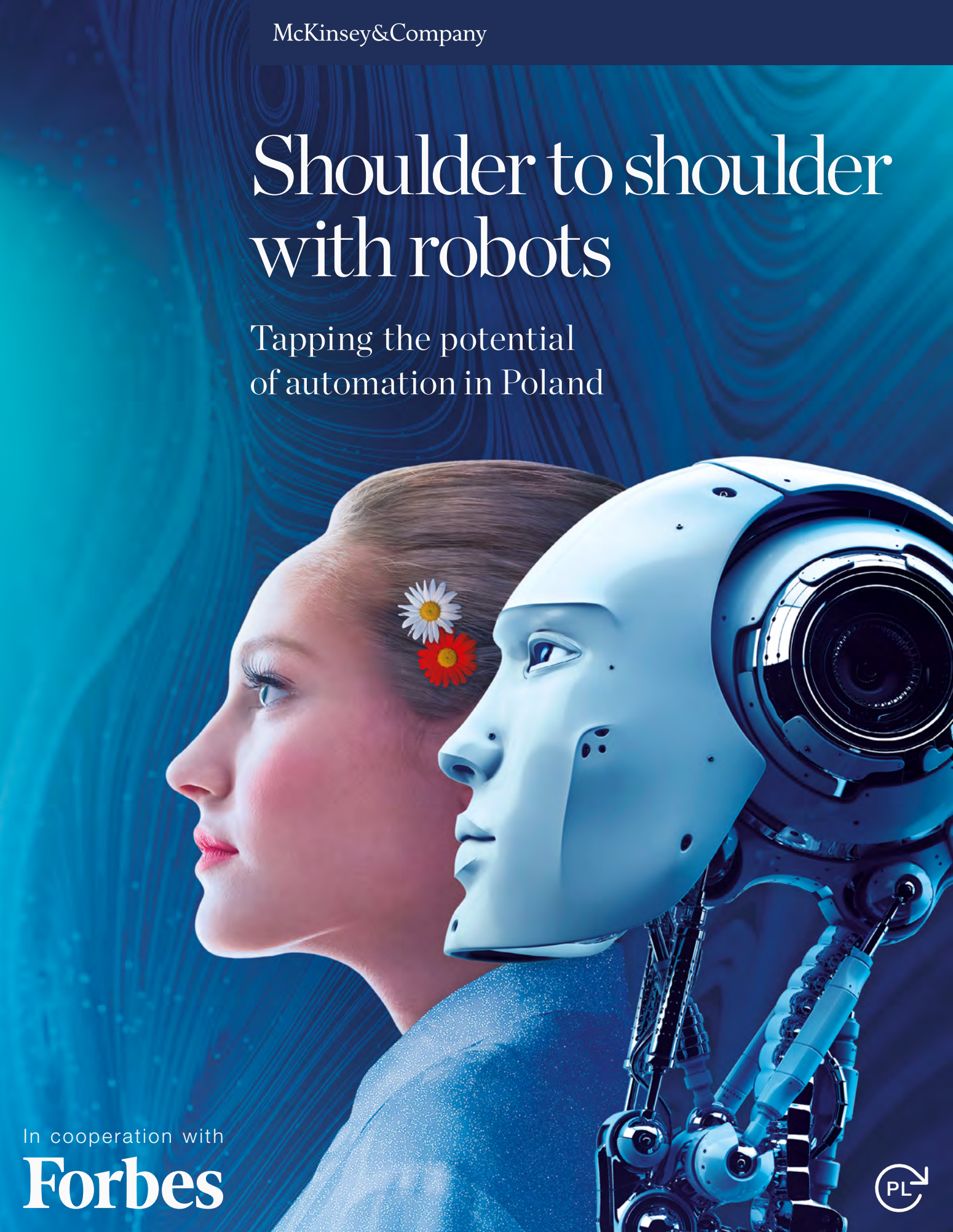
McKinsey&Company

Shoulder to shoulder with robots

Tapping the potential of automation in Poland



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McKinsey & Company around the globe

McKinsey & Company is a global strategic consulting company that has been operating for more than 90 years. We advise the largest companies in the world, including 90 of the top 100 companies on the Forbes Global 2000 list, as well as governments and public institutions. Our company currently consists of 27,000 people working in 127 offices in 65 countries.

Besides strategic advice, knowledge forms a main pillar of our activity. In 1990 we established the McKinsey Global Institute, an analytical center that conducts research and reports on the most important challenges facing the global economy. We invest 600 million dollars a year on developing knowledge and training – more than the combined research budgets of the three top business schools in the United States.

Another key area of interest for us is the "digital world" in its broadest sense. Set up a number of years ago, our strategic department Digital McKinsey now employs over 3,000 people, including more than 1,000 developers, IT architects, designers, data engineers, and experts in robotics. At Digital McKinsey we focus on the digital transformation of companies and the creation of innovative solutions, including IT tools, and support their integration into existing systems. This is possible in part thanks to our partnerships with more than 150 software companies and technology platforms around the world.

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McKinsey & Company in Poland

This year, McKinsey & Company's Polish office celebrates the 25th anniversary of its founding. Over the last quarter of a century, we have become the largest strategic consultancy in Poland, and today employ more than 1,350 people. We serve as a trusted adviser to Poland's largest companies and key public institutions. We are proud to have shared the transformation and growth journey with industry leaders in banking and insurance, consumer goods, energy, oil, telecommunications, mining, and many other sectors. In total we have carried out more than 850 projects for our Polish clients.

Three key dates changed the face of McKinsey in Poland. In 2010 we opened our Polish Knowledge Center in Wrocław, which now employs more than 200 outstanding knowledge professionals. One year later, we established the EMEA Shared Services Center in Poznań, where more than a thousand colleagues work today.

Since 2017 the Warsaw office has been home to the McKinsey Digital Lab. Our developers, IT experts, and business consultants support companies undergoing comprehensive digital transformation. This includes making improvements in customer experience, the rapid implementation of business applications, Big Data solutions and analyses, the Internet of Things, artificial intelligence and blockchain technology. We are able to support our clients at every stage of their digital transformation – from strategy development to full implementation.

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Preface

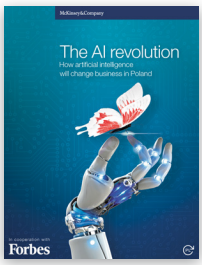
Shoulder to shoulder with robots: Tapping the potential of automation in Poland is a report by McKinsey & Company, developed in cooperation with Forbes Poland. It presents an analysis of the impact of automation on the Polish economy and labor market. In it, we outline the key challenges that automation brings and the opportunities that it creates. We also present a series of actions that can help prepare Poles for the upcoming changes in the labor market.

This report, written and published on the occasion of the 25th anniversary of McKinsey & Company in Poland, reflects our deep commitment to the development of the Polish economy and its success on the global stage. We aim to provide a fact-based perspective on how the country can accelerate growth in the next decade by using the latest technology. The ideas we present build on those outlined in the previous reports *The AI revolution, Digital Poland, Digital Poles, 5 opportunities for Poland, and Poland 2025: Europe's new growth engine*.

We would like to take this opportunity to thank Paweł Zielewski, Editor in Chief of Forbes in Poland, for his contribution and inspiration. The work on this report was led by Marcin Purta, Managing Partner at McKinsey & Company Poland, and Tomasz Marciniak, Partner. They worked together with a team consisting of the consultants Maria Ballaun, Karol Ignatowicz, and Kacper Rozenbaum, with Communications Specialists Joanna Iszkowska and Milena Tkaczyk, Adam Chrzanowski from the Research Department, and Małgorzata Leśniewska, Robert Wielogórski and Jan Zieliński from our Graphics team. We also received invaluable contributions to the report from Michael Chui, Partner, and from McKinsey Global Institute (MGI) Automation Specialist Gurneet Singh Dandona, who led the research and analytics on the topic of automation.

We are also grateful for the contributions made by many of our colleagues, especially the following individuals: Norbert Biedrzycki, Digital McKinsey Vice President in the CEE region; Daniel Boniecki, Senior Partner, Dorota Machaj, Local Partner; Wiktor Namysł, Senior Partner; as well as Ola Bojarowska, Krzysztof Kwiatkowski, Mateusz Zawisza, Arkadiusz Żarowski, and members of the Research and Analytics team at McKinsey.

This report is based on the MGI publication *A future that works: Automation, employment, and productivity*, by the following authors: James Manyika, Senior Partner based in San Francisco; Jacques Bughin, Senior Partner in Brussels; Katy George, Senior Partner in New Jersey; Paul Willmott, Senior Partner in London; Martin Dewhurst, Senior Partner in London; Michael Chui, Partner in San Francisco; and Mehdi Miremadi, Partner in Chicago. The report also draws on findings and analysis from the MGI publications *Jobs lost, jobs gained: Workforce transitions in a time of automation* (published December 2017) and *Digitally-enabled automation and artificial intelligence: Shaping the future of work in Europe's digital front-runners* (October 2017). We would like to thank the authors of these reports for sharing their expertise and insights with us.■



Key insights

We stand on the brink of a revolution: the Fourth Industrial Revolution, driven by automation and robotics. The new technology it brings with it will transform the labor market as we know it today.

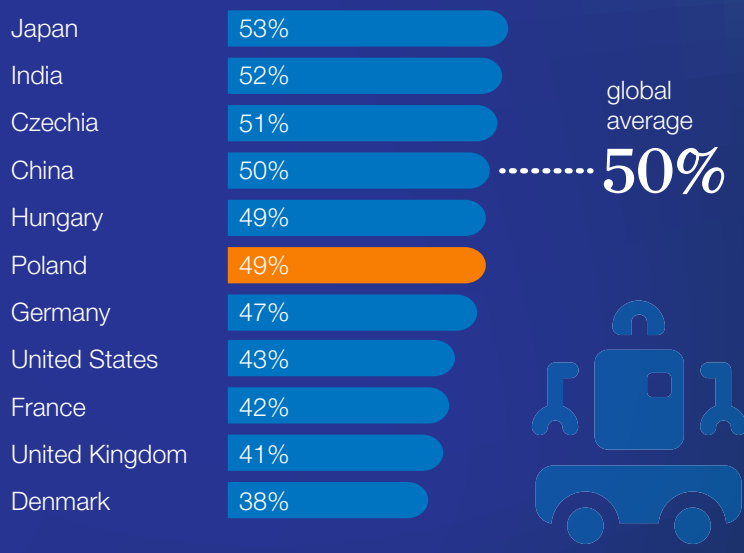
- According to our estimates, automation and the resulting increase in productivity could push up Poland's GDP by an extra 15% by 2030, while average annual economic growth in the period 2020-2030 could be more than one percentage point higher than without the impact of automation.
- Our analysis shows that up to 49% of workplace activities today in Poland – the equivalent of 7.3 million jobs – could potentially be automated by 2030 using technology that already exists today. However, the percentage of activities that will actually be automated will likely be lower due to technological, economic, legislative, and social barriers.
- The figure for automation potential in Poland – 49% – is not far off the global average of 50%, and close to that of other developed countries. According to analysis by the McKinsey Global Institute, automation potential is 53% for Japan, 51% for the Czechia 49% for Hungary, 43% for the United States, and 38% for Denmark.
- The jobs most suitable for automation are typically those based around predictable activities, both physical (such as packaging, welding, loading, preparing meals) and mental (data collection and analysis, filling out forms, generating invoices, updating and processing data). These jobs are performed more often by employees with a lower level of education, and statistically more often by men than women.
- Automation may actually lead to the creation of many new jobs. In the first place, new technology increases productivity, enabling companies to lower their prices, raise salaries, and increase profits. This stimulates demand, which leads to jobs being created. Second, the technologies of automation themselves create jobs – such as those of data analysts, to create and refine the necessary automation algorithms. Third, new jobs will appear as global trends take hold. Analysis by the McKinsey Global Institute (MGI) identifies a number of dominant global trends: an increase in personal income; the development of services for seniors, especially medical support; technological advance and implementation; greater investment in real estate; greater investment in infrastructure; and greater investment in energy.
- In tomorrow's labor market, the key competencies will be soft skills such as creativity, teamwork, empathy, critical thinking, problem-solving, and the use of technical knowledge with the help of technology. These are skills that can be used in many different professions, not just one industry. Today, employees' feeling of security comes from having a particular job; in the future, that feeling of security will come from having skills that are in demand in the labor market.
- The main challenge of automation facing Poland is how to effectively combine two markets: on the one hand, the market of people looking for jobs, often experienced in traditional sectors such as industrial processing, transportation and logistics, or agriculture, with secondary education or less and limited skills working with modern technology; and on the other, the market of jobs looking for people – new jobs, in both new and traditional sectors, that require specialist skills and the ability to work with technology.
- To exploit the full potential of automation in Poland, policymakers can already start helping employees adjust to the requirements of tomorrow's labor market, strategically guiding the process of automation and robotics, and preparing a safety net for individuals and businesses during the changes.
- Businesses in Poland can benefit from the opportunities brought by automation. They could first focus on the new technology powered by automation – not just implementing it but adapting their business processes and organizational structures accordingly. Second, they could invest in human capital as the basis for creating value and competitive advantage. The key will be to analyze the changes required to the structure of qualifications and employment, anticipate which skills the company will need in the future, and develop training programs that enable employees to adapt to the changing conditions.■

TOTAL AUTOMATION POTENTIAL IN POLAND

49% of working time is spent on activities that could be automated

7.3 m jobs

AUTOMATION POTENTIAL AROUND THE GLOBE



ACTIVITIES WITH THE GREATEST AUTOMATION POTENTIAL

75%

predictable physical activities, e.g., operating machines, working on production lines

65-71%

collecting and analyzing data

SECTORS WITH THE GREATEST AUTOMATION POTENTIAL

65% transportation

64% industrial processing

56% mining

HOW AUTOMATION WILL IMPACT THE LABOR MARKET THROUGH 2030

New jobs will be created as a result of

- increased productivity
- introduction of new technology
- global trends, e.g., aging society

SKILLS THAT WILL GROW IN IMPORTANCE

- ability to work with technology, e.g., programming, operating robots
- soft skills, e.g., creativity, teamwork

HOW MIGHT POLAND BENEFIT FROM AUTOMATION?

+15% extra GDP growth by 2030

+1 percentage point

additional average annual economic growth in 2020–2030

Chapter I

The fourth industrial revolution

The world is entering a new industrial revolution. The First Industrial Revolution was driven by steam power, the second by the discovery of electricity, and the third by electronics and computer science. Today's revolution is not just an extension of the last one, but a new phenomenon that may fundamentally change many economic, political, and day-to-day aspects of our lives. It is a revolution driven by the development of digital technology and artificial intelligence, which is increasingly blurring the lines between the digital and physical spheres.[1]

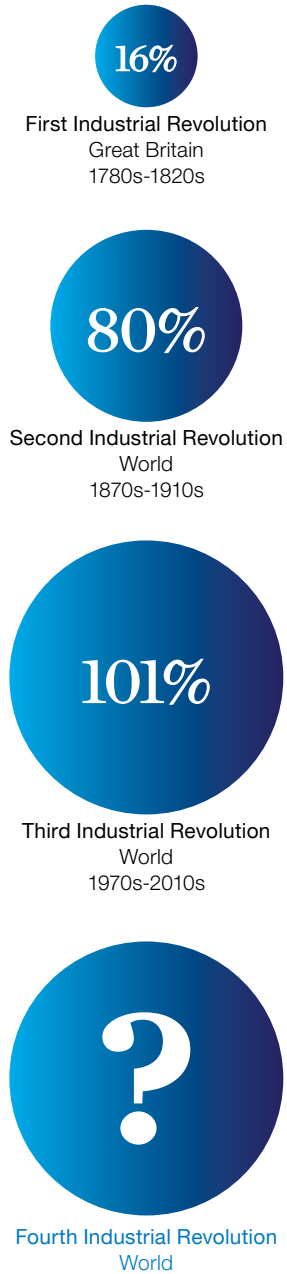
The pace of technological change and progress is increasing with each new revolution. During the first 40 years of the Industrial Revolution in eighteenth-century Britain, GDP per capita grew by 16%. This was a huge leap considering that GDP per capita around the world had grown by just 32% over the previous 1,700 years. The following revolutions brought even faster growth. During the first 40 years of the Second Industrial Revolution (1870-1910), GDP per capita grew by 80% around the world, and in the first 40 years of the Third Industrial Revolution by more than 100%.[2]

Why may the Fourth Industrial Revolution bring even faster growth? The reason lies in the pace of technological development. We are currently witnessing a massive increase in the power of supercomputers – an increase of more than 3,500% in the period 2000-2018. The empirical "Moore's law" – the prediction that computing power would double every two years until physical limits are reached – is still in effect[3]. Added to this is the fact that the cost of data storage fell by as much as 99.5% in the period 2000-2017, leading to a rapid increase in the total volume of data generated by humanity (80% of data in world history was created between 2015 and 2018) and the number of devices connected to the network (forecast to surpass 50 billion in 2020, or several times the number of people on Earth).[4]

> Today's revolution is not just an extension of the last one, but a new phenomenon that may fundamentally change many economic, political, and day-to-day aspects of our lives

This unprecedented growth in the volume of data and a surge in computing power has enabled artificial intelligence (AI) and machine-learning algorithms to develop with hitherto unseen predictive ability. These technologies have permitted the development of other technologies connecting the digital and physical worlds. Thanks to those technologies, machines can now move about in both predictable and unpredictable spaces, which has in turn enabled the

Exhibit 1.
Increase in GDP per capita in first 40 years of each industrial revolution



development of autonomous cars, drones, and robots. We can also communicate with virtual assistants or "chatbots" who understand what we write or say to them. In a nutshell, the new technology allows machines and computers to do many things that in the past were the preserve of human beings. This will have an enormous impact on the shape of the labor market in Poland and the rest of the world in the near future.

However, the great potential offered by automation also raises fears of a fundamental transformation of the labor market. This is nothing new, of course: The fear that rapid technological development would lead to mass unemployment and consequently a sharp increase in social inequality has raised its head repeatedly over the centuries.[5] In early nineteenth-century Britain, the Luddites – as they later came to be known – famously destroyed the newfangled looms that threatened to automate their jobs.[6]

It was John Maynard Keynes who, back in the 1930s, first used the term "technological unemployment."[7] This refers to the type of unemployment that arises when the means of optimizing labor and improving productivity (through automation) are introduced faster than new jobs emerge in other areas.

Politicians, academics, and businesspeople have been predicting job shortages and technological unemployment since the time of the First Industrial Revolution. In 1821 the economist David Ricardo noted that the substitution of machinery for human labor would render part of the workforce redundant, leading to a significant deterioration in the material condition of society.[8] In 1931 Albert Einstein pointed to machines as a source of emerging socio-economic problems.[9] In 1955 one American congressman requested the creation of a commission to examine automation and draw up a plan to counter mass unemployment.[10] The 1960s were a period of intense debate about the impact of automation on the future of the labor market, which in the United States led among other things to the creation of the National Commission on Technology, Automation, and Economic Progress. The development of personal computers in the 1980s refueled discussions about the impact of automation on jobs – this time not just jobs in industry but ordinary office jobs, too.[11]

So, is today's anxiety simply the continuation of a debate that has been going on for the past two centuries? Many researchers believe that this time around we are dealing not just with the automation of physical tasks through mechanization, which we have seen in the past, but with the automation of cognitive tasks through digital technology on an entirely new scale. Erik Brynjolfsson and Andrew McAfee, leading researchers on digitization at MIT, argue that "computers and other digital advances are doing for mental power […] what the steam engine and its descendants did for muscle power."[12]

Automation is a global trend today. Understanding its scope and possible impact on the Polish economy is crucial if we wish to exploit its potential and minimize the challenges it presents. In the following chapters we calculate what portion of labor could be automated in Poland in the near future and discuss how this may affect the labor market and economy. Finally, we present the main opportunities and challenges for Poland as a result of automation, and outline some potential solutions for both policymakers and the private sector.■

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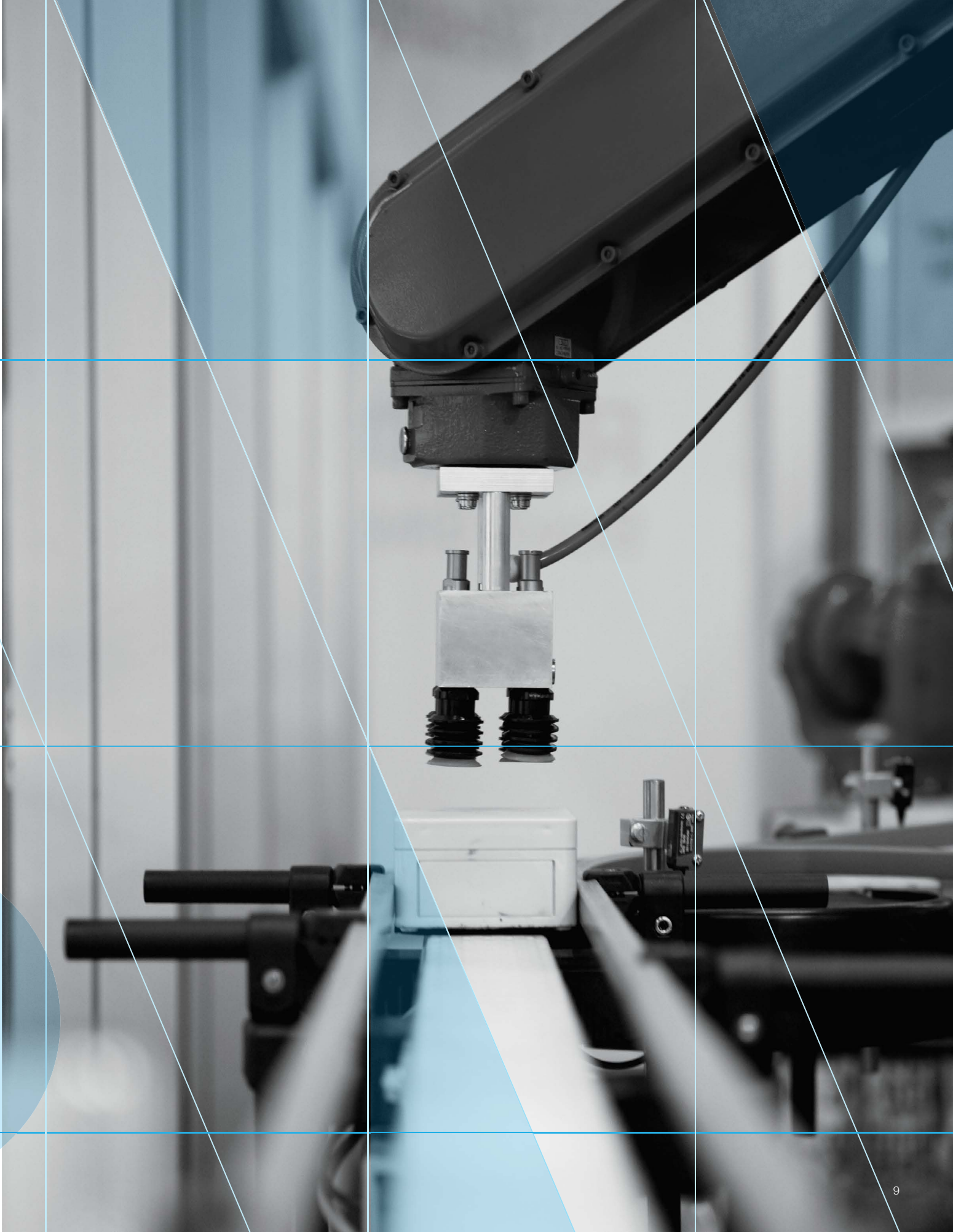


Box 1.

Artificial intelligence, drones, and chatbots...

Artificial intelligence (AI) will play a key role in today's Fourth Industrial Revolution. AI is the ability by machines to perform human cognitive functions, such as image recognition, language processing, inference, learning, interaction with the environment, problem-solving, and even creativity. The latest developments in AI have been possible thanks to the application of machine learning (ML) to large volumes of data from the internet and the Internet of Things (IoT) and internal databases of companies or academic centers.

Machine-learning algorithms recognize patterns in data; they learn to make forecasts and recommendations by means of inductive reasoning based on the data, rather than just using subjective business rules explicitly programmed into the system. Increasing the amount of data used by the machine-learning algorithms improves the efficiency of the model, as well as its precision. "Deep learning" is a type of machine learning that can process a wider range of data resources, requires less data preprocessing by humans, and can often produce more accurate results than traditional machine-learning approaches (although it requires a larger amount of data to do so). Among other things, it can reduce the error rate for image recognition by 41% compared to traditional methods.[13] In the future, the development of artificial intelligence will probably focus on cognitive computing, a set of technologies that mimic the way information is processed in the human brain and increase the quality of the decision-making process by humans.[14]

Advances in AI have enabled robotics and automation technology to develop rapidly. Innovations include autonomous vehicles, drones, and virtual assistants, which are becoming more and more popular in the business world by the day.

Robotics is the combination of engineering and IT to create solutions for industry. The term covers a wide range of areas, including the following:

- "soft robotics" constructed of flexible materials modeled on living organisms
- "swarm robotics" or large groups of robots connected to one another, each working independently, the whole group forming a common system
- tactile/touch robotics for precision tasks
- humanoids, or robots that are designed to look like humans and perform human activities[15]

Depending on their purpose, robots can be classified as either "industrial robots" or "service robots."

Industrial robots – automatically controlled, programmable, multitask machines with a high degree of freedom of movement. They are most often used for repetitive, difficult, or hazardous industrial tasks such as welding, painting, packaging, labeling, and assembly. "Robotizing" production lines improves the speed and precision of the tasks performed. Production of industrial robots is concentrated in China, Korea, Japan, the United States, and Germany. Together, these five countries accounted for 75% of sales in 2016. The International Federation of Robotics estimates that the global scale of robotic installations will increase by at least 15% per annum through 2020, which translates into 1.7 million new machines by the end of the decade.[16]

Service robots – machines that fully or partially support people at work or in their homes. They are used in logistics (for example, to move goods around warehouses), medicine (as exoskeletons or surgical robots), the military (autonomous robots can be used on the battlefield), agriculture (for planting and harvesting), and sales and marketing (to give customers information about special offers, for instance). Robots for domestic use can help people clean their houses or mow the lawn, say, or act as helpers or carers. The International Federation of Robotics estimates that the service robot market was worth USD 4.7 billion in 2016 and will grow by around 20–25% annually

... automation technologies and techniques

through 2020. The main producers of service robots are US and European companies. In Europe 30% of robot producing companies are startups.[17] Other areas of automation include autonomous vehicles and the "robotization" of business processes.

Autonomous vehicles – autonomous vehicles bring benefits such as increased safety, time savings for drivers, mobility for non-drivers, less environmental impact, and lower costs. At the same time they may lead to significant changes in supply chains and business models, as well as changing the skills that are most in demand from employees (for example, competence in the area of cybersecurity). Autonomous vehicle technology is revolutionary, but its global adoption is more likely to be evolutionary.[18] According to McKinsey forecasts, the technology needed for partially autonomous vehicles (operating within virtual geographic boundaries) will become available between 2020 and 2022, while full automation will arrive by 2030 at the earliest.[19]

Drones – businesses across industries realize that drones have multiple commercial applications, some of which go beyond basic aerial photography. Drones can perform accurate three-dimensional mapping of terrain, and insurance companies are using them to inspect the damages caused by natural disasters, for instance. Construction companies are using them to keep a watchful eye on building supplies, and farmers are sending them to monitor crops and collect soil data. Drones also have applications in entertainment: At the opening ceremony of the winter Olympic Games in PyeongChang, for example, 1,218 drones with lights on them formed the shape of a snow-boarder in the sky, and then the Olympic rings.[20] Drones are also currently being tested for use in the transportation of goods and people.[21]

Robotic process automation – RPA is software for coordinating activities between existing applications in a company without human involvement. Using a "virtual employee," RPA can copy the activities of users of the payroll system, for instance, reducing or even eliminating completely the simple, repetitive actions currently performed by hand. Adding artificial intelligence to RPA leads to the intelligent automation of processes, which enables even greater automation of business processes.[22]

Chatbots, virtual assistants – chatbots are interactive computer programs with artificial intelligence, whose job is to conduct a conversation using natural language. They frequently feature on websites instead of customer support agents, to answer questions or provide information about the company. Siri (from Apple) and Alexa (Amazon) are examples of virtual assistants.■

Chapter II

The impact of automation on the Polish labor market

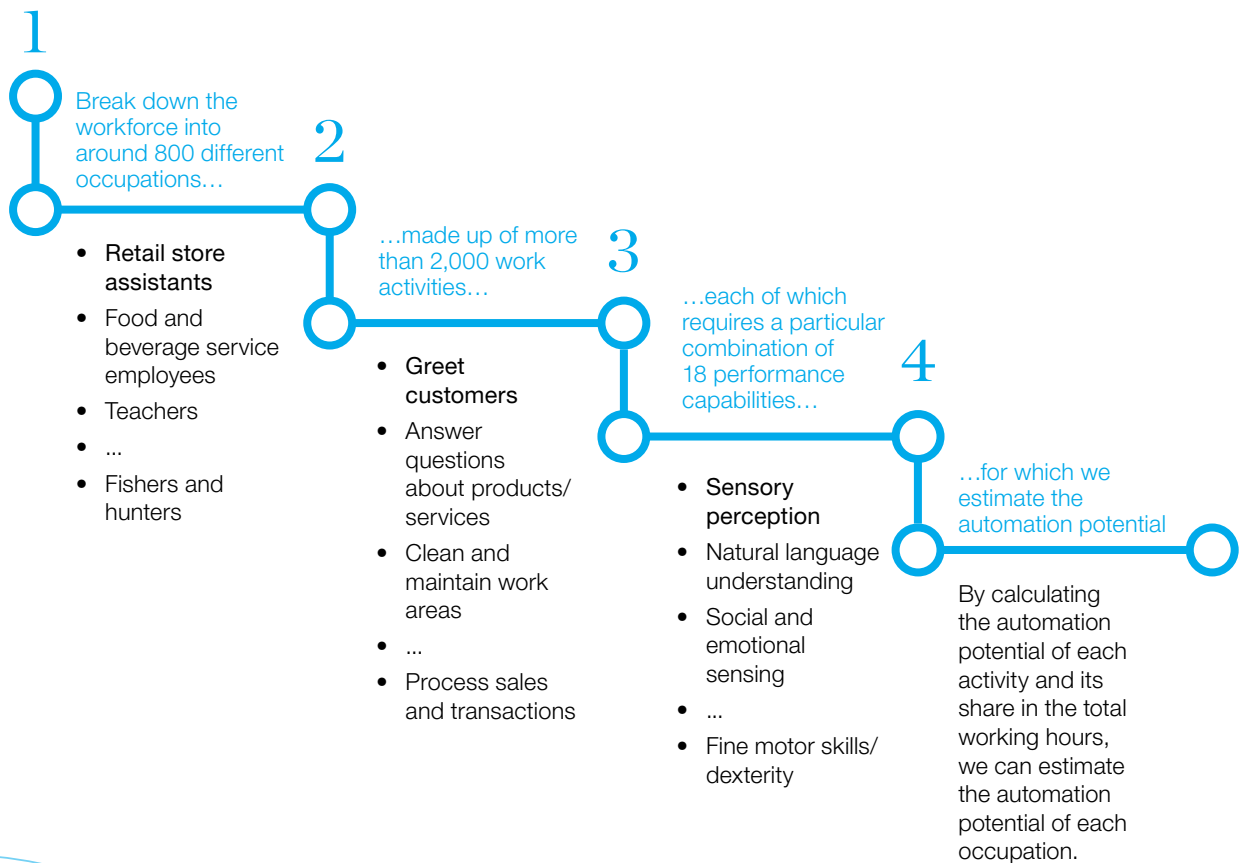
To understand the impact of automation on the Polish labor market, the McKinsey Global Institute analyzed some 800 professions in terms of the possibility of automating them using technology that already exists today[23] (for details of the methodology, see Exhibit 2). It was possible to estimate the potential automation for each profession by calculating the potential for automating specific work activities and the share of those activities in total working hours for the profession in question. We present six main findings from our analysis below.

I. ALMOST HALF OF THE TOTAL HOURS SPENT ON WORK IN POLAND COULD BE AUTOMATED

According to estimates by McKinsey, 49% of total working hours in Poland – the equivalent of 7.3 million full--time jobs – could be automated using currently available technology. That technology includes artificial intelligence and industrial robots fitted with AI, autonomous vehicles, virtual assistants, chatbots, and robotic process automation.

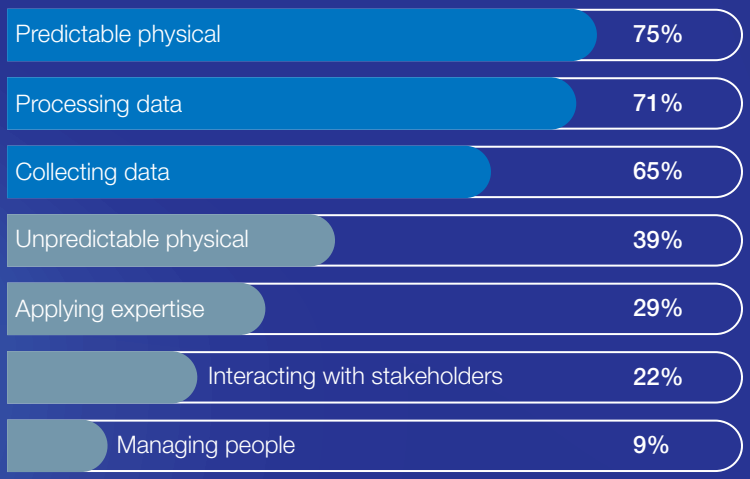
Our analysis leads us to two main conclusions. On the one hand, automation can help employees by performing repetitive tasks for them, such as working on production lines or making financial transactions. This frees employees up to focus on activities that are more difficult

Exhibit 2.
We applied a rigorous methodology to estimate the potential automation.



AUTOMATION POTENTIAL IN POLAND

AUTOMATION POTENTIAL BY TYPE OF ACTIVITY



TOTAL AUTOMATION POTENTIAL

of working time is spent on activities that could be automated

equivalent number of jobs

FACTORS INFLUENCING THE SPEED AND DEGREE OF AUTOMATION

POTENTIAL IMPACT OF AUTOMATION BY EDUCATION

POTENTIAL IMPACT OF AUTOMATION BY GENDER

AUTOMATION POTENTIAL BY SECTOR

	%	full time job equivalent (m)
Transportation & warehousing	65	0.6
Manufacturing	64	1.9
Mining	56	0.1
Construction	52	0.5
Agriculture	52	1.0
Trade (retail & wholesale)	50	1.1
Accomodation & food services	49	0.2
Utilities	47	0.4
Real estate	42	0.1
Public administration	40	0.7
Arts, entertainment & recreation	37	0.1
Telecommunication	36	0.1
Finance & insurance	36	0.1
Professional, scientific & technical services	35	0.2
Healthcare & social services	33	0.3
Education	26	0.3

THE MOST AUTOMATABLE OCCUPATIONS

1. Food production
2. Textile and apparel production
3. Joinery
4. Food preparation
5. Metal and plastic processing

to automate, which often bring more value to the organization. For example, doctors and nurses can spend more time with patients rather than on administration.[24] On the other hand, some employees will find that they are no longer required in specific jobs.

The automation potential in Poland is not far off the global average of 50%, and close to that of other developed countries. According to analysis by the McKinsey Global Institute, automation potential is 47% in Germany, 43% in the United States, 41% in the United Kingdom, and 38% in Denmark. Among major world economies, higher levels are found for Japan (53%), China (50%), and some other countries. The structure of the labor market is the key factor behind these differences.[25]

II. TODAY'S AUTOMATION POTENTIAL CAN ONLY BE FULLY REALIZED BY 2030

The automation potential identified does not mean, however, that the technologies in question can be applied in the workplace today. Many such technologies are not yet ready for widespread use. How fast they are applied, and to what extent, depends on a number of factors:

Technical feasibility – there is generally a lag between a technology being demonstrated and a viable product based on that technology being developed for everyday use. The Wright brothers demonstrated the possibility of flight in 1903, but it was not until the 1920s that commercial airlines came into being. Things are similar for today's autonomous vehicles: Although they have been around for many years, their everyday use on a larger scale still requires a lot of work on the engineering front and finding solutions to numerous regulatory and ethical issues.[26] It is safe to assume that the large-scale implementation of other automation solutions that are around today will only be possible once the technology is sufficiently mature and can be widely used in everyday work environments.

Technology costs – automation technologies usually involve capital expenditure or operating costs. Ultimately, they will only be implemented once they can compete on price with human labor.

Labor market dynamics – decisions about automation depend on supply and demand on the labor market, and also on salary levels. If there are a lot of people on the market applying for jobs with low- or medium-level salaries, companies may delay their decision to introduce technology.

Acceptance by society – in some cases, social acceptance is a significant barrier to the adoption of technology. For example, certain tasks performed by doctors could be automated today, but lack of social acceptance and the existence of regulatory barriers slow this process down.

Regulatory environment – regulation can significantly reduce the speed of automation. Permitting autonomous vehicles on public roads is a good example.

McKinsey analysis shows that Poland cannot realize its full technical automation potential any earlier than 2030. This is the most optimistic scenario. In the most conservative scenario, it may take until 2060 or even later. In the remainder of this report we focus on the consequences of the first scenario, as it involves both the greatest potential and the biggest challenges.

III. PREDICTABLE ACTIVITIES ARE EASIER TO AUTOMATE

We divided up the 2,000 activities performed by employees into seven main categories (see infographic on page 14). The automation potential differs for each type. The greatest potential occurs for "Performing physical activities and operating machinery in predictable environments." The high automation factor – 75% – is due to the routine nature of the tasks involved, which means that machines and computers can replace humans.

Two categories that have around the same level of automation potential are "Processing data" and "Collecting data." The activities they involve – transferring wages, documenting loan applications, issuing invoices, and so on – are most often the domain of administrative and support workers. What these tasks have in common is that they are based on a finite number of rules. Algorithms and specialized software are already beginning to take over many of these responsibilities today.

The four remaining categories are "Performing physical activities and operating machinery in unpredictable environments," "Interacting with stakeholders," "Applying expertise to decision-making, planning, and creative tasks," and "Managing and developing people." Automation is much less significant for these activities, as technology is not yet advanced enough to cope with them. Moreover, their highly irregular nature prevents the use of automated solutions in practice. Some of these tasks are based on interpersonal relationships – an area where humans have a natural advantage over machines.

IV. AUTOMATION POTENTIAL VARIES BETWEEN DIFFERENT SECTORS AND OCCUPATIONS

In Poland, automation could have the biggest impact on the transportation and warehousing sector and in the field of manufacturing. Some 64–65% of activities performed today by people in these sectors can be automated. Robots are already starting to take over tasks such as packing goods or stacking them on shelves. Autonomous vehicles will take care of transportation. In agriculture, trade, and administrative and office support, our analysis shows that the percentage of automation is lower, ranging from 40 to 52%. However, given the large number of people employed in these industries, this translates into a significant volume of jobs that are susceptible to automation – around three million in total. In education, healthcare, and business services, a significant proportion of activities involve direct contact with stakeholders, be they schoolchildren, students, patients, or clients. This fact makes automating these jobs more difficult.

For the purposes of this report, we analyzed the potential of automation in Poland not just by sector of the economy, but also by occupation. In terms of sectors, the results show that manufacturing could be the area most affected by automation (see Infographic at the top of this chapter). In terms of occupations, jobs cooking and preparing food have a potential automation factor in excess of 88%. In fast-food restaurants, for instance, some of the tasks involved – such as assembling the various components of a hamburger – can be seen as a type of manufacturing.

V. AUTOMATION POTENTIAL IS GREATER FOR EMPLOYEES WITH SECONDARY EDUCATION OR LESS

We also analyzed the structure of employees in Poland in terms of their education. Our estimates imply that

automation potential differs significantly depending on level of education: 22% for people with higher education and 57% for people with secondary education or less.

VI. JOBS MORE OFTEN DONE BY MEN IN POLAND HAVE GREATER AUTOMATION POTENTIAL THAN JOBS MORE OFTEN DONE BY WOMEN

Activities taking up 45% of the working time of women are susceptible to automation, compared to 52% for men. The difference is due to the fact that men make up the vast majority of employees in industries with high automation potential, such as transportation and logistics, manufacturing, mining, and construction – 68% in manufacturing and as many as 89% in mining and construction. Women, for their part, dominate in industries with low automation potential, such as healthcare (80%) and education (78%).■

Chapter III

The impact of automation on the Polish economy

Economists believe that economic growth in Poland may slow down over the coming decades, due in part to the shrinking labor force as the population grays.[27] Our analysis shows, however, that the Polish economy may actually develop much faster than current predictions. Automation and the resulting increase in productivity could push up Poland's GDP by an extra 15% by 2030. In addition, average annual economic growth in the period 2020–2030 could be more than one percentage point higher than without automation.

However, these levels will only be achieved if the individuals losing their jobs due to automation can smoothly transition into new positions: A full 100% of them would need to find work within a year (see Box 2). In a pessimistic scenario, where only 25% find a new job within a year, GDP in 2030 may still be 11% higher than if no automation were to take place.

Average annual economic growth in the period 2020–2030 could be more than one percentage point higher thanks to automation. If employees fail to find new jobs in the new, automated labor market, the country's economic growth may still be up, but unemployment may also temporarily spike.

The labor market in Poland has been through major changes in recent decades. In the period 1994–2017,[28] employment in agriculture and mining fell by 50–55%, while employment in some other sectors increased by 100–200% (Exhibit 3).

Box 2.

Methodology

To assess how automation is set to affect the Polish economy, we draw on the McKinsey Global Growth Model, a macroeconomic model of supply that uses data for the years 1960–2015 from more than 100 countries. The model looks at four factors influencing economic growth through automation: the adoption curve of new technologies, reduction in employment, investments needed for the introduction of new automation technologies, and increase in productivity per employee.

Two parameters are crucial for estimating the impact of automation on economic growth in Poland: the speed of adoption of automation technology, and the impact of automation on employment.

Our analysis shows that up to 49% of workplace activities today in Poland could potentially be automated by 2030 (see Chapter II) in the fastest adoption scenario. We estimate that by 2030, technologies that already exist today will have improved to such an extent that it will be cost-effective to use them to replace humans for those activities and introduce corresponding organizational solutions. Furthermore, we assume that in the run-up to 2030, both managers and rank-and-file staff will have gotten used to handing some tasks over to machines. In many sectors, it is also likely to take this long for appropriate legislation to come in.[29] However, it should be noted that the implementation of technology may in actual fact be slower, for any of the reasons mentioned above. If this happens, it will obviously have an impact on the scale of benefits and threats arising due to the automation of work in Poland.

The second parameter affecting the scale of economic growth due to automation is the number of employees who lose their jobs and fail to find new employment within a year – in other words, the reemployment rate. The model considers four different scenarios, each assuming that a different percentage of people return to the labor market within a year of their jobs being automated:

- pessimistic – 25%
- average – 50%
- high – 66%
- smooth – 100%

Employees whose work is automated but do not lose their jobs technically fall under those returning to the labor market within a year, although of course they are more productive thanks to the new technology.

The speed of employees returning to the labor market will determine the opportunities for economic development in Poland arising as a result of automation.

In recent years, the situation on the labor market has been favorable for employees. Unemployment rates are low[30] and the number of vacancies has been growing since 2013 – by 235% between the fourth quarter of 2013 and the third quarter of 2017 (Exhibit 4).[31]

According to the 2018 Occupational Barometer, it is becoming increasingly difficult to find suitable workers in Poland, and the challenges this creates are set to grow.[32] Clearly, the Polish economy is suffering from an increasing shortage of labor – a trend that automation may strengthen further still.

As we saw in Chapter II, as much as 49% of today's workplace activities in Poland could be automated by 2030. But that does not mean that the same proportion of workers will lose their jobs. Some employees will be able to focus on other types of tasks; others will change the type of work they do within the organization. Thanks to automation, these two groups will become more productive than ever before. Of course, for those who do lose their jobs, finding a new position may be challenging, and they will have to acquire new skills and competencies. Accordingly, we consider four different reemployment scenarios in our model (see Box 2).

If all the people whose jobs are automated enjoy a smooth return to the labor market, we do not foresee an increase in unemployment (Exhibit 5). But if only 50% of them manage to find a new job within a year – our "average" scenario – the unemployment rate may rise temporarily to 10% or more. In our pessimistic scenario, where as few as 25% of them are reemployed within a year, unemployment may exceed a level of 25%. It is therefore vital that Poland ensures the rapid "reskilling" of workers – as we discuss in detail in Chapter IV.

Automation brings new opportunities as well as concerns. Besides its positive impact on GDP, automation may improve the situation in sectors where demand for employees is highest – notably in construction, information and telecommunications, and services (Exhibit 6).

It is safe to assume that many new jobs will emerge in Poland – although it is difficult to predict in which areas precisely. A decade or more ago, few imagined that developers of smartphone applications and cybersecurity experts would be hotly sought after in today's labor market.

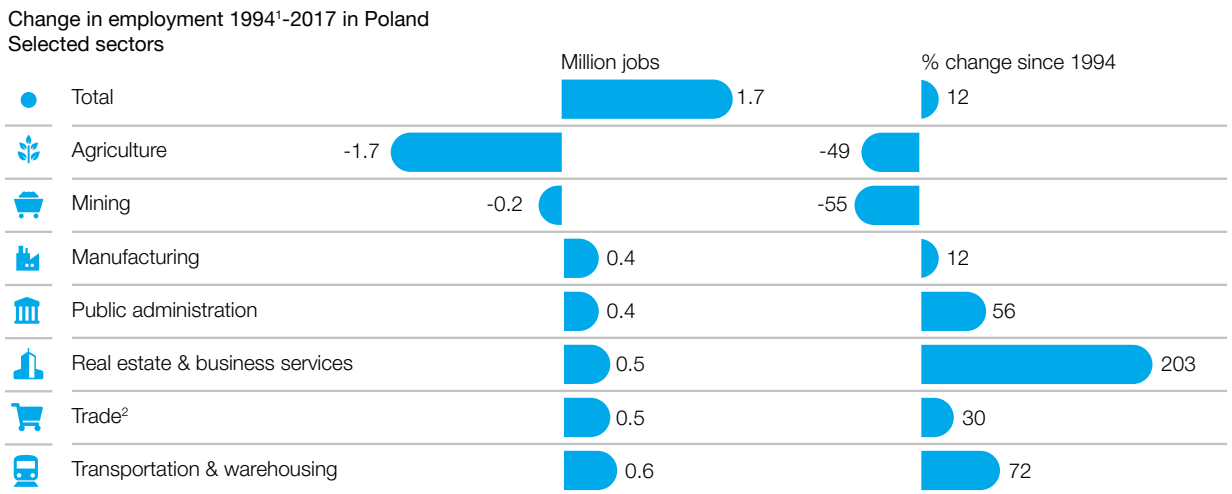
Our analysis indicates that the new jobs created in Poland in the period through 2030 will fall into three main categories, as we discuss below.

I. JOBS RESULTING FROM INCREASED PRODUCTIVITY IN AUTOMATED OCCUPATIONS

So far, the structural changes in Poland have not triggered mass unemployment. That is because technology helps create new jobs. Often, jobs emerge in occupations that previously did not exist. For example, the introduction of personal computers – one of the biggest technological changes that took place in the twentieth century – led to the disappearance of over 3.5 million jobs in the United States between 1970 and 2015. Those affected were mainly secretaries, typists, other office workers, and people producing and repairing typewriters.

But many new jobs were also created in the same period. We estimate that the rise of PCs led to the creation of over 19 million jobs in the United States, in sectors such as hardware and software production, component supply, and IT services – and beyond this in areas where computers enabled new methods of management and customer service.[33]

Exhibit 3.
Poland's historical structural changes resulted in a transfer of workers between sectors and an increase in total employment.

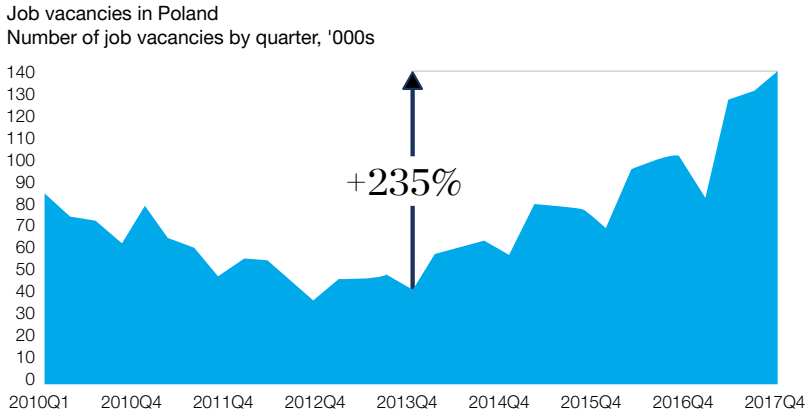


1 Poland began using the NACE (PKD) classification in 1994
2 Trade & repairs
SOURCE: GUS; McKinsey analysis

Similar trends can be seen today. Researchers estimate that at least 0.6% of new jobs in the United States each year are in new professions.[34] This is in keeping with the claim by economist Milton Friedman that "human wants and needs are infinite, and so there will always be new industries, there always be new professions."[35]

Robust aggregate demand and economic growth are essential for job creation. New technologies have raised productivity growth, enabling firms to lower prices for consumers, pay higher wages, or distribute profits to shareholders. This stimulates demand across the economy, boosting job creation.[36] One study found that European businesses adopting technologies that perform routine tasks first reduced jobs by ten million, but the resulting increased demand in the economy allowed the creation of nine million new jobs. Additionally, spillover effects (whereby the additional jobs that are created due to increased demand generate income that then goes back into the economy, creating even more new jobs) led to the creation of between three and 12 million jobs. The ultimate effect on the labor market was therefore positive.[37]

Exhibit 4.
Increasing productivity and labor supply could solve the challenges of labor shortage in Poland.

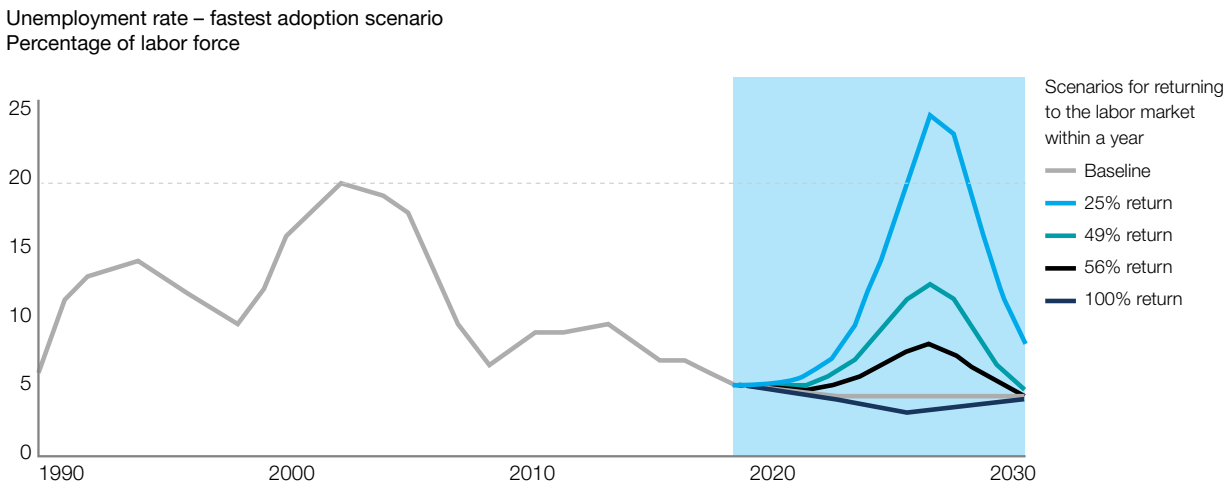


SOURCE: GUS; Eurostat

An interesting example demonstrating the mechanics of job creation is what happened to staff in bank branches after the introduction of ATMs in the 1970s.[38] In the four decades through 2010, over 400,000 ATMs were installed in the United States. But despite fears that this innovation would reduce the number of jobs, in fact the opposite happened: The number of bank employees rose over the same period from around 300,000 to almost 600,000.

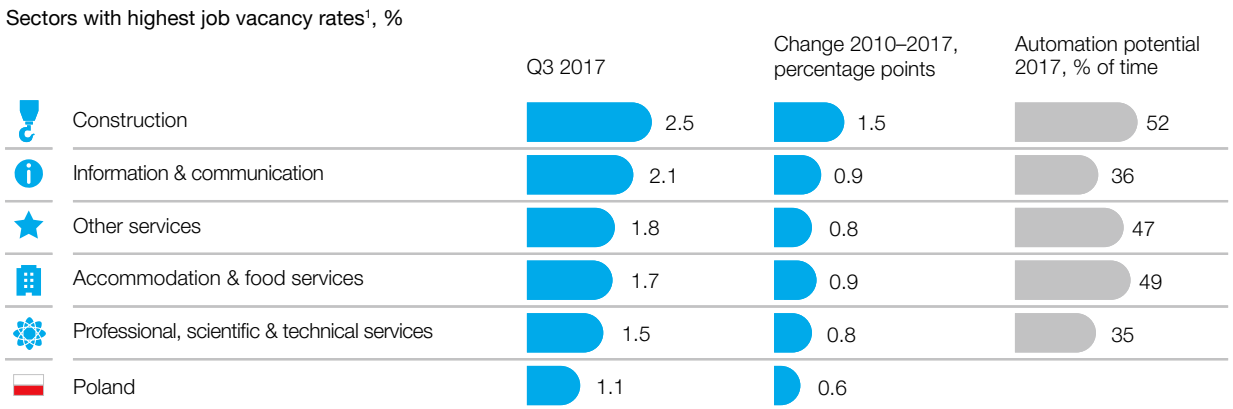
There were two reasons for this positive development – both of them grounds for optimism about the next wave of automation. First, the introduction of ATMs reduced the cost of running branches thanks to reductions in the number of staff. At the same time, banks began opening more branches (a 43% increase in urban areas of the United States), which in turn increased demand for branch staff. Second, ATMs only automated some of the activities traditionally performed by employees. Activities that were not automated, such as building relationships or advising clients, in fact proved to be more valuable for banks.

Exhibit 5.
Without rapid retraining of workers, unemployment levels may spike.



SOURCE: McKinsey analysis; MGI

Exhibit 6.
Sectors with the most vacancies could benefit from automation, unlocking the economic growth so far stifled by inadequate labor supply.



1 Job vacancy rate = number of job vacancies /(number of occupied posts + number of job vacancies)
SOURCE: OECD; Eurostat

Economists believe that automation will create jobs as long as there is unmet demand in a particular sector.[39] This mechanism is illustrated by what took place in the car industry in the early twentieth century, when the industry was on the verge of automation. With the introduction of production lines, productivity more than doubled in the period 1909–1915 in terms of the number of cars produced per employee. But despite this massive increase in productivity, the number of jobs grew almost tenfold. This was the result of the enormous demand for cars, which grew as their prices fell – by 50% over the period in question.[40]

In the coming automation revolution, we may see a similar mechanism occurring for truck drivers when self-driving trucks come in. Analysis by McKinsey indicates that up to 80% of truck drivers' working time could be automated by the new technology. Automation will likely be simplest on long, predictable routes, such as highways. But tasks such as maneuvering vehicles around busy logistics centers at loading docks will be much more difficult for autonomous vehicles, and humans will be better at them than machines for a long time yet.

Automating long routes will boost the efficiency of truck utilization, as breaks for drivers will no longer be needed.[41] It will also reduce the cost of transportation. This cost efficiency may lead to an increase in the volume of transported goods. In turn, the larger volume will drive the creation of new jobs – in logistics centers, monitoring the work of autonomous vehicles, and elsewhere.[42]

This mechanism for job creation will also affect Poland. Sectors currently with unmet demand for employees include construction, communications, and professional services (Exhibit 6).

II. JOBS RELATED TO THE PROGRESS OF AUTOMATION

Another source of new jobs will be the development of automation technologies within Poland – be they robots working in factories, agriculture or trade, autonomous vehicles, or programs for automating office work. To develop new technologies you need people who can work out what is required, devise solutions, and implement them from a technical, organizational, and business perspective. Another potential source of employment will be using the new technology, monitoring it, maintaining it, and improving it. We identify three new types of jobs in this field:[43]

Creators and suppliers of technology – people involved directly in the production of robots and their introduction into companies (engineers, programmers, and so on).

Users and enablers – participants in the ecosystem who maximize the value created by the new technology. This includes the people gathering, analyzing, and protecting data (potentially collected for the first time ever thanks to the new technology) and the people using that data to improve the organization's performance.

Other professions related to automation – including experts in legal matters related to automation, and experts in managing the organizational changes that are needed to exploit the full potential of automation

III. NEW JOBS CREATED BY GLOBAL TRENDS

The McKinsey Global Institute identifies a number of global trends that will

lead to job creation.[44] These trends also apply to Poland.

Increased personal income

Conservative estimates[45] foresee GDP per capita in Poland reaching over 85% of the current level of Western European countries (EU-15) by 2030. According to an ambitious scenario developed by McKinsey,[46] it could actually be more than 100%. Increased earnings will translate into increased spending on leisure, tourism, education, vehicles, clothing, and electronics. This is actually a global trend, with the size of the middle class expanding across developing countries.

The McKinsey Global Institute estimates that as many as 280 million new full-time equivalent jobs could be created worldwide. In Poland, this will be the result of an increase in internal demand, exports, and the number of tourists visiting the country.

Another source of new jobs will be the development of automation technologies within Poland.

Health services for the elderly

Developed countries tend to have graying societies. This trend also affects Poland, where according to UN estimates, the number of people over 65 will grow from 6 million in 2015 to 8.0–8.5 million in 2030, meaning an increase in the share of seniors in society from 16% to 22–24%.[47] This demographic shift will create greater demand for healthcare for the elderly, both medical services and nursing. The trend may be even more pronounced in Poland, as the current number of healthcare professionals (doctors, nurses, and carers) is 53% below the European Union average, at 58 per 10,000 inhabitants (compared to 124 per 10,000 in the EU).[48]

Technological advance and implementation

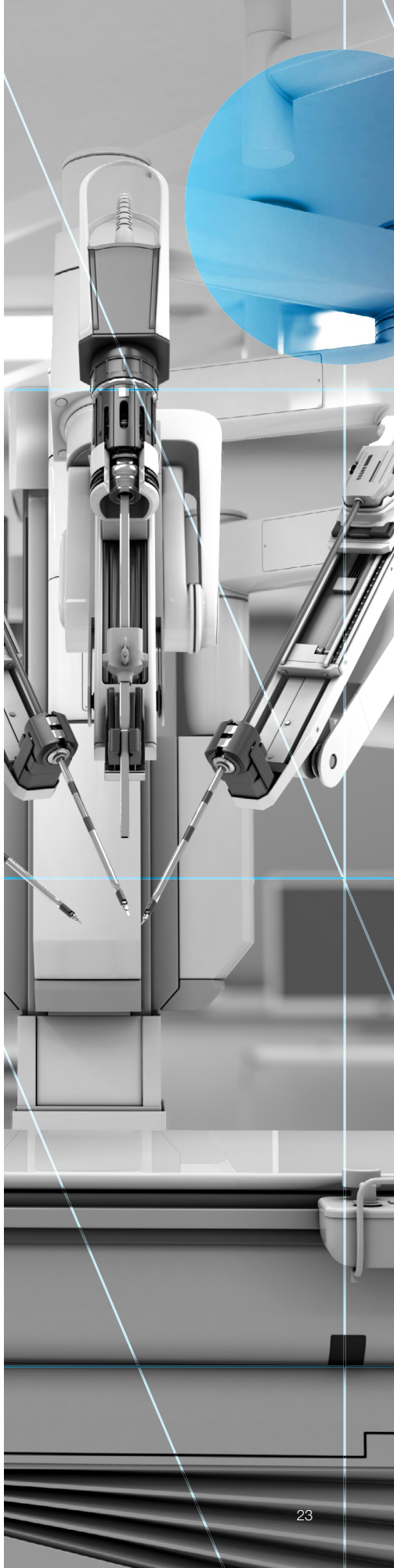
The McKinsey Global Institute estimates that between 20 and 46 million new jobs will be created worldwide, net of automation, thanks to the development of new technology and its implementation. In Poland, over and above the jobs resulting directly from automation, there is also potential for the creation of jobs related to technology. According to analysis by McKinsey, the Polish economy has so far only exploited 8% of its digital potential, compared to 12% in Western Europe and 18% in the United States.[49]

Investments in real estate and infrastructure

In Poland, as in the rest of the world, investments in real estate and infrastructure can be an important source of jobs. The value of Polish infrastructure assets as a share of GDP, at 113%, is much lower than the EU average of 229%. The same is true of the value of apartments and residential buildings, at 191% of GDP in Poland compared to 460% on average in the EU.[50]

Investments in energy

Growing demand for energy and installed electricity capacity is a significant trend globally. It is also important for Poland. In 2015 the Polish Ministry of the Economy estimated that as much as 27 GW would need to be installed in order to replace decommissioned power plants and meet the country's expanding energy demand.[51] ■



Chapter IV

Key skills in tomorrow's labor market

According to analysis by McKinsey, no increase in demand will take place for activities with the greatest automation potential in Poland. However, there will be an increase in demand for activities such as managing and developing people, interacting with stakeholders, and applying expertise.[52]

Other studies have come to similar conclusions.[53] Researchers have identified the following key skills for tomorrow's labor market: problem--solving, critical thinking, creativity, teamwork and team management, and emotional intelligence. World leaders have a similar perspective on the development of the labor market. At the Davos Economic Forum in January 2018, for example, the founder and CEO of Chinese e-commerce giant Alibaba, Jack Ma, stated that independent thinking, teamwork, care for others, and artistic activities are key directions for education of the future.[54]

These are the "soft skills" that economists consider an essential complement to cognitive and technical skills.[55] They point out that having a high level of soft skills is highly valued on the market. Indeed, some believe that soft skills are a better predictor of a person's employment and earning level than hard skills.[56]

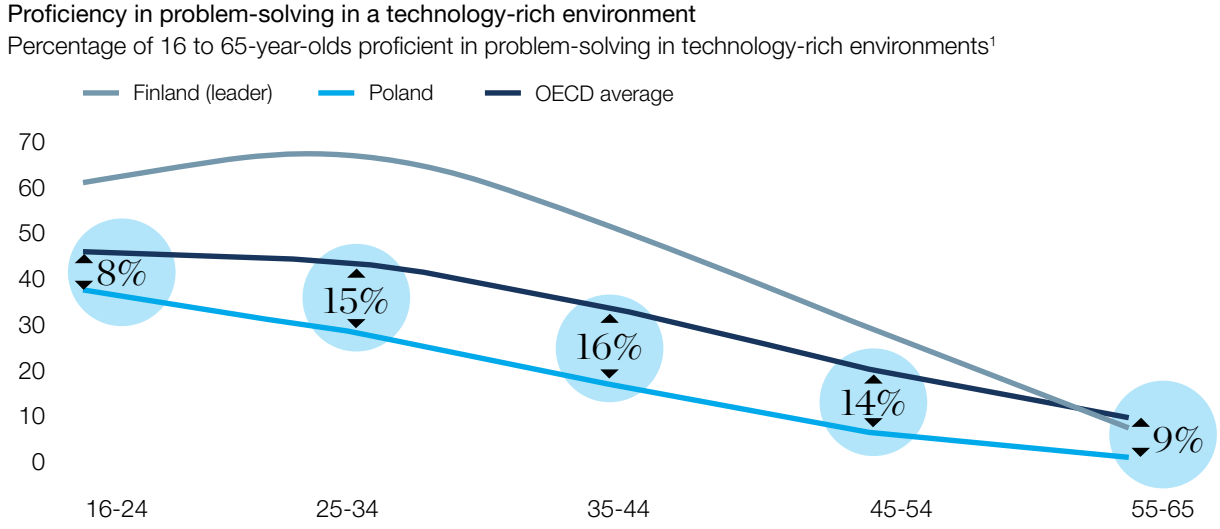
Another way of looking at the key skills needed in tomorrow's labor market is to divide up activities:

- those that can be substituted by technology
- those where technology is a complementary element
- those for which technology does not represent a threat (usually tasks involving personal relationships)[57]

> The key skills in tomorrow's labor market will be those traditionally considered soft skills.

Activities where technology is complementary may gain in importance and value as the technology itself continues to develop. The rapid development of advanced data science is a good example. Developments in

Exhibit 7.
Polish workers are less skilled in technology than workers in other OECD countries.



1 Percentage of adults reaching Level 2 or 3 of four levels of proficiency in problem-solving in technology-rich environments (Level 3 – the highest)

technology – in this case, increasing computing power and the emergence of the internet and the Internet of Things – has made the ability to analyze large volumes of data a highly desirable skill. Data analysts have become one of the most in-demand occupations.[58]

Everything points to the fact that the key skills in tomorrow's labor market will be those traditionally considered soft skills, problem-solving, and the use of technical knowledge with the help of technology. These skills are highly transferable between occupations and industries – an important fact, given the pace of technological change. Clearly, employees' feeling of security in the future will increasingly come from having the right skills and less from being employed in a particular job.[59]

How does Poland perform in terms of the skills that are important for tomorrow's labor market? The OECD's Survey of Adult Skills (PIAAC) assesses proficiency in literacy, numeracy, and problem-solving in technology-rich environments (the use of computers and the internet to search for and analyze information, communicate with others, and perform practical tasks in a private, professional, and social contexts). These skills are considered the "key information-processing competencies" that are necessary for fully integrating and participating in the labor market and acquiring new knowledge and skills.[60] In other words, the PIAAC study covers most of the basic skills that will be indispensable in Poland's future labor market – with the exception of some interpersonal skills, for which no international, large-scale, comparative research exists.

For the use of information and communication technology, Poland is 12 percentage points below the OECD average.

For literacy and numeracy, Poland is around the average OECD level in the PIAAC study.[61] However, for the use of information and communication technology, the country is 12 percentage points below the OECD average, coming roughly 25th among the countries surveyed.[62] The gap is even bigger for Poles at the beginning or in the middle of their professional careers (Exhibit 7). This finding suggests that many other countries have been faster at training workers with the desired skills. On the positive side, the gap between Poland and the OECD average appears to be closing for the youngest group of Poles.

Poland performs respectably on literacy and numeracy compared to other OECD countries. But clearly the level of use of information and communication technology needs improvement – especially given that problem-solving in technology-rich environments will represent a key skill in tomorrow's labor market. ■

Chapter V

Challenges and potential solutions

Technology may have a major impact on the Polish labor market in the period through 2030. As many as 7.3 million jobs could be automated, primarily in industrial production, agriculture, administrative and office support, call centers, and trade. Automation may affect over 50% of workers with secondary education or less. Some of these individuals will have to change their occupation.

New jobs will appear in other occupations, some of which are only now emerging. But these new roles will require new skills. The scale of change may be similar to that seen on the Polish labor market in the 1990s, when more than 1.7 million jobs disappeared in agriculture alone. That level is not far short of the 1.9 million jobs at risk in industry in the period through 2030.

But if anything, this time the challenge is even bigger. Previous changes, both in Poland and elsewhere, were spread over many years. A more natural turnover in human resources could take place on the labor market. Some people retired and those that took their place had more time to identify the needs of the market and start their careers in sectors where demand was strongest. This time around, the changes may be faster. Poland will face the challenge of having to "reskill" many middle-aged workers who are already halfway through their careers, helping them sidestep into different industries.[63]

As we saw in Chapter IV, as long as the individuals who lose their jobs due to automation can smoothly transition into new positions, it will be possible to achieve both a reduction in unemployment and an increase in economic growth. For Poland and other developed countries, ensuring this smooth transition may ultimately represent the greatest challenge of automation.

We believe that policymakers and business leaders can do much to make this transformation less of a bumpy ride. They will need not only to overcome the challenges for employees, but also to exploit the chances and opportunities for Poland. The time is ripe to start the debate about possible solutions.

OPTIONS FOR POLICY-MAKERS

A key challenge facing Poland with respect to automation is how to merge two disparate markets. On the one hand we have people looking for jobs – individuals with experience often in traditional sectors (industrial processing, transportation and logistics, agriculture), with secondary education or less, and limited skills working with modern technology. On the other hand, we have jobs looking for people – new jobs that require specialized skills and the ability to work closely with technology.

Policymakers can play an important part in this transformation. They have the ability to shape education, take a comprehensive, strategic view of the labor market and the economy, and influence spending on research and development. To take full advantage of the opportunity created by automation, policymakers could consider the following actions:

I. INTRODUCE A WIDE-RANGING RESKILLING PROGRAM FOR WORKERS

We believe that the most important thing to do to help prepare for the challenges of automation is to improve workers' skills. A number of reasons lie behind this assertion.

First, if employees whose jobs are automated fail to transition smoothly from their current jobs to new ones, we may witness a significant increase in unemployment levels (see Chapter III). At the same time, we cannot count on "generational change," as about 80% of people currently active in the labor market in Poland will still be in the market in 2030 (Exhibit 8).[64]

Rapid technological advances and the great automation potential of multiple sectors of the Polish economy mean that many employees may be forced to retrain at some point in their careers. For this to be successful, employees need to be aware of the importance of continuous self-improvement and able to take specific actions, such as accessing a structured training system.

Second, Polish employees are not highly skilled in working with new technology. As we saw in Chapter IV, they are less advanced in this respect than their peers in other OECD countries (Poles are 8-16% below the OECD average, depending on the age group).[65] Improving these skills will be crucial, as using

technology will form an indispensable part of tomorrow's world of work.

In Chapter II we saw that automation may affect employees with secondary education or less much more strongly than those with higher education. Less well-educated workers have fewer skills that they can apply in other occupations, and they may be less open to acquiring new skills. Moreover, according to research by the OECD, they are less skilled at working with technology.[66]

A particular challenge given the future requirements with regard to employee training and career changes, plus the relatively low level of basic skills in technology in Poland, is the low level of public spending on training. Spending in Poland has fallen significantly since the mid-1990s and remains at a much lower level than in other OECD countries (Exhibit 9).

One solution to this problem would be to create a national reskilling program. Such programs are already in place in some countries, for example Singapore (see Box 3). The first step would be to identify which industries are likely to see the emergence of a large number of new, well-paid jobs. For selected industries, jobs should then be matched with the required skills – technical skills, soft skills, and team management skills. Making this information public would allow employees to plan their careers effectively and acquire the skills that they will need if they have to change jobs or industry.

The next step is to match skills with educational institutions, so that people know where to go to acquire the competencies they need. Given the wide diversity of skills in question, both public and private educational institutions can be involved in providing training, and courses can be either real or virtual. In Poland, public colleges and universities could participate on a massive scale in this endeavor. Indeed, given the coming demographic decline, this could be something of a lifeline for them.

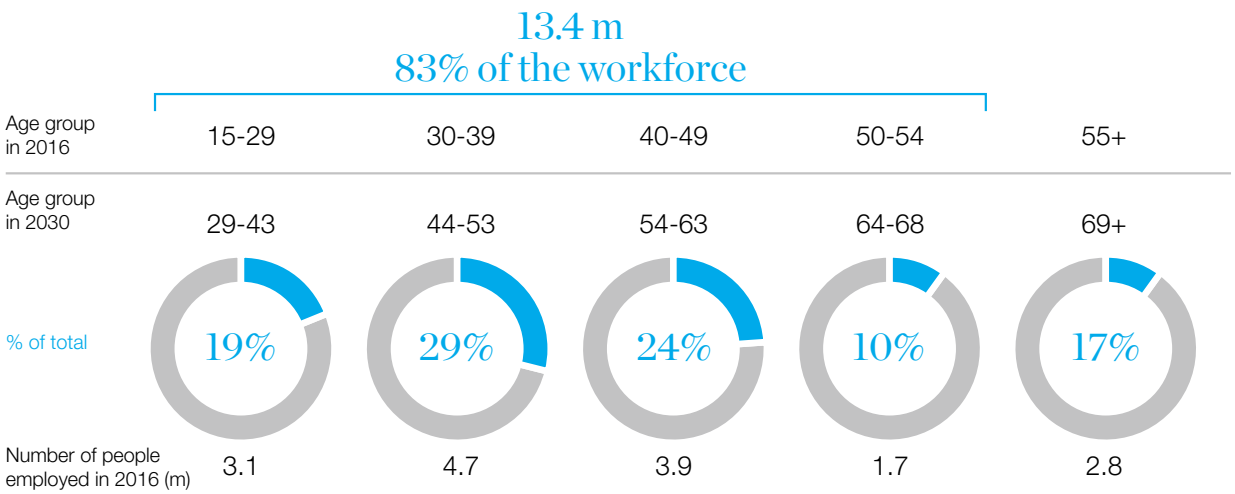
The following stage is for the program to provide financing for training courses to ensure that they are easy for people to access. The state could provide full funding, or money could come from European Union funds or the private sector. One idea currently under debate is the creation of a new Universal Right to Learn (URL) system by the European Union, under which citizens would be given tokens that they could then use for skills training.[67] Another form of support would be to extend the possibility of paid leave for training purposes.

II. PROMOTE LIFELONG LEARNING AND MID-CAREER TRAINING

For the transformation of the labor market to be successful, it will be critical to convince Polish workers that lifelong learning forms an essential part of life and work in the twenty-first century. At the same time, it will be necessary to provide mid-career training opportunities. This will require a change in mentality. Poles must come to realize that what they learn in college will not be enough to keep

Rapid technological advance and the great automation potential of multiple sectors of the Polish economy mean that many employees may be forced to retrain at some point in their careers.

Exhibit 8.
83% of today's workforce will still be in the labor market in 2030 – some of those workers will have to change occupation.



SOURCE: Eurostat; McKinsey analysis

them going for the subsequent 30 or 40 years in the labor market.[68]

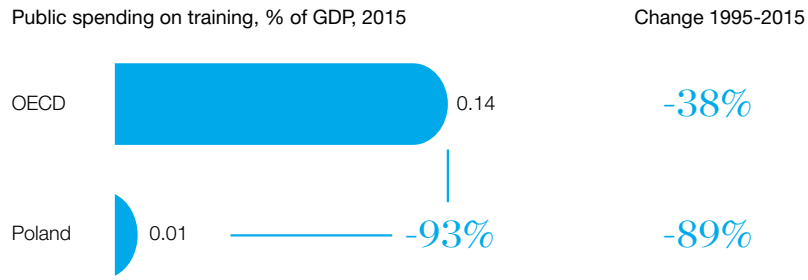
Changes will also be needed in the model of education. Adults in Poland are currently much less likely to engage in lifelong learning than elsewhere in the European Union (Exhibit 10).

In the future, it may also be necessary to completely retrain employees for new occupations – often occupations that require greater skills. Our analysis of the potential of automation indicates that people with secondary education or less are more likely to see their jobs automated.

The current model of education in Poland is based on qualifications that take many years to acquire: a first degree, maybe a master's, and often a graduate internship after that. Tomorrow's labor market may necessitate the introduction of much shorter periods of study, potentially combined with work, in the form of training courses or short online "nanodegrees." These forms of study allow people to acquire the specific skills they need to start working in a new area after a year or so. Instead of IT degrees, for instance, it could be possible for people to take intensive courses in one or two selected programming languages.

One of the characteristic features of tomorrow's labor market will be the need for people to change occupation mid-career. But it could be very difficult for people who are forced to change direction to stop working altogether and study for new qualifications. More likely, they will have to leverage their existing skills in their new occupation or acquire new skills in their own time – either by studying online or, ideally, with the help of the national reskilling program. It is safe to assume that in tomorrow's labor market, specific skills will count for much more than diplomas and certificates. In many countries, past approaches have led to an inflation of qualifications, resulting in higher education being required for positions where it is not strictly necessary.[71]

Exhibit 9.
Public spending on training in Poland is below the OECD average – and falling.



SOURCE: OECD, McKinsey analysis

Box 3.

SkillsFuture – Singapore's industry transformation program

To respond to changes in the labor market, the government of Singapore has developed an initiative known as SkillsFuture to promote mastery and recognition of skills and to foster a culture of lifelong learning. The aim of this program is to improve citizens' skills and support innovation in focus industries, such as manufacturing, infrastructure, trade and connectivity, and services.[69] To encourage individuals to take ownership of their development, all citizens over 25 years of age will receive an opening credit of approximately 350 USD from the government, to be spent on courses they can sign up with recommended partners.

One of the program areas is focused on citizens aged 40 and above, who can receive extra subsidies to help them upgrade their skills to remain competitive in the job market or to move into new occupations or sectors. Since its launch in 2015, more than 285,000 Singapore citizens have benefited from SkillsFuture to gain new skills.[70]

As part of this initiative, the government has also developed Skill Frameworks which cover the most important information about each key industry and employment, career paths, and a list of required skills and growth areas required for the job roles in that industry. Individuals, employers and training providers can use the framework as a guide to chart their pathways and develop programs.

III. GIVE ALL EMPLOYEES A SET OF KEY SKILLS

In Chapter IV we identified two broad groups of skills that will enable current and future workers to successfully participate in tomorrow's job market. The first group is skills that enable people to work effectively with technology. The second group is soft skills, including social, emotional, and behavioral skills, as well as entrepreneurship. These are transferable skills – they are useful whatever the occupation or industry. A knowledge of English may also become a prerequisite for getting a job in Poland.

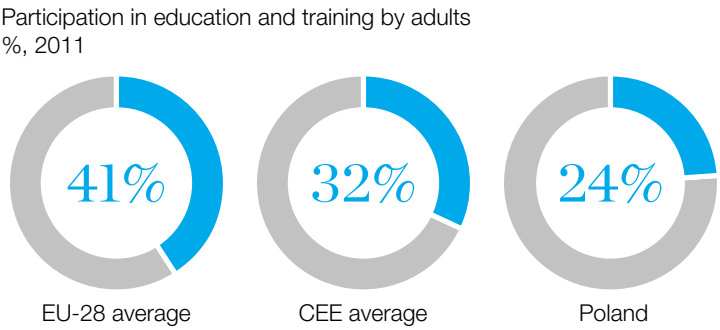
In occupations where automation is set to boost productivity and earnings, an understanding of technology may become a basic skill, essential

for success. For this reason, learning to program should become a key part of education. In fact, learning to program does more than give people the skill to work with technology: It teaches other vital skills for tomorrow's labor market, such as critical thinking, problem-solving, and communicating thoughts and ideas. As we saw in Chapter IV, according to the PIAAC study, Poland lags behind other OECD countries here. Another benefit of learning to program in school, albeit less critical, is that it enlarges the pool of potential programmers in the country – an important resource as new technologies are created and implemented.

A second key element for the labor market is soft skills. Experts believe that these skills can be learned, and that having a high level of them improves both academic performance and success on the job market.[72] Indeed, learning these skills has an impact even in childhood.[73] The entire system of education, from elementary school to higher education, should therefore put greater emphasis on soft skills and take a methodical approach to teaching them.

A third important factor is English language skills. English will be essential in the future for two reasons: first, because of the increasingly frequent exchange of ideas at a global level; and second, because of the fact that the global knowledge base is largely in English and the necessity of acquiring new skills, particularly when it comes to lifelong learning. This will be a challenge for Poles, as just 68% claim knowledge of at least one foreign language, or just 44-51% in the case of people with simple or physical jobs. Moreover, just 40% of Poles who claim a knowledge of foreign languages say they can speak them fluently or at an advanced level. This is well below the EU average of 70%, to say nothing of the 80-90% found in Scandinavia and the Benelux countries[74].

Exhibit 10.
Adult learning in Poland is significantly below both the European Union and Central and Eastern European average.



1 Participation by people aged 25-64 in formal and/or non-formal education and training in the 12 months prior to the survey.
SOURCE: OECD 2011, Adult Education Survey (AES); McKinsey analysis

The figures above imply that just 27% of Poles[75] can effectively use the English-language knowledge base available on the internet.[76] A good knowledge of English will therefore be crucial for employees, particularly those with lower educational achievements and working in occupations with a higher level of automation.

IV. USE TECHNOLOGY IN EDUCATION AND MEASURE THE EFFECTIVENESS OF TRAINING

Technology itself can also play an important part in the education and training system, both for people entering the labor market for the first time and for those needing to reskill mid-career. Increasingly popular since 2013 are "massive open online courses", or MOOCs – courses or subjects from particular fields of study available via internet platforms, which include videos, notes, and interactive quizzes and tests.[77] Many platforms providing MOOCs also offer nanodegrees.[78]

MOOCs offer access to top researchers and teachers, are affordable, and have no time restrictions. This potentially makes them a key technology for supporting the transformation of the labor market. However, few such courses exist in Polish. We analyzed the two biggest platforms offering MOOCs. Of the more than 9,400 courses from over 800 universities, only about 30 had the option of Polish subtitles, and there were no courses created from scratch in Polish. This represents a challenge for the Polish workforce, whose lack of foreign languages means that significant numbers of them cannot effectively follow courses in English. Research also indicates that people assimilate knowledge more effectively in their native language.[79]

One potential solution could be to create courses in Polish or to offer support for creating them on currently popular international platforms. Polish universities can get involved in developing such courses on their own platforms or other, foreign platforms.

When it comes to systems for developing skills, the key thing is how effective they are. That may seem obvious, but in fact most of these systems are ineffective: The World Bank estimates that just 30% of

Understanding technology, soft skills, and knowledge of English are essential for success in tomorrow's labor market.

programs designed to teach young people new skills and help them find jobs actually work.[80] Having an accurate system for monitoring the effectiveness of your program is an important success factor. A monitoring system makes it possible to create a program that works effectively despite dynamic changes on the labor market. For a detailed cost-benefit analysis, a holistic approach is required – one that also takes into account how participants do after the end of the program.

The best way to measure the effectiveness of skills-improvement programs is to look at the equivalent of "total cost of ownership" (TCO) – the combined costs of acquisition and use. This indicator has proven valuable in business thanks to its focus not just on current costs but on long-term results. The equivalent of TCO for skills-improvement programs is "cost per employed day" (CPED), a figure that combines the cost per student, the employment rate, and the retention rate in the new job.[81]

V. ACTIVELY SHAPE THE PROCESSES OF AUTOMATION AND ROBOTIZATION

Participating in the creation of new technologies and providing support for them could be an important factor in Poland's success in the labor market of the future. The country could potentially become a leader in the production of automation technology. That would require highly-qualified graduates in science subjects – an area where Poland has room for improvement. At present, just 22% of university students graduate in STEM subjects (science, technology, engineering, mathematics), compared to 27% on average in the European Union and 37% in Germany.[82] The same goes for PhD students: In Poland only 32% specialize in STEM subjects, compared to 44% in the European Union and 52% in Germany.[83]

An additional challenge is current low spending on research and development (R&D). In Poland, this represented just 1% of GDP in 2016, compared to 2% on average in the European Union and 3.3% in Sweden, the country topping the rankings.[84] Another area for improvement is the number of people working in R&D. This is just 0.7% of the workforce in Poland, compared to an average of 1.2% in the European Union and 2.1% in leading countries such as Denmark (Exhibit 11).[85] The reason for this may lie with the small proportion of graduates and PhD students in STEM subjects, as mentioned above.

Potential solutions would be to increase state support for R&D and the number of graduates in STEM subjects, as well as the number of employees working in R&D, especially at the university level. This step would allow Poland to participate more actively in the creation and use of new technologies.

Policymakers may also consider actively attracting foreign R&D investment to Poland, especially in areas related to automation technology. Big technology companies are beginning to set up centers in countries where traditionally they did not have large R&D networks.[86] Polish IT specialists and mathematicians, who are highly regarded on the global market, are certainly an advantage here.[87]

Another option that policymakers can use to encourage businesses to be more active in the area of R&D is to create "regulatory sandboxes," or areas where regulation on innovation is less restrictive. The creation of these areas encourages companies to experiment and come up with further innovations.

VI. SUPPORT EMPLOYEES DURING TRANSITION

According to analysis by McKinsey, automation may lead to an increase in unemployment unless people whose jobs have been automated get back into the labor market quickly (see Chapter III). Both public and private sectors have an important role to play here. In Sweden, for example, "job-security councils" financed and run by the private sector provide displaced workers with a comprehensive suite of income support, training, and coaching.[88]

It would be useful for the relevant public bodies to examine the current support system for employees during the transition period, particularly from the perspective of how efficient the system is in helping affected workers find new jobs, access training, and make use of career counseling. The next step might be for them to consider alternative financing models for support programs, and the criteria that people must meet in order to qualify for them.

OPTIONS FOR THE PRIVATE SECTOR

Capturing the full opportunities offered by automation, including both the labor substitution and other performance benefits, is likely to give companies a competitive advantage. But doing so will likely require them to conduct a thorough review of corporate activities and potential overhaul of business processes and workflows.

Automation also brings a whole set of new challenges for companies. If they choose not to implement automation technology, they risk losing their competitive advantage as a result of having higher costs and lower productivity. At the same time, tomorrow's jobs call for new skills. If companies fail to educate their workforce and attract fresh talent, they risk squandering the opportunities offered by automation. Companies in Poland may therefore wish to consider the following actions.

I. BE OPEN TO NEW TECHNOLOGY AND BUSINESS PROCESSES

To benefit from the upcoming technology revolution, companies in Poland must be open to new technology. A good start would be to diagnose where automation could most profitably be applied to improve performance, and then prioritize a set of active pilot projects to start climbing the learning curves and training specialists early on. These internal specialists will later be responsible for implementing the new technology in the company.

Of course, applying new technology to old business processes may not bring the desired results. Management should be aware that realizing the potential of automation will often only be possible once the old processes have been replaced. A valuable lesson can be learned from the industrial production sector in the United States at the time of the Second Industrial Revolution and the introduction of electricity.

The first commercial power plant started operating in New York in 1882. However, it took until the 1920s for labor productivity in the United States to grow significantly, when engineers and managers made fundamental changes to the operating processes in factories. Up until that point, despite using electricity, factories still employed a system, with central power transmission and line shafts, that dated from the days of the steam engine.[89]

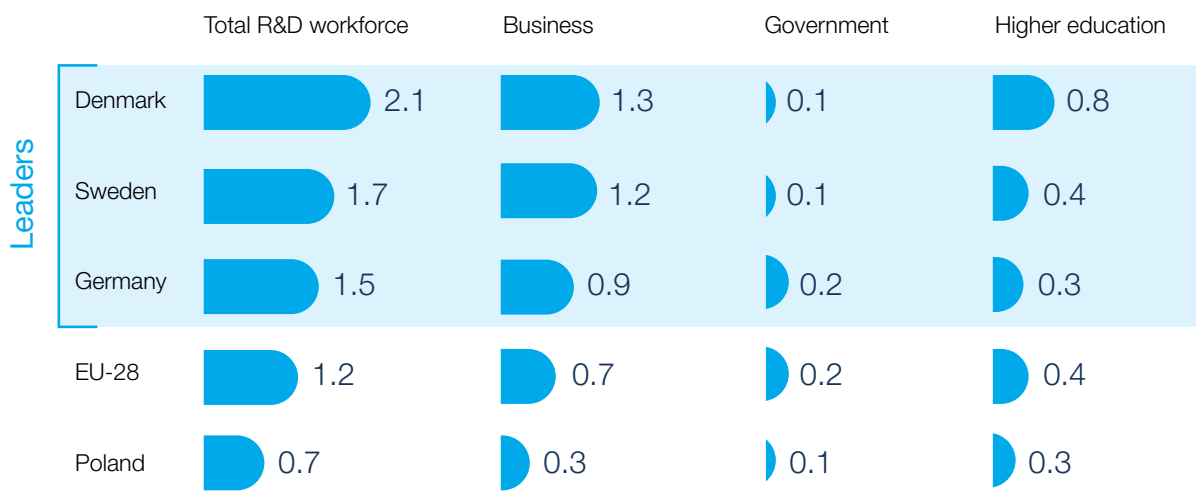
It was not until assembly lines powered externally by electricity were introduced that mass production could begin. The average annual increase in labor productivity in the US industrial sector grew from just over 1% in 1900–1920 to 5.6% in the 1920s. It took an entire generation to change the established business processes and take advantage of the opportunities offered by technological innovation – a telling example of the necessity of profound change in order for innovation to bring value.[90]

Automation is a global trend – it will affect businesses and employees around the world. Polish companies have a chance to benefit not only by exploiting the opportunities that automation brings in terms of increased productivity, but by themselves becoming active providers of the technologies in question.

The range of new technologies is as wide as the scale of investment required. For example, autonomous vehicles and industrial robotics require huge investment and expertise, and will certainly be challenging for novice players. But Polish companies can become suppliers of specific technologies. In the McKinsey report *The AI revolution: How artificial intelligence will change business in Poland*, we show that Poland has the potential to

Exhibit 11.
The share of the workforce working in R&D in Poland is below the EU average.

Full-time equivalents working in R&D as a percentage of the labor force, 2015



SOURCE: Eurostat; McKinsey analysis

become a regional center for the development of AI.[91] It may also be able to flourish in the area of software based on AI and other technology, such as virtual assistants and chatbots.

Service robots may represent another opportunity for Poland. Already 75% of service robots are sold by small and medium-sized enterprises, almost half of them startups. Roughly two-thirds of service robots use open-source robotics software platforms.[92] This is a space where entry barriers are relatively low and Polish companies could compete.

Polish companies can make use of emerging European Union funding for robotics[93] and benefit from the exchange of experiences. International cooperation in the field of robotics is also an opportunity for Polish enterprises, although at present only seven of the members of euRobotics AISBL – the European association of stakeholders in robotics – are Polish institutions, including four educational institutions.[94]

The multitude and diversity of automation technologies and their varying investment requirements mean that, with sufficient determination and the right experts working for them, Polish companies can compete effectively in the creation of solutions for automation.

II. ACKNOWLEDGE THE IMPORTANCE OF HUMAN CAPITAL AS THE BASIS FOR CREATING VALUE AND COMPETITIVE ADVANTAGE

To remain competitive in the era of automation, companies will need qualified experts to help them implement and utilize technological innovations. This will not be possible without the help of interdisciplinary employees who, thanks to their combination of hard and soft skills, will be able to ensure the organization's success in a rapidly changing business environment.[95]

In the book Talent Wins, coauthored by Dominic Barton, global managing partner of McKinsey & Company,[96] it is argued that businesses should elevate human resources to the same level as finance. In the era of automation and digitization, business strategy is no longer about planning the coming years but about sensing and exploiting new opportunities and adapting to a constantly changing environment. Implementing new ways to manage talent can help companies stay competitive.

Companies can use human capital to create value in the era of automation in a number of ways, which we outline below.

Identify the future competencies required: digital capabilities and soft skills will be critical

In a survey of companies carried out by McKinsey in late 2017, 76% of managers in Europe felt that their workforce had skills gaps related to automation and digitization. Addressing this gap was considered at least a "top-ten priority" for management.[97]

The first step for ensuring competitiveness in the era of automation is to identify the types of skills needed and the future employment structure. Companies should carefully analyze which types of tasks will be performed by employees, and how often, and which tasks will be replaced by technology.

Provide transparency to the workforce on the future skills and competency requirements

The next step for companies wishing to exploit the full potential of automation is to provide transparency to the workforce on the skills that they will require in the future. It will be crucial for firms to draw up information about which positions will require which skills, and establish a talent management system within the company.[98] Using tools and digital HR platforms can also be very helpful when analyzing employee profiles, recruiting new staff, onboarding them, and planning their professional development.[99] An open dialogue with employees about which skills and competencies will be most in demand within the company will help them understand what direction the company is headed in and to what extent they must learn new skills.

A good example of the sort of comprehensive approach needed is the program put in place by one international telecommunications company. The managers of the company were tasked with identifying gaps in their teams' skills and defining what the profile of their team would be like in five years' time. All employees then received copies of these profiles. Staff in areas that were not critical for the future of the company were given the option of reskilling or retiring when the new technology came in.

The company in question also helped staff plan their own development by setting up a digital platform on which they could update their skills, experience, and references. Employees could then compare their personal profile on the platform with the requirements for new jobs, and identify any missing skills.[100] In addition, the company created a special data-analytics dashboard focused on four key measures for employees attending training courses: engagement, awareness, participation, and competency. To date, the company has trained more than 1,000 employees, and engagement is up. It is also hiring fewer outsiders, since staffers who have completed the training can fill challenging new roles.[101]

Provide guidance and upskilling opportunities, and take an active role in shaping internal and external training programs

Providing employees with internal or external training programs will help

companies through the transformation caused by automation and changes in the labor market. Firms should decide which model or combination of models will be the most effective in their specific case – be it traditional offline training, online courses (for example, on MOOC platforms), or partnerships with universities and other institutions.

To ensure that they are using funds for training effectively and actually improving skills within the organization, companies would be well advised to measure their return on investment (ROI). Useful indicators here are retention rates, annual performance reviews, employee satisfaction levels, and speed of promotion.

Companies should plan how they are going to acquire the necessary skills – by recruiting new staff or reskilling their existing workforce. Well qualified workers are in great demand and many companies compete for them, so investing in improving skills internally will likely be necessary. Demand for some skills, especially in scientific fields, may quickly outstrip supply – that is, the number of graduates in STEM subjects.

Stress the development of soft skills

As we saw in Chapter IV, automation will enhance the value not only of technical skills but also of soft skills such as creativity and team management. A combination of technical skills and interpersonal skills will be particularly valuable.[102]

When one technology company evaluated the profiles of hundreds of its managers, it found no correlation between their level of education and professional success.[103] Another global technology firm in Silicon Valley analyzed all the data it had collected on hiring, firing, and promotion since the company was founded. It turned out that among the eight most important qualities of the firm's top employees, STEM expertise came bottom of the list. The seven top characteristics for success were all soft skills: being a good coach (supporting the development of others), communicating and listening well, respecting the values and points of view of others, empathy and support for colleagues, critical and conceptual thinking, and problem-solving.[104]

> To remain competitive in the era of automation, companies will need qualified experts to help them implement and utilize technological innovations.

Clearly, companies should invest in developing soft skills, and also increase the weight they give them when recruiting and evaluating employees.■

CONCLUSION

The coming era of automation will bring both challenges and opportunities for Poland, as it will for the rest of the world. Challenges include the transformation of the labor market and the question of how to ensure a smooth transition into new jobs for people whose work is automated. New jobs will not be lacking, but they will require different types of skills: the ability to work not just with technology but with people, too. At the same time, automation will significantly improve the productivity of many workers. Instead of spending time on repetitive activities that bring little value to stakeholders – be they customers, patients, or students – employees will be able to focus on what makes their jobs really valuable. This shift could give new impetus to the Polish economy and create opportunities for companies. For policyholders and the private sector, now is the time to start preparing to face the challenges and exploit the coming opportunities.■

Box 4.

This report draws its findings from the McKinsey Global Institute's research program on the future of work, and is by no means the final word on this topic. The technology continues to evolve, as will our collective understanding of the economic implications. The report builds on our previous research on labor markets, incomes, skills, and the expanding range of models of work, including the gig economy, as well as the potential impacts on the global economy of digitization, automation, robotics, and artificial intelligence.

The methodology used to model automation in Poland is based on the report *A future that works: Automation, employment, and productivity* published by the McKinsey Global Institute (MGI). We received invaluable support from Michael Chui, Partner at the MGI, and MGI Automation Specialist, Gurneet Singh Dandona, who led the research and analytics for automation.

This report and the MGI publication mentioned above contribute to MGI's missions to help business and policy leaders understand the forces transforming the global economy, identify strategic locations, and prepare for the next wave of growth. All analyses by MGI are independent and are not commissioned or sponsored in any way by any business, government, or other institution. We welcome your comments on any reports by MGI at MGI@mckinsey.com.

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