred equipment options and accessories. The custom-built vehicle is then delivered to the end user without any intermediaries. Of course the choice is limited to a number of options, but the prospective owner has the sense of participating in the creation of his dream car.

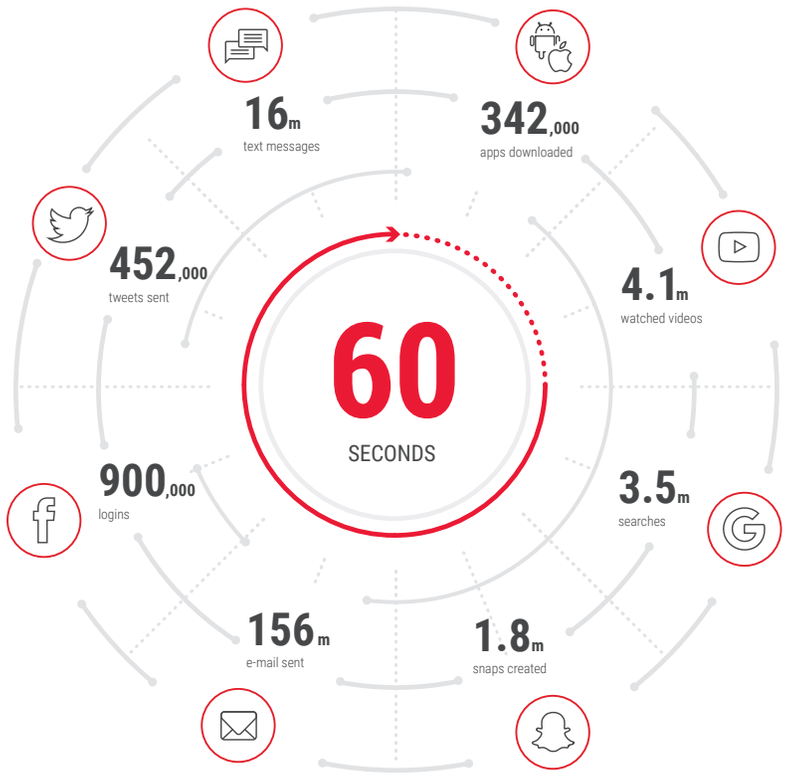
For manufacturers, this approach is an opportunity to make their offer more attractive and to build a competitive advantage. Customers are willing to pay more for built-to-order items, so personalised products can earn higher margins at a relatively low cost achieved thanks to process automation. Improved customer satisfaction and loyalty are also a boon.

An interesting tool for customising production are 3D printers, used to make complete products or their vital components according to customer's design.

Economy 4.0 is helping businesses to achieve a new level of operational efficiency. With sensors, algorithms, advanced analytics and the ability to draw conclusions from in-house data.

Manufacturing companies can more effectively eliminate bottlenecks, for instance by reducing downtime through preventive maintenance. The efficiency of the production chain also improves thanks to lower raw material costs, reduced inventory levels, better product quality, shorter delivery times, and improved after-sales service.

In order for the effects of Economy 4.0 to be sustainable, manufacturing companies must switch to operating mode 4.0, which involves:



Source: In-house analysis based on: J. Desjardins, *What happens in an internet minute in 2017?* [online], on: World Economic Forum.

Figure 20. The unprecedented digitisation of the world is best evidenced by what happens in an internet minute

- continuous analysis and drawing conclusions based on the available data, sharing knowledge and information within the organisation,
- asset digitisation, i.e. connecting production, sales and distribution into one efficient ecosystem; streamlining procurement, decision-making and other processes,
- implementing a flexible approach, e.g. in meeting customer needs.

CREEPING DIGITISATION

The growing presence of digital technologies in our everyday lives is a great opportunity for suppliers of goods and services. Mobile Internet, Internet of Things, and the popularity of wearables and beacons make it easier to address consumers' needs, even the latent ones. Thanks to direct communication between devices, combined with geolocation, consumers may be sent offers customised not only on the basis of the consumer's location but also based on how they are feeling or what physical activity they are doing. Beacons, which are microcomputers using Bluetooth connections, identify customers who had left their data, for example when requesting loyalty cards, when they are within their range and send them targeted messages with information about special promotions or products that the customers may be interested in. Development of facial recognition technology and extensive analytics create new opportunities in this respect.

Automatic data exchange offers possibilities used by service providers to sell their services to individual consumers and groups of consumers, e.g. whole cities. In the Smart City concept, city authorities and municipal services use state-of-the-art technologies to promptly respond to changing conditions so as to maximise the living comfort for the residents, in an economical way.

Smart City solutions are most widely applied in transport and communication. 'Shaping the Competitive City', a report by Urban Land Institute & EY, emphasises the needs to enhance communication systems in cities, particularly in terms of increasing the capacity of roads and the speed of public transport (79% of respondents ranked these as a high priority). Separate public transport lanes, bike lanes and infrastructure for car sharing (which lacks

SMART CITY

Smart Mobility
Integration of transport and ICT*, e.g. in traffic control

Smart Environment
Economical management of natural resources using ICT* (e.g. sensor-based city lighting)

Smart Economy
Building international competitiveness at city agglomeration level

Smart Authorities
Building digital public services

Citizens participating in decision-making processes

Smart Living Conditions
Improving quality of life by testing and adapting new solutions in urban space organisation and functions

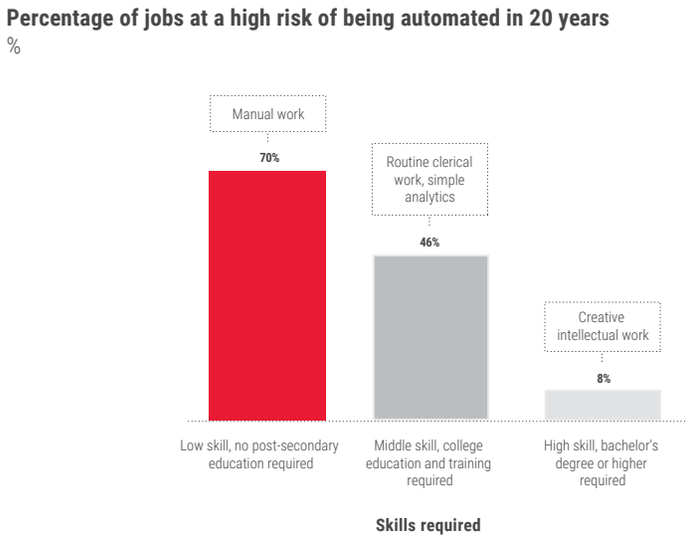
Smart People
Growth of social and human capital to build human resources for advanced economy

*ICT – Information and Communication Technology.

Source: In-house analysis based on: R. Giffinger et al, *Smart Cities. Ranking of European medium-sized cities* [online], on: smart-cities.eu; team analysis.

Figure 21. Areas of Smart City solutions[21]

[21] R. Giffinger at all, *Smart Cities. Ranking of European medium-sized cities* [online], on: smart-cities.eu [accessed on October 7th 2017], <http://www.smart-cities.eu/download/smart_cities_fi- nal_report.pdf>.



Source: M. Webster, *Could a robot do your job?* [online], on: usatoday.com.

Figure 22. Work automation and robots are a threat to low-skill jobs

critical mass) are considered the least-developed elements of municipal transport infrastructure[22].

Amsterdam, the first European city to have a municipal Wi-Fi network, pioneered the deployment of Smart City solutions. It now has smart parking systems, smart street lighting and smart power grids. Pisa, Italy, also has smart parking solutions – after installing an application, drivers can see where parking spaces are available, pay the parking fee remotely, and extend the stay. In Barcelona, there are smart bus stops with Wi-Fi hotspots and touch screens that display information for residents and tourists. The system collects and analyses data, for example, for available bus capacity, and helps to improve travel comfort and reduces travel time.

In Helsinki and several other cities there are systems for smart monitoring of waste bins. Sensors installed in the bins send information on fill levels to the central database, where it is analysed and optimal transport routes for refuse collection vehicles are planned. Some elements of the Smart City concept are also being implemented in Poland. For example, a smart street lighting system has been put in place in Lubin. Street lamps have built-in power and luminous flux reduction circuits that reduce power consumption at night. Thanks to sensors that detect movement, the lamps shine brighter when a pedestrian, a bicycle or a vehicle approaches them. The solution helps to reduce electricity bills by up to 75%.

LABOUR MARKET – WHERE ARE THE PEOPLE?

New technologies are rapidly changing the labour market, where Uberisation is spreading (for a discussion of why Uber has become a byword for new solutions, see earlier in this report). Uber and other platforms, e.g. TaskRabbit, link persons who have the skills and resources to perform a specific job with people who want to use their services. The development of new business models relying on digital tools boosts the requirement for on-demand project work done by a person

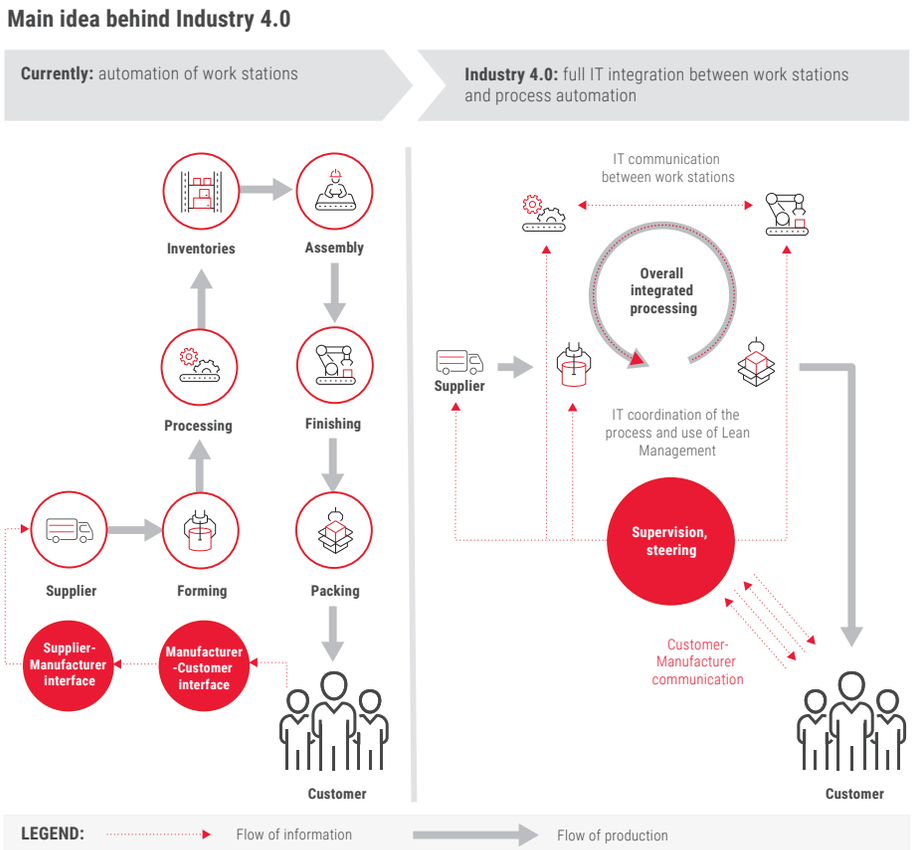
[22] Urban Land Institute & EY, *Infrastructure 2014: Shaping the Competitive City* [online], on: ey.com [accessed on October 7th 2017],<http://www.ey.com/Publication/vwLUAssets/EY_-_Infra-structure_2014:_shaping_the_competitive_city/$FILE/EY-infrastructure-2014-shaping-the-competitive-city.pdf>.

contracted to perform a specific task. In many cases, the final pay is not known at the time when such person offers their services to perform the task.

Many of us believe that even though such solutions facilitate finding customers and people to do a job, they do not guarantee permanent earnings and thus deprive workers of social safety. Therefore, the model is considered a source of additional income rather than a way to earn a living. We could not be more wrong. In Economy 4.0, finding a job (or a task/project to do) through digital platforms will be the norm.

Many jobs are threatened by the automation of production, which brings about similar effects to those described in the Uber case. A business which collects orders from its customers via the Internet sends the processed data on demand for particular products to the production line, where all the tasks are performed by appropriately programmed robots. Other robots transport the goods to the warehouse, pack them and make shipments to the customer. More complex and detailed elements may be made using 3D printers. The whole factory needs several highly-qualified staff servicing the production machinery and maybe several low-skill workers to do the simplest tasks, such as keeping the premises clean.

This is not science fiction – such factories already exist, mainly thanks to the rapidly falling cost of advanced robots and 3D printers. 3D printing costs decreased by 60% between 1990 and 2014, and the price



Source: In-house analysis based on: The Boston Consulting Group, *Przemysł 4.0 PL. Szansa czy zagrożenie dla rozwoju innowacyjnej gospodarki?* (Industry 4.0 PL. A threat or opportunity for innovation-driven economic development?) [online], on: bcg.com; team analysis.

Figure 23. Economy 4.0 in production chain – from automated work stations to full integration

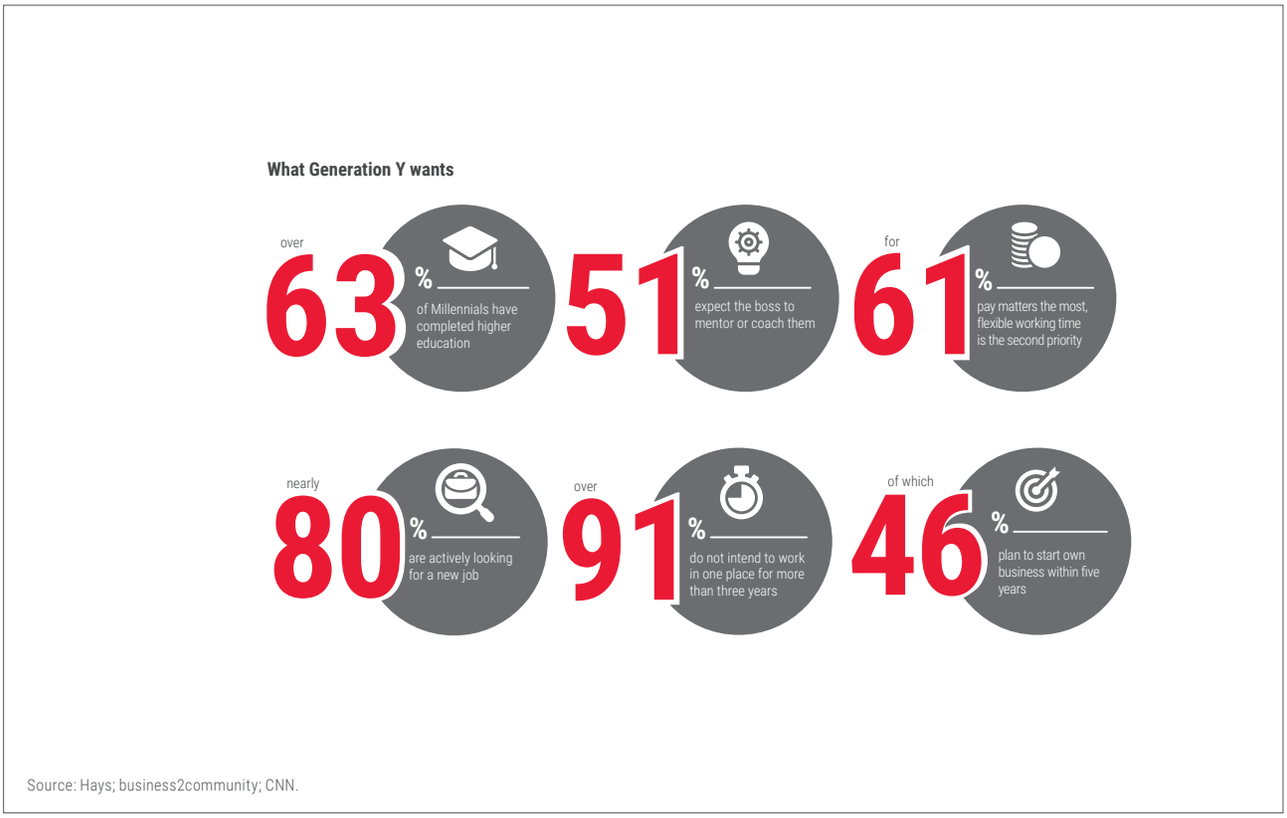


Figure 24. Generation Y's expectations concerning work are a challenge to employers

of industrial robots declined at an annual rate of 5% between 2000 and 2012.[23]

However, as the Uber case showed, while some jobs are cut, other, more effective ones, are created. Let us look at the question of jobs through the prism of global value networks. At the heart of these networks, there are high-performance jobs – design of new products and services and scaling up of relevant business models. On the periphery, there are jobs related to the production of assemblies and sub-assemblies on assembly lines. The periphery is at the greatest risk of job cuts due to digitisation (automation and robots). In the past, the periphery was poorer countries whose main competitive advantage was low labour cost. Today, these jobs can be automated. They are losing competition to machines and robots.

However, it will be increasingly difficult to recruit highly qualified specialists, especially from Generation Y (see discussion on new type of consumers), who expect much more of employers than Generation X or baby boomers.

In the first place, the Millennials need to feel what they do makes sense, also in their professional life. The work-life balance matters a lot to them – work cannot be a limit or take away the time they want to devote to their passions. They want to work, but work is not the meaning of their life. At the same time, they do not want to work too hard, but expect high pay. They are not interested in a life-long job and are willing to set up their own businesses.

The Millennials want to make a lot of money, but can reduce their expectations for a higher reason. Research shows that nearly 60% of Generation Y employees might agree to a 15% pay reduction in exchange for work at a company that shares their values. As many as 45% of them would accept 15% lower compensation for work at a company that makes a positive impact on the environment or the local community.

Many companies offer young employees unique, non-standard and attractive working conditions to attract and retain them. Stories about high earnings in Facebook, Google or Allegro headquarters (reaching USD 5,000–6,000 for trainees and USD 8,000-9,000 for full-time employees), but also about free meals, cafes, gyms and massage rooms or corporate integration trips and unexpected bonuses have become legendary now.

[23] P.-L. Caylar, K. Naik, O. Noterdaeme, *Digital in industry: From buzzword to value creation* [online], on: Digital McKinsey [accessed on October 7th 2017], <https://www.mckinsey.com/busi- ness-functions/digital-mckinsey/our-insights/digital-in-industry-from-buzzword-to-value-creation>.

First three revolutions in retail[24]:

- **Retail 1.0: Birth of the modern supermarket.** In 1916, Clarence Saunders founded the first Piggly Wiggly store in Memphis, Tennessee, where customers were not served by clerks at a desk, but would walk along the shelves themselves, taking the products they needed. The self-service format was patented a year later, and in 1932 there were already 2,500 such stores in the US, attracting customers primarily with larger choice of products and lower prices.
- **Retail 2.0:** Rise of the hypermarket. Carrefour opened its first store in the Paris suburbs in 1963 (around the same time the first Walmart appeared in Arkansas in the United States). The modern hypermarket, whose key idea was 'everything under one roof', was a radical step ahead in terms of space utilisation, productivity, efficiency, and cost management.
- **Retail 3.0:** The rise of e-commerce. In 1995, Jeff Bezos recognized that the Internet was a perfect channel to sell bulky items like books and founded Amazon. In order to get repeat traffic and differentiate his online bookseller from brick-and-mortar competitors, he added the option for buyers to write their own book reviews. Bezos also tackled delivery costs by essentially eliminating them and treating them as a marketing expense. E-commerce is the most rapidly growing area of retail now.

[24] P. Desai, A. Potia, B. Salsberg, *Retail 4.0: The Future of Retail Grocery in a Digital World* [online], on: sipotra.it [accessed on October 7th 2017], <http://www.sipotra.it/wp-content/uplo- ads/2017/06/The-future-of-retail-grocery-in-a-digital-world.pdf>.

These inevitable processes on the labour market are posing new challenges both for the working community and regulators. How to define a working person in the new circumstances? Is the currently used category of 'self-employed' sufficient? How to ensure that workers have the same degree of social security that is now enjoyed by those in full-time employment for an indefinite period, with the employment protection system set out in the Labour Code? How to prepare the people who already work and those who are entering the labour market for the situation where they will earn their total income from many sources, which they need to find themselves? What should tax systems be like? What should retirement systems be like? What to do to make sure that more and more new jobs in Poland are in the centre of value chains, rather than on the periphery?

RETAIL FOR THE LAZY

Widespread digitisation also paves the way for profound changes which can revolutionise retail, ushering it in to Retail 4.0. Side by side with 'traditional' e-commerce, whose value has been growing by several percent every year, m-commerce has emerged, driven by the increasing role of smartphones and mobile applications in the buying processes.

Shopping and buying using PCs, tablets and mobile phones has become so popular that it forced brick-and-mortar retailers to experiment with virtual stores and new forms of communication with customers. Retail 4.0 is multi-channel (omni-channel) and it is still not apparent what shape it will eventually take. The key trends to form it are visible, though.

One of the phenomena which traditional retailers are trying to respond to is the continued influx of new e-commerce players experimenting with different categories of goods. Using their advantages, such as lack of storage costs and no need to maintain space and staff, online stores are entering new product categories, capitalising on the economies of scale. Quidsi, a New Jersey-based company that was acquired by Amazon, for example, has created category killers like Diapers.com and Soap.com, entering sectors which were once the preserve of the supermarket.

In response to threats from e-commerce, brick-and-mortar retailers are using the latest technologies to engage customers and create purchasing occasions in and beyond traditional stores. The line between online and offline is blurring. In South Korea, Home Plus, a discount chain co-owned by Tesco and Samsung, offers a virtual grocery store on the walls of subway stations. To access the 'store', subway riders can scan product codes with their smartphone. The goods are then picked up at the chosen traditional store.

New opportunities are arising from the widespread use of smartphones, development of mobile payment systems, including NFC (near field communication), mobile wallets, or BLIK, which has gained great popularity in Poland. The customer no longer needs a credit card, and the purchase can be made via smartphone. In the UK, Sainsbury's is testing its Mobile Scan & Go service with 800 customers. They can download an app to their smartphone to scan items as they shop, allowing them to pay at the check-out area without unloading their cart, or trolley. In Poland, similar service is offered by Tesco and Piotr and Paweł chains.

Retailers can benefit greatly from equipping their employees with tablets. The

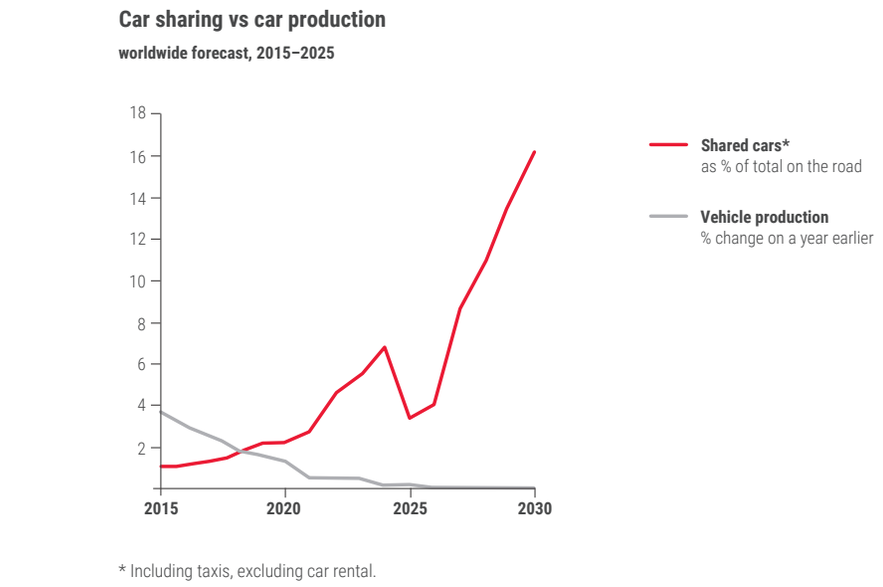


Figure 25. According to Morgan Stanley, shared vehicles will represent more than 15% of vehicles on the road in 2030

How to attract customers

Retailers are using social media to more strongly engage customers. For example, in Japan, Seiyu, co-owned by Walmart, launched a Twitter campaign allowing customers to suggest items for which they think prices should be lowered. Eventually, the company reduced prices of more than 100 items across its stores nationwide for four weeks.

Social media are being more and more widely used by retailers to communicate with customers, for example in promotional coupon distribution campaigns, which strongly engage customers with the store and allow the retailers to learn more about their customers' needs and expectations.

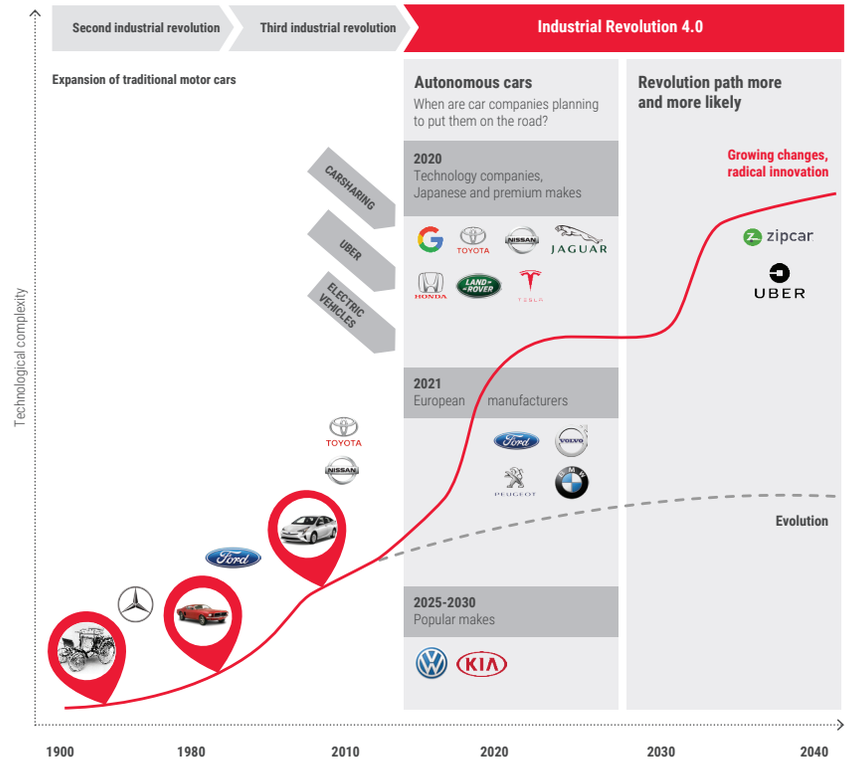
devices, connected by special applications with the head office, can be fed with various useful data. With product descriptions and consumer reviews at their fingertips, the staff can quickly answer a wide range of customer questions. And thanks to access to information that can be displayed on the tablet, sales assistants can show customers a wider range of products than that currently available on the shelves. Mobile devices can also facilitate managers' access to performance data – from inventory metrics to personnel performance – and increase the amount of time they can spend on the store floor versus tied to a computer in the backroom.

WHY OWN A CAR?

Services offered in new models are changing consumer habits and preferences. Thanks to the widespread use of smartphones, customers can be offered applications which better meet their needs, e.g. with respect to mobility. Uber is in fact a digital robot that gives access to transport services in a non-traditional model. It beats traditional taxis with ease of use, efficiency and lower costs. A different model of car use is offered by companies renting cars on a pay-by-minute basis for short rides around the city.

The phenomenon where you no longer need to own a car to use one is an embodiment of what is called Mobility-as-a-Service (MaaS). The trend is expected to develop with the emergence of driverless cars, worked on by the largest automotive and IT companies. In that model, a car requested via an app would pick up the user at the designated place and time and would take them to the destination along the optimum route (e.g. avoiding traffic jams thanks to the traffic monitoring centre), with the transaction settled electronically.

When do carmakers plan to launch autonomous cars on roads[25]



Source: In-house analysis based on: P. Barycki, *Jak daleko nam do autonomicznych samochodów* (How far to autonomous cars) [online], on Spider's Web; Yole Développement materials posted on slideshare.net.

Figure 26. Impact of Revolution 4.0 on the automotive industry

[25] Based on P. Brycki, *Jak daleko nam do automatycznych samochodów* (How far to automatic cars) [online], on Spider's Web [accessed on October 7th 2017], http://www.spiderweb.pl/2016/autonomiczne-samochody-kiedy.html.

The widespread use of such services in cities will probably lead to a significant reduction in the number of cars in the streets and a decrease in demand for parking spaces. There will be fewer cars, but the shared ones will be almost constantly in motion. Currently, in the European Union private cars are in actual use for only 7% of the time; during the remaining 93% they are parked at the house, work or shopping centre.

In addition, if autonomous cars are electric, they will produce much fewer harmful emissions and less nuisance noise.

DIGITAL DISRUPTION

Innovative products and services are in many cases neither original nor brand new ideas. They usually emerge when a niche or a new trend is identified, and then they evolve rapidly based on the latest digital technologies.

A good example here is Zipcar, the world's largest car-sharing company. It was founded in 2000 by Antje Danielson and Robin Chase when they were on maternity leaves. The idea of renting a car for a short time soon gained in popularity and today the Zipcar fleet of several thousand vehicles are driving around the streets of several dozen cities

around the world. During its IPO in 2011, the company was valued at USD 1bn. Zipcar is now owned by Avis, which took it over in 2013 for USD 491m.

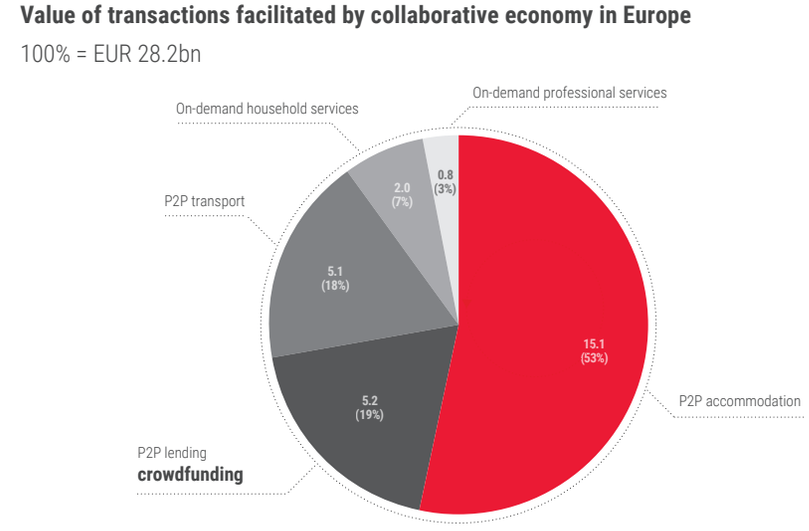
Another innovative business, Airbnb, which connects potential hosts with people looking for lodging, was invented by Brian Chesky and Joe Gebbia when they were roommates in San Francisco. After all the hotel rooms in the city were booked before an international conference, they came up with the idea of renting out three air mattresses they found in the closet (hence the name of the company – Air Bed and Breakfast). The service started in 2007 and today it has 3 million lodging listings in 191 countries and 150 million users. Initially perceived as niche, it is now a major competitor to the largest hotel operators.

In the latest financing round in March 2017, Airbnb was valued at USD 31bn.

Airbnb, Zipcar, and Uber (discussed above) represent (at least partially) the sharing economy model. It provides opportunities to earn income through platforms that connect service providers with users and through sharing of free resources such as a car, a room, capital, or time. This business model category, based on digital platforms, is quickly penetrating industry and services, transforming production (economy) into mass production (economy) on demand. According to an analysis made by PwC for the European Commission, the value of transactions in this sector (collaborative economy, economy on demand) within the EU reached EUR 28.1bn in 2015, with the accommodation segment being the largest by transaction value (EUR 15.1bn).

Another business which radically transformed the market using digital technologies is Spotify. Founded in 2008 by two Swedes, Spotify is a music, podcasts and video streaming service that changed the way people listen to and pay for music. It is a freemium service, which means that basic features are free with advertisements, while better quality and additional features (such as music downloads) are offered via paid monthly subscriptions. According to Spotify, it now has more than 140 million active users and 50 million paying subscribers, who have access to over 30 million tracks. Spotify is currently valued at USD 16bn and plans to go public next year.

To sum up, new technologies and business models offer the opportunity to better read and respond to customers' requirements and to better tailor the offerings to individual preferences. The latest trends (e.g. social media) also offer easier ways to provide customers with information about products and services, and engage customers more, while obtaining more data to better respond to their needs, including



Source: PwC, *Assessing the size and presence of the collaborative economy in Europe* [online], on: ec.europa.eu.

Figure 27. Revenues and value of transactions facilitated by collaborative economy platforms in Europe

Top 10 business models most affecting the market[26]

1. **The subscription model** – locks access to services or products traditionally purchased on an *ad hoc* basis; after paying a subscription fee users gain continued and unlimited access to the product/service (e.g. Netflix, Apple Music).
2. **The freemium model** – users pay for a basic service or product with their data or 'eyeballs' (watching advertisements), rather than money, but are charged when upgrading to the full offer. It works where marginal cost of reaching new customers is lower than revenue from advertising or sale of personal data (Spotify, LinkedIn, Dropbox).
3. **The free model** – it is an 'if-you're-not-paying-for-the-product-you-are-the-product' model where users pay for what seems to be a free product or service by leaving their personal data or attention (Google, Facebook).
4. **The marketplace model** – provides digital marketplace that brings together buyers and sellers, in return for a transaction or placement fee or commission (eBay, iTunes, App Store, Uber, Airbnb).
5. **The access-over-ownership model** – provides temporary access to goods and services that traditionally were only available through purchase. It includes 'sharing economy', where commission is charged from people who monetise their assets by lending them (Zipcar, Peerbuy, Airbnb).
6. **The hypermarket model** – by 'brand bombing' it uses sheer market power and scale to crush competition, often by selling below cost price (Amazon, Apple).
7. **The experience model** – provides a superior experience, for which people are prepared to pay (Tesla, Apple).
8. **The pyramid model** – recruits an army of resellers and affiliates who are often paid on a commission-only basis (Amazon, Microsoft, Dropbox).
9. **The on-demand model** – monetises time and sells instant access at a premium. It includes taking a commission from people with money but no time who pay for goods and services delivered or fulfilled by people with time but no money (Uber, Taskrabbit).
10. **The ecosystem model** – sells an interlocking and interdependent suite of products and services that increase in value as more are purchased. It creates consumer dependency. (Apple, Google).

[26] P. Marsden, *The 10 Business Models of Digital Disruption* (and how to respond to them) [online], on: Digital Intelligence Today [accessed on October 7th 2017], <https://digitalintelligencetoday. com/the-10-business-models-of-digital-disruption-and-how-to-respond-to-them/>.

the latent ones. However, it is important to stay open to new developments and ready to adapt your organisation to new business models.

Regulatory aspect

All new technological, business or social innovations come to the focus of regulators at some point. Most of the innovations operate in 'legal vacuum', or even contrary to the law. Therefore, mass market adaptation of most new solutions is sooner or later followed by the emergence of various lobbies demanding that the innovations be regulated, to ultimately speed up or slow down their development.

For example, many taxi companies and taxi drivers wishing to preserve the *status quo* are strongly lobbying against Uber, as they feel threatened by the rapidly growing popularity of the application. In many cities (e.g. Berlin) and even in whole countries (e.g. Spain, China) Uber is banned. Such bans and fear of legal restrictions may jeopardise innovation. A much better way is to establish a framework for action which would ensure that innovation can develop legally. Regulations should be dynamic and should not only govern – in the interest of consumers and societies – what is already up and running, but also stimulate development of business models in which consumers get completely new products and services that meet their needs better and at a lower cost. Cybersecurity is a major challenge to regulators in Economy 4.0.

INNOVATION ECOSYSTEMS

The state can assume a passive role (regulating phenomena which already exist) or actively support creation and development of innovation. As part of its mission to ensure safety to citizens, including in the material aspect, it should lay foundations for stable and long-term economic growth, keeping in mind that the main driving force behind the most developed economies is innovation.

The state can at the same time be a consumer and a co-creator of innovative solutions and put forward problems to solve. By building favourable climate, creating organisational frameworks, offering economic incentives, securing prospective customers and creating marketplaces, it can inspire creative thinking.

Development of the electric vehicle market in Norway is an example of how a proper state policy can support pursuit of specific objectives. The country is the world's leader in electric cars' share in total sales of new

cars. In 2016, electric vehicles represented around 30% of the market (battery electric vehicles (BEV) – 17.7%, plug-in hybrid electric vehicles (PHEV) – 13.4%), and their share has been growing year by year.

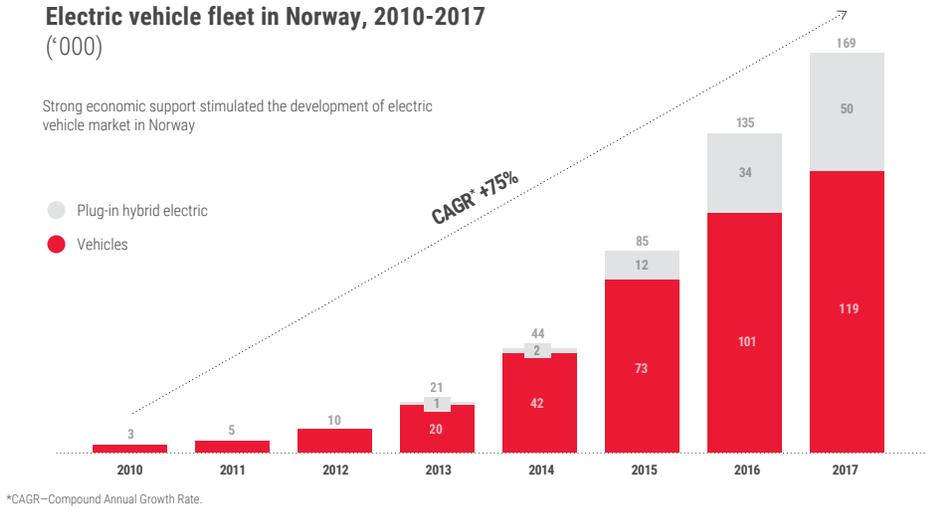
Norway's transition to electric transport has been possible thanks to numerous incentives, the first of which was the temporary cancellation of purchase/import tax on electric vehicles in 1990 (in 1996 the tax was abolished altogether). In the second half of the 1990s, the registration fee was reduced and charges on toll roads were waived for owners of electric cars. In 1999, people driving electric vehicles were offered free municipal parking and registration numbers starting with EL (now also EK) were introduced to facilitate identification of such vehicles. In 2000, tax on electric cars purchased by companies was lowered by 50%, and in the following year VAT rate on purchase of electric vehicles was cut to 0% (0% VAT rate on leasing was introduced in 2015).

Although the production cost is far higher for electric cars than for a similar class of vehicles with combustion engines, the tax incentive system in Norway has brought their prices to a comparable level. Furthermore, the lower operating costs and additional privileges (besides free parking, EV owners are also not charged on ferries and can drive on bus lanes in cities) make electric vehicles clearly more economical. There are currently about 170,000 such cars (including electric hybrids) in Norway, and their share in total sales has exceeded 50% in recent months.

Significantly, in its development plan for electric mobility the Norwegian government also focuses on infrastructure. When EVs grew in popularity, the government began investing in charging stations. In 2007, it spent EUR 7m (subsidising EUR 1,200 to each charger installed) on the programme, whose aim was to increase the number of publicly accessible chargers to 1,900 within four years. It also launched a programme to construct high-speed chargers at the main roads. Thanks to the government funding, fast charging stations are to be available every 50 km by 2017.

Much later, but with greater impetus, the issue of electric mobility was embarked on by Germany, as part of the German Energy Transition programme, whose aim is to reduce greenhouse gas emissions by 40% by 2020 relative to the 1990 levels (or by 80–95% by 2050). In addition to development of alternative energy sources and increased energy efficiency, the programme envisages reduction of carbon dioxide and other harmful gas emissions in road transport.

Innovative ICT technologies underlying smart grids and energy marketplace, where consumers acting as producers of electricity are at the centre, are of key significance in Germany's National Electromobility Development Plan. The power grids of the future are to supply power for electric vehicles in the most efficient way, taking into account daily demand



Source: NPRA, based on: Elbil, Norwegian EV market [online], on: elbil.no.

Figure 28. Strong economic support stimulated the development of electric vehicle market in Norway

Source: Germany Trade & Invest Electromobility Germany: Vision 2020 and Beyond [online], on: gtai.de.

Figure 29. Implementation of electric mobility in Germany – putting the user at the centre and relying on Economy 4.0 technologies for success

peaks and the use of domestic energy storage devices to balance the market. Initially, EUR 500m was earmarked for initiatives related to the development of electric vehicles, energy storage devices and infrastructure.

Germany set up an agency for electric mobility to bundle and coordinate the federal government's electromobility tasks. The National Electric Mobility Platform was also established. It consists of representatives from politics, industry, science, local authorities, and consumers. Its working groups' areas of activity include drive technologies, battery technologies; charging infrastructure and network integration, standardisation and certification, materials and recycling, and development of the legal framework. A total of EUR 130m has been allocated to pilot electric mobility projects in the following eight regions: Hamburg, Bremen/Oldenburg, Rhine-Ruhr, Rhine-Main, Saxony, Stuttgart, Munich, and Berlin-Potsdam. The model regions are to test the application of battery-driven mobility solutions in collaboration with carmakers and research institutes.

In 2014, the Bundestag passed the Electric Mobility Act providing a number of incentives to use electric vehicles. These include exemption from motor vehicle tax, preferential tax treatment of companies using electric cars, special parking places

In the National Electromobility Development Plan, the German government is looking to have one million electric vehicles on the road by 2020 and up to six million by 2030. At the end of 2016, there were only about 50,000 electric cars registered in Germany, and in the spring of 2017 Chancellor Angela Merkel acknowledged that the 2020 target would not be reached. However, prospects of meeting the next deadline are promising because German carmakers have announced their plans to launch plenty of new electric vehicle models in the coming years. To a large extent, this is a consequence of the scandal over Volkswagen cheating emissions tests in vehicles fitted with Diesel engines. Abandonment of the Diesel technology and shifting the focus of development spending to electric drive are expected to improve vehicle performance and reduce their cost.

for electric vehicles, suspension of restricted entry access for electric vehicles, and authorised use of bus lanes for electric vehicles. Special traffic lanes for electric vehicles are also planned.

Besides supporting BEV technologies and accompanying infrastructure, the German federal government has set aside EUR 1bn for the development of hydrogen and fuel cell technologies by research institutes and industry in public-private partnership.

THE GOVERNMENT MUST PICK UP SPEED

The examples provided above demonstrate that governments have the ability and tools to create conditions conducive to fostering innovation. A strong case in point is the Polish Energy Ministry's competition for a small electric car body design. The winners were announced in September 2017, and the competition was the first stage of the work on developing a made-in-Poland electric car. The next stage will be to make the car's prototype.

Regulatory framework is just one area of activity, a very important one but insufficient to establish infrastructure that would not only help to create and commercialise new ideas but also provide benefits for the public at large, like well-paid jobs in high-tech sectors.

The regulatory development process should take into account the benefits of innovation which accrue to society as a whole rather than particular interest groups. Let us look again at the Uber example. Some states and regions banned Uber on complaints from taxi drivers and transport companies who feared losing customers to the app. In fact, one of the effects of more affordable and convenient passenger transport services having emerged on the market was that people who had never used taxi services started to use them. Traditional taxis will probably lose some of their customers, but this need not necessarily herald the end of their current model of operation. The regulators may impose certain restrictions or new requirements, for instance in respect of insurance cover or driver qualifications, to ensure that Uber drivers' operating conditions and the level of service do not grossly differ from those of traditional taxi drivers.

It is imperative for governments to understand the importance of promoting conditions conducive to the development of innovative businesses and even creating platforms for cooperation between innovators, academia and business, particularly creative industries. A great example of an institution involved in this kind of work is UK's Catapult centres network set up by the Technology Strategy Board, the public innovation agency. They are physical non-profit centres where businesses, scientists and engineers work together to transform high potential ideas into new products and services to generate economic growth.

Each Catapult centre specialises in a different area of technology: cell and gene therapy, compound semiconductor applications, digitisation, energy systems, future cities, medicines technologies, offshore renewable energy, satellite applications, transport systems and high value manufacturing (itself a network of seven centres). They have been identified as areas in which the UK already has strong growth potential and the ability to strengthen its position in global markets. The centres are for businesses – both big and beginner – to access expert help and specialist facilities for research and testing.

The name Catapult is by no means accidental. The project's goal is to accelerate growth and international expansion of innovative businesses and 'catapult' them into the global economy. For example, the Transport Systems Catapult is already testing a self-driving vehicle and the High Value Manufacturing Catapult is building a composite robot in a project that has brought together research institutions, robot manufacturer Exechon and Airbus.

Building a culture of innovation concerns business and science but also society as a whole. The duty of the government is to provide a model of education that promotes thinking outside the box, fosters cooperation and helps to develop openness to new ideas. Singapore authorities have gone as far as to introduce innovation as a school subject. Children as young as elementary

As new technologies are transforming the labour market, suppressing demand for employees in old economy sectors and spurring demand for new professionals, it is necessary not only to overhaul secondary and post-secondary curricula but also to offer existing employees opportunities to improve their qualifications or even change their career paths.

New trends in the labour market, including the specific expectations of the young generation, require aligning of the labour law to the changing conditions. What is needed is, on the one hand, to cater to the needs of employers who increasingly prefer to hire employees to perform a specific task or project and, on the other hand, to provide casual staff with at least a minimum of social security.

school students are encouraged to analyse and come up with social innovations.

Digital security is another issue. Novel methods of making money and doing business that are emerging with the development of new technologies often turn into illegal schemes. Personal data, retailers' valued asset, are increasingly hard to protect against leaks. Cyber attacks are a threat faced by even the biggest of companies, which have precious technology development data stolen from them or become the target of crippling attacks with the use of sophisticated malware.

Obviously, the role of the government in this domain is to establish and enforce compliance with minimum requirements for digital network security. But how active should it be in the fight against hacker attacks? Many governments have set up dedicated agencies to analyse malicious code or, in some cases, even to create invasive software, and they are not limited to North Korea, China and Russia. The media around the world have speculated that the virus which caused a major failure of Iranian nuclear installations had been created in US and Israeli laboratories.

Data privacy regulations remain an extremely sensitive issue. The government must impose a framework to regulate the use of personal data by personal data holders. But too restrictive rules may impede the development of innovation projects that involve collecting and processing sensitive data.

How to find success with Industrial Revolution 4.0? A view from the perspective of an energy company

Digitisation is not happening in the virtual world but is creating and moving real world objects. With the press of a button on your smartphone, a real car with a real driver will show up at your door. Despite the virtual nature of the relationship with the customer, the effects for the industry are 100% real. The technologies that embody the unfolding industrial revolution provide us with tools to reinvent our relationships with customers, build rapport with partners and suppliers, improve efficiency in production and logistics and build new growth areas.

Technology is just a tool. In order to use it effectively, we need to rethink the logic of change and how it will affect the way we do business. We observe market trends: changing business models, pervasive digitisation, automation, and marketing personalisation. For an integrated energy market player like PKN ORLEN, Economy 4.0 presents numerous opportunities across all areas of activity, from retail, through production, to administration. The impact of these changes is so great that we have no choice but to become actively involved.

In order to find success with Economy 4.0, companies (particularly offline businesses) should seek to consolidate their competitive edge and market position by taking decisive actions in key areas such as **strategy, organisation and competence** and **contribute to developing a regulatory environment supportive of Economy 4.0**. Below we present our insights and recommendations of such actions.

Area I: Strategy and competitive advantage

1 Economy 4.0 will impact refinery and petrochemical production because of increased use of renewable energy that will drive down costs and cause shifts in the product mix

Digitisation entails electrification because what is digital must be electric. Interconnected machines, devices and production lines as well as the management servers are powered by electricity.

Electricity can be produced from virtually anything. So far, fossil fuels have dominated the energy mix, with the share of RES rising. Economy 4.0 is changing this on both ends: needs and capabilities, which interact with each other.

On the one hand, digital business, where electricity represents the lion's share of the cost base, is interested in having access to an uninterrupted supply of electricity at stable and predictable prices. These criteria are met by solar, wind and geothermal sources, in the case of which the cost of generating a unit of electricity comprises stable depreciation of incurred capital expenditures and very low operating costs that are also predictable. The cost of primary energy is null. No wonder Google sites its data centres where they can be powered directly from renewable sources.

"Two trends have captured my attention. The most important one for us is the advancement of the alternative fuels market, or e-mobility to be precise. Watching the public debate in Poland and the intensity of government efforts to support the advancement of electric mobility, both in terms of its utility and harnessing its potential for the benefit of the national economy and business community, I have no doubt that something big is going on," says Andrzej Kozłowski, PKN ORLEN Executive Director for Strategy. "Properly positioning PKN ORLEN in alternative fuels such as electricity or hydrogen is critical to us. We have been making preparations and taking active efforts to that end for quite some time. We have installed Tesla superchargers at our retail locations and opened the first service stations with hydrogen refuelling infrastructure. The other trend that has particularly attracted my attention is robotisation in the transport industry, manifesting itself in autonomous vehicles. It will not only change the way we navigate the roads but also how we get what is needed on route. How the fuel market will change remains unknown but the implications will be profound. Retail chain owners will have to live up to this challenge and align their business models to harness the trend for further growth rather than fall victim to it," continues Mr Kozłowski. "On the other hand, robotisation combined with virtual reality will spur revolution in production, providing opportunities for optimisation, shortening delivery times of new process units and improving work safety. You can imagine how much of the onerous maintenance work would be entirely done by robots controlled by qualified engineers, aided by virtual reality, from any location in Poland. Spare parts needed for repairs would be made on-site using the 4D printing technology from 100 percent recycled plastics."

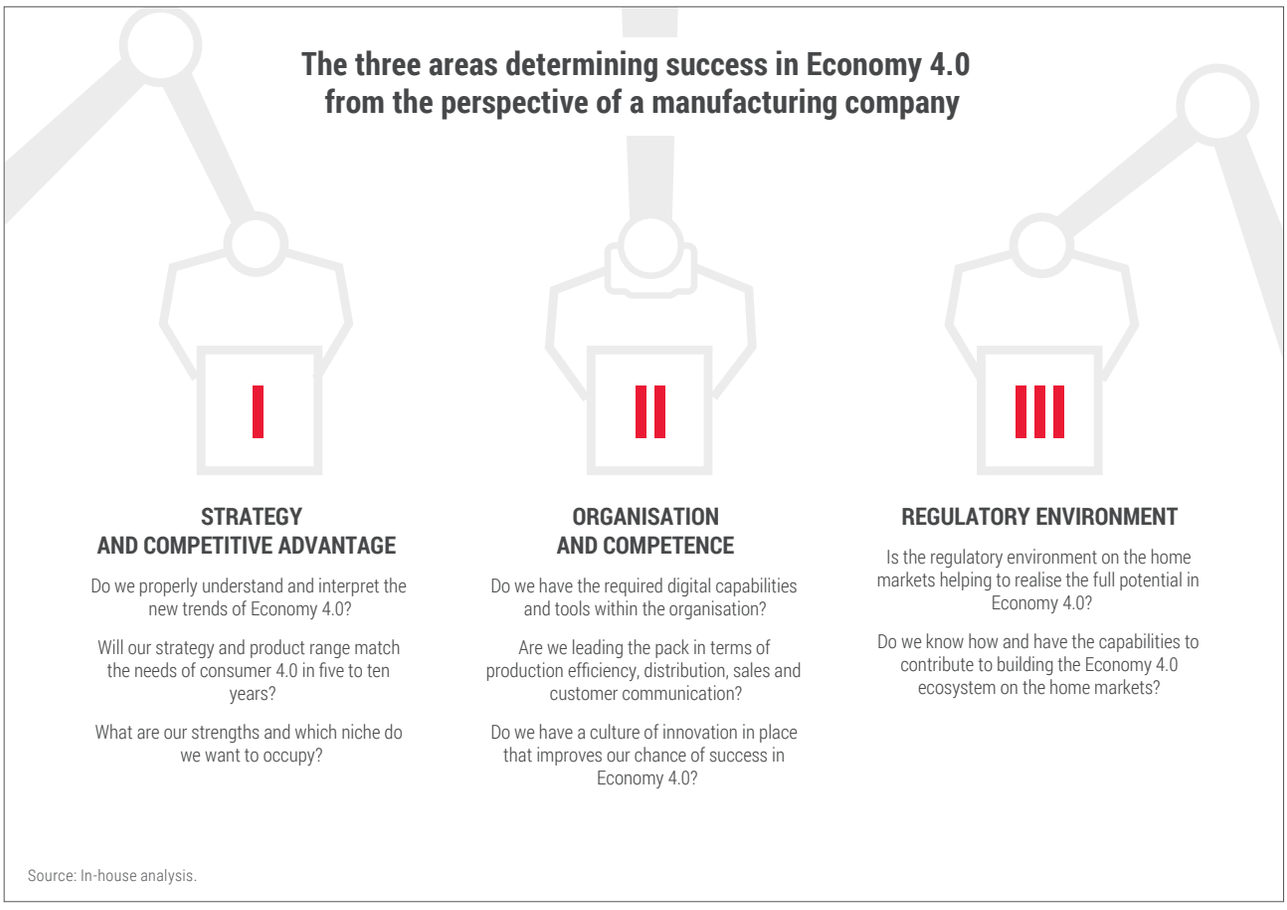


Figure 30. The three areas that determine success in Economy 4.0 from the perspective of a manufacturing company

On the other hand, technological advancement is leading to reduced costs of generating and storing renewable energy. With the digitisation of energy generation and distribution, households can produce electricity on a small scale. Thanks to the concurrent development of electric car batteries serving to store energy, households with solar panels or wind turbines can now export surplus electricity to the grid. The Internet of Things and appropriate algorithms can be used to connect wind and solar farms into smart energy systems linking producers with consumers. This feedback relation between supply and demand drives change in the energy sector.

"From the perspective of a fuel and energy group, the key characteristic of renewable energy sources is that they help to reduce operating costs associated with power generation. In order to explore the potential of RES, PKN ORLEN has launched a project to install vertical wind turbines at its service stations. Another initiative is the installation of photovoltaic cells to reduce grid electricity consumption. In addition, renewable energy combined with energy storage technology can be used in the future to produce hydrogen to fuel cell vehicles. Therefore, at PKN ORLEN our renewable energy agenda is broad-based, covering both production and operating cost optimisation and new fuel product offering," says Marcin Wasilewski, PKN ORLEN Executive Director for Energy.

2 In the energy sector, virtual power plants with no physical generation assets may prove sufficient to support e-mobility[27]

A service station managing the local power grid is only a step away from 'uberisation of the prosumer energy industry', which may become serious competition to traditional energy sources; it is safer because it is distributed and it is cheaper because it is amortised. For many housing communities, investment in equipment satisfying their power needs on site may prove an important cost-saving method in the future. The concept of a service station as a centre for balancing the physical flow of electricity in the local power grid can be extended to contemplating a complete model of a virtual power plant.

Today we associate the power industry with giant power plants. But an alternative market model – the virtual power plants – may soon become commonplace. Companies will move away from owning generation assets to renting them. This will spur expansion of the market of aggregators integrating small and privately-owned sources (mainly RES) and managing them as one large virtual power plant. Virtual power plants will have the effect of discouraging potential investors from financing conventional power plants. The capital-intensive power generation business relies on high and stable capacity utilisation rates to earn a profit. In this context, flexible producers ready to deliver zero marginal cost energy when needed will be very difficult competition. In Economy 4.0, increased demand signalled to a virtual power plant will in each case be automatically satisfied in the most efficient way from the cheapest available source.

As the group operating the most advanced energy assets in the country, PKN ORLEN predicts that in the not so distant future managing the distributed prosumer segment will be, in addition to centralised power generation and trading, an attractive business area for energy companies.

3 Service stations may become centres for balancing the local power grid, where consumers are also producers of electricity

In organising a distributed energy system it should be taken into account that power generation from multiple renewable sources depends on weather conditions. This distinguishes them from conventional energy systems, characterised by stable production but also by the limited ability to increase or reduce output on demand, leading to their low compatibility with RES. What can be done to overcome this obstacle and guarantee the much needed stability of supply is to increase flexibility on the supply side of the market, for instance by using CCGT power plants, which can adjust output faster, or by deploying energy storage systems. To manage balancing on the customer side (electrical usage, residential photovoltaic systems, electric car charging), an energy company of tomorrow will employ end-user metering and dedicated mobile apps. The optimal solution would be to integrate all systems with Economy 4.0 technologies and to create a smart power grid of low and medium voltage, capable of responding to local fluctuations in electricity supply and demand. For this model to materialise, electrical usage metering would have to be commonplace and the physical infrastructure on the supply and demand side would have to be integrated with the use of dedicated software, high-quality forecasting system and instant data analysis.

4 Urban service stations will become demand centres 4.0 and motorway service stations will become relaxation centres 4.0

Cities are attractive for their dense amenities, but city centres are increasingly congested. Economy 4.0 responds to that challenge with autonomous transport. It will allow drop-off at destination and parking elsewhere, fleet-based route optimisation and establishment of autonomous vehicle transport systems, similar to the existing bike sharing schemes.

Increased use of autonomous vehicles will have serious ramifications, particularly for refuelling in urban locations. It is quite possible that cars will self-drive and plug themselves into chargers or dispensers.

Service stations in city locations will make sense as:

- automated technical service stations with no additional services included,
- service hubs and meeting places with convenience stores and catering facilities (integrated into other urban mobility sys-

[27] Sioshansi, *Innovation and Disruption at Grid's Edge*, Elsevier Science 2017.

tems, such as park and ride electric bike networks, service stations might help to alleviate the congestion issue and facilitate better access to central city functions),

- central energy management points within charging points networks, balancing the smart grid infrastructure supply and demand.

In the world of autonomous vehicles, users will leave their car if they find the service station offering attractive enough. For a station to become a service centre for local residents, the additional services portfolio will need to be constantly modified to meet changing customer needs.

"In line with our strategy, we are getting our retail locations ready to play the role of service centres for local residents. In the UK, over 50% of customers at some suburban service stations drop in only to have coffee or shop and leave without refuelling the car. In Lithuania the figure is a whopping 70%. Looking to meet the changing needs of our customers, we have launched the Stop Cafe 2.0 and O! Shop formats. We offer products and services tailored to individual customer preferences. We have also teamed up with logistics operators to enable PKN ORLEN customers to collect parcels at our service stations," says Krzysztof Łagowski, PKN ORLEN Executive Director for Retail.

The way customers use service stations located on intercity roads will be somewhat different. Even when charging times are reduced dramatically with the deployment of chargers with a power output of 350 kW and more, charging an electric vehicle will consume close to ten minutes. To encourage the user to leave the car, the service station has to offer something better. The model of all-inclusive customer service points on dual carriageways will have to guarantee that a family travelling with children can spend time in a fun way, eat a healthy meal and have access to a playing area, a quiet work area or an open-air playground.

"Formulating an attractive offering and getting it across to potential customers in real time with the use of advanced communication techniques, for instance head-up displays or targeted ads popping on the screen of an in-car system, like Apple CarPlay or Android Auto, will be vital to attract them to intercity service stations. At PKN ORLEN, we see advances in autonomous car digitisation as a new channel to reach customers with our products," comments Rafał Pasieka, PKN ORLEN Executive Director for Marketing.

5 To own or to use? In Economy 4.0, customers pay for mobility services, not fuel

Instead of owning a car, customers increasingly prefer to use a model or service they need when they need it. Leasing, car rental by the hour or longer periods, car hire with driver and, in the future, autonomous car hire are the services in demand.

To be able to cater to new customer expectations, PKN ORLEN has forged an alliance with Poland's leading carsharing service provider Traficar, providing a platform for entry into the new urban mobility model–on-demand mobility.

"Carsharing is a very promising service. We know for a fact that young people are the first to embrace digitisation and other technologies of Economy 4.0, and we want to reach out with a modern service offering. Owing to the progress in digitisation and automation, about 10%–15% of all cars sold in 2030 will be shared vehicles. We want to be prepared for this new market trend. We are already feeling the benefits of our involvement in the carsharing market since the daily number of vehicle miles travelled by shared cars is 7%–10% higher compared with traditional cars, according to carsharing providers" says Krzysztof Łagowski, PKN ORLEN Executive Director for Retail.

6 The on-demand economy is getting larger, with sensors and big data used to ensure faster service and more personalised offers

Automation and digitisation are contributing to the fast-paced world. Customers want to make the most of their time, without sacrificing choice or quality. Some even want to partake in creating the products they buy. This means PKN ORLEN needs to introduce solutions that minimise the time of interaction where it has no direct value for the customer.

Competition is going beyond the fuel industry, and cross-industry competition is accelerating. Consumers want the standard and speed of service they have got accustomed to using smartphones or shopping online. With this in mind, service station chains will enable customers to pay at self-service terminals located at the pumps or in on-site stores, following the steps of McDonald's, which first introduced self-service kiosks. Self-service terminals will also display personalised content, allowing customers to choose the preferred options.

Customisation will heavily rely on the efficiency of systems analysing data collected from smart sensors, social media and other sources. Analysing data to discover cross-category purchasing patterns has already become a common practice. Generating product recommendations for a customer waiting at the checkout is easier with statistical analysis of the customer's purchase history.

"We personalise offers for members of the customer loyalty programme Vitay, and new big data techniques facilitate this job. The most powerful leverage in getting deep customer insights is the rollout of the loyalty programme in combination with a mobile app," notes Rafał Pasieka, PKN ORLEN Executive Director for Marketing.

Area II: Organisation and competence

1 Economy 4.0 requires businesses to transition to digital competence

To that end, companies should focus on:

- devising a digitisation strategy,

- increasing resources allocated for that purpose,
- getting senior management involved in strategy implementation.

Without clearly defining the goal of digital transformation, companies run the risk of spreading themselves too thin and getting involved in too many projects and following too many paths without gaining any tangible advantage. It is not enough to set aside a digital transformation budget and contemplate acquiring a startup or setting up an incubator, because such an approach prematurely places focus on tactics for achieving a goal that has not yet been defined in business terms.

Digital transformation will fail without allocating adequate resources to competence development and R&D.

"What we call Economy 4.0 is made up of dozens of new technologies at varying stages of advancement. All require solid foundations in the form of IT infrastructure, which must be much more available and change-ready than in the earlier periods of economic evolution. It is a daunting challenge because technologies often change and many of them are short-lived. Local players are important actors in informed digital transformation. They can and should make decisions about strategic directions of change best suited to their particular circumstances and learn from the experiences of global leaders but apply only carefully selected solutions, preferably incorporating their own ideas. Another integral element of Economy 4.0 is robust IT security, which must be kept front of mind," says Marek Frąckiewicz, PKN ORLEN Executive Director for IT.

Finally, a project needs to receive senior management support and promote a culture of innovation encouraging employees to take a test-and-learn approach and learn from failure. It is also important to appoint experienced change leaders, who could guide the organisation through the process, since digital transformation impacts all business segments and functions.

2 Building digital competence should be a priority for all business segments within the value chain

Supply chain management

The need to expand and make optimal use of data sets is evident in internal analysis, where all parameters are under the company's control. But external data analysis is becoming increasingly important for optimisation.

"One of the challenges related to the use of conventional fuels is setting the right investment direction, as many types of fuels are subject to parallel and ever stricter regulations. Marine fuels fall within the scope of the IMO sulfur content cap regulation, there is a strong drive towards biofuels, and diesel cars are under regulatory scrutiny. Often the optimum response to what is happening in one area exacerbates the situation elsewhere," says Robert Czekaj, PKN ORLEN Executive Director for Supply Chain Management. "Logically linking the responses as to what and how much to produce and properly allocating investment expenditures require increasingly sophisticated analytical and forecasting capabilities."

Optimisation of refinery operations poses similar challenges.

"Advanced forecasting systems provide an opportunity to take production portfolio and supply chain management to the next level of excellence," explains Robert Czekaj. "The available sources of knowledge can be more widely used to feed traditional optimisation models with more accurate estimates and to better align production with market demand. Integrating thousands or millions of time series is made possible by high performance computers. Having in-house analysis capabilities and internal data sets is vital to the success of PKN ORLEN."

Refining – innovation drives efficiency

"We implement the latest technical solutions as the key method of streamlining our production processes. We have deployed the APC (Advanced Process Control) and EMS (Energy Management) systems, which facilitate day-to-day optimisation activities, helping to improve production efficiency. We will strive to integrate our production assets and to create an umbrella to coordinate their operation," says Jacek Smyczyński, Head of the Production Optimisation and Efficiency at PKN ORLEN. "Virtual reality seems promising as a training tool for employees, operations staff in particular. Efficient execution of day-to-day maintenance work delivers substantial cost savings. It is difficult to hold hands-on training in a real-world environment, and virtual training models help to increase training intensity."

Logistics: metering systems support optimisation

Smart meter deployments and optimisation of logistics systems are major sources of cost savings. For example, RFID tags (electronic circuits with no internal power source that are activated in response to radio waves and can be read over a distance of several metres) are attached to tank cars to help track their movement. In road transport, CAN terminals installed in vehicles (the Controller Area Network is a computer-based communication network that allows to read vehicle usage data) not only remotely track speed and fuel consumption, but also provide information on the driving style of the driver and any identified overloading. In the future, logistics systems may become fully automated and use digital platforms like Uber to connect on-demand ordering systems with transport vehicles ready to deliver cargo.

"The major changes occurring today have implications for goods in transit. Installation of smart meters across the entire transmission system helps to identify points where changes in fuel quality occur. Such changes can be subsequently compensated during the blending process," says Rafał Jędrzejewski, PKN ORLEN Executive Director of Logistics. "Also, monitoring of fuel flows with road infrastructure like smart toll gantries or

electronic sealing systems, coupled with advanced data analytics, contributes to further curtailment of illegal fuel trade."

Human resources

Although computer science, technology and engineering, the fields of study that involve advanced data analytics, are increasingly popular with students, the labour market is still struggling with a shortage of professionals. In response to the trends of digital economy, PKN ORLEN has launched a training programme aimed at preparing specialists to use advanced data analytics for projects implemented by the Group companies, taking into account the specific nature of their operations and seeking to support the development of employee knowledge, competencies and skills. At PKN ORLEN, we realise that advanced technologies in the workplace increase productivity and bring measurable benefits to the organisation.

"We are aware that the competencies required to participate in Economy 4.0 differ from those we have previously used across the various areas of our activities, including production. When hiring and providing development opportunities to employees with appropriate competencies, their expectations regarding financial and non-financial incentives and working environment need to be factored in. In Economy 4.0, incentive schemes should be more about encouraging employees to explore and test new ideas, and this involves monitoring market trends and applying best practices, but also taking risks. In addition, we should take a different approach to matters related to the implementation of system solutions, corporate standards or best practice sharing as a method for managing knowledge within the organisation. This is why we have launched the Market of Opportunities initiative, a platform designed to make it easier for employees to engage in multidisciplinary projects that extend beyond the specialisation of their own department. The platform enables employees to apply their knowledge, share experiences, get insights into other areas of the Group's activities, and develop their competencies. As a forward-looking organisation, we are geared towards applying new technologies (analytics, process efficiency measurement, big data, mobile technologies, gamification) and implementing state-of-the-art flexible solutions that are tailored to our business needs and meet the expectations of consumers and employees," explains Grażyna Baka, PKN ORLEN Executive Director for HR.

Mergers and acquisitions

In Poland, the path of development through modernisation – the fastest and the most effective one in terms of income growth – is being exhausted. For continued economic growth, it is necessary to create a real pillar of innovation. We can innovate internally, but also through M&A.

"Few companies in Poland know the taste of large-scale M&A transactions as well as PKN ORLEN. Few realise how difficult it is to succeed in this domain. In 2002, we acquired a German service station chain, marking the pioneer expansion of a Polish company into a Western European market. The price of EUR 140m was at the time the largest Polish foreign investment since the beginning of the political transformation. In 2005, PKN ORLEN acquired Unipetrol, the largest petrochemical group in the Czech Republic, and in 2006 it took over the Mažeikiai refinery, Lithuania's largest company. In a transaction, successful delivery of the business plan depends on a number of factors, many of them outside our control, from global economic conditions to cultural differences. The point is to skilfully balance risks and rewards involved in the transaction and have an experienced team competent at change management," says Piotr Kearney, Head of the Equity Investments Office at PKN ORLEN.

"Our observation is that in Economy 4.0 startups are where a great deal of innovative ideas are born. This is a big change over the past decades when innovation was the domain of the R&D arms of large corporations. Today, local startups are capable of revolutionising entire industries, like Estonia's Skype has changed the rules of the game in telecommunications. In Economy 4.0, startup acquisitions provide large companies with opportunities to access new competence and quickly build innovation-based pillars of growth. The potential of startups Airbnb, Spotify and Zipcar, which have now grown into companies worth billions of dollars, went unnoticed at big-business headquarters. Therefore, in response to trends of Economy 4.0, PKN ORLEN is keeping a watchful eye on startups that could enhance the competitive edge of its existing business segments and also create shareholder value in entirely new areas," adds Peter Kearney.

Area III: Regulatory environment

1 By definition, breakthrough innovations are born above law

Innovation and new business models are changing the world. It is important to make law more flexible to keep up with or even surpass these fast-paced changes where this is in the interest of consumers. It worth learning from the experience of US regulators, who allow small-scale innovators to operate outside the regulatory framework and, when their business grows big, work with the creators of new business models as partners, co-authors and consultants in making new law. If we try to immediately force a new business model into an old regulatory regime, we will be doomed to failure. The new idea will get nipped in the bud, presenting a lost opportunity for consumers and the economy.

It is crucial to closely follow and implement the world's best regulatory practices to gain experience in formulating forward-looking regulation that drives the desired change and, thus, in shaping a proactive modern industrial policy.

2 The consequences of adjusting the law to the requirements of Economy 4.0 will not always be trivial, with questions about security and the labour market being particularly relevant

How to reconcile technological progress with consumer safety in areas such as autonomous cars or remote medical care so that end-users can benefit from them?

Safety considerations

The digital space is exposed to cyber threats, which increase as digital spreads into all areas of human activity. It is a common practice that offline companies seeking to digitally automate selected areas of their business (failure prevention, logistics) do that by using (and often by acquiring) third-party service providers. Sometimes the acquisition targets are business ventures set up by competitors to destroy a company at the right moment. So it is important to establish a public institution that would discreetly check the credibility of a startup before a transaction is consummated.

Labour market

Innovative technologies used to replace people with machines to get work done cheaper and faster lie at the heart of every industrial revolution. To do work, you need usable energy. An industrial revolution is about converting primary energy sources into work. The achieved sustainable increase in productivity results in wage and income growth and improved social well-being. From this perspective, the Fourth Industrial Revolution will be no exception, and in the long run it will contribute to improving social well-being.

The previous revolutions did not produce armies of unemployed people, but the transition to a new reality required profound labour market adjustments. New professions appeared, some disappeared. Some competencies gained and some lost their value. The education system had to keep up with technological progress to prepare society to deal with new challenges. This will be the case this time round too, as the Fourth Industrial Revolution, like the previous revolutions, is part of the inevitable social and economic development process. What is different is the pace of change. Not everything technological progress brings with it is desirable and safe, just like not every change is a threat to social security. It is society that determines, through regulatory regimes and government institutions, whether technological advancement leads to prosperity or destruction.

3 For regulation to be innovation-friendly in Economy 4.0, regulators need to engage in dialogue with business

The regulator explains what it wants to achieve. The company responds by explaining what it does. Then they negotiate what can be done together. Access to data – both generated and used by digital platforms – can help with the process. If regulators gain access to such data, they are able to assess market behaviours and make better regulatory decisions.

The approach described above helps to produce data-dependent algorithmic regulation, which is healthy in market terms. It also requires companies to be ready to cooperate. The point is to allow businesses to operate and intervene only if they act inappropriately (violate rules, consumer interest, security, etc.). It is important for regulators not to start with imposing rules. Companies enter the market and operate, and regulators monitor and analyse their operations and adjust the rules if needed.

In the era of rapid change, regulators should not be passive or assume that the regulatory *status quo* is a good solution and businesses should simply toe the line. It is vital that regulators engage with companies, inform them of the regulatory objectives, and seek advice on how to best achieve them. In the end, it's all about trust.

Final remarks

Economy 4.0 is not a growth option that traditional businesses can use or forego. **Economy 4.0 is an imperative for change whose direction we already know**: digitisation, automation and robotisation aimed at improving efficiency and the ability to sense and quickly respond to shifting customer needs. What can be automated will be automated to enhance quality and reliability. Studies already show (McKinsey) that competition is taking place between industries, not countries. **Companies that go digital are able to offer higher quality products at lower prices**, and by winning over customers and top talent from competitors, they strengthen their advantage even further. **Companies that fail to do so will lose out to those who entered the process early refusing to wait for what others will do.**

What cannot be automated? Design, creativity, innovation. **Benefits accrue to those who have invented a business idea and are sitting at the centre of the value chain. Those who occupy the peripheries, supplying materials, spare parts and components, may and will likely be replaced with cheaper suppliers**. This holds true for companies as well as entire economies relying on cheap labour as the cornerstone of their development models.

It is the role of the government to ensure that value chain centres originate and remain at home. Regulators need to be active and dynamically align regulations to the requirements of new business models. Groundbreaking innovations change how we live. We notice this when they are fully-fledged products. Most innovations provide solutions that were previously unknown and, therefore, do not fit the existing regulatory frameworks. The effects of forcing them into existing regulatory formats right away will be mostly negative. On the other hand, allowing innovators to operate above the law undermines the principle of legal equality and the authority of the state. How to resolve this issue? A number of standards have been established: infant industry protection, the good practice of US regulators to allow a business scale-up where no threat to consumer interests has been identified, and subsequently to adjust existing regulations in consultation with business so that it is all safe and beneficial.

A business success in Economy 4.0 is predicated on transparent regulations that favour innovative business models. Such regulations should be developed through dialogue with business and consumers as the prime movers of Economy 4.0. **Industrial policy-makers need to closely monitor areas where technological innovations and new business models are emerging in order to understand their needs and implications and to make the necessary regulatory adjustments**. Such a broad-based approach to regulation is a prerequisite for economic and social success.

However, simply **initiating change early under the pressures of Economy 4.0, which is a precondition for success, is not a guarantee of a successful business transformation**. The success largely depends on the company itself – its strategy, organisational culture and competencies, as well as its ability to interpret trends, smoothly carry out the corporate transformation and adjust its product mix to ever changing customer needs. **It is also crucial that management has the determination to pro-actively address change**. This determination needs to go hand in hand with reasonable investment decisions, in line with the principle of 'show me your CAPEX, and I'll tell what your strategy is'.

Finally, the most important thing of all. **It is impossible to introduce innovations and related business models without taking risk**. The manufacturing sector in Poland has begun to realise that it needs to change because the pressure from other players – including those outside the sector – is immense. If we do not innovate and change, someone else will. The examples of Uber, Airbnb, Spotify, and digital giants like Google and Amazon, demonstrate that **new confident players are born every day, having huge potential to reframe industry for a digital future. We should do our best to join them**.

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