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Transforming our jobs: automation in Hungary

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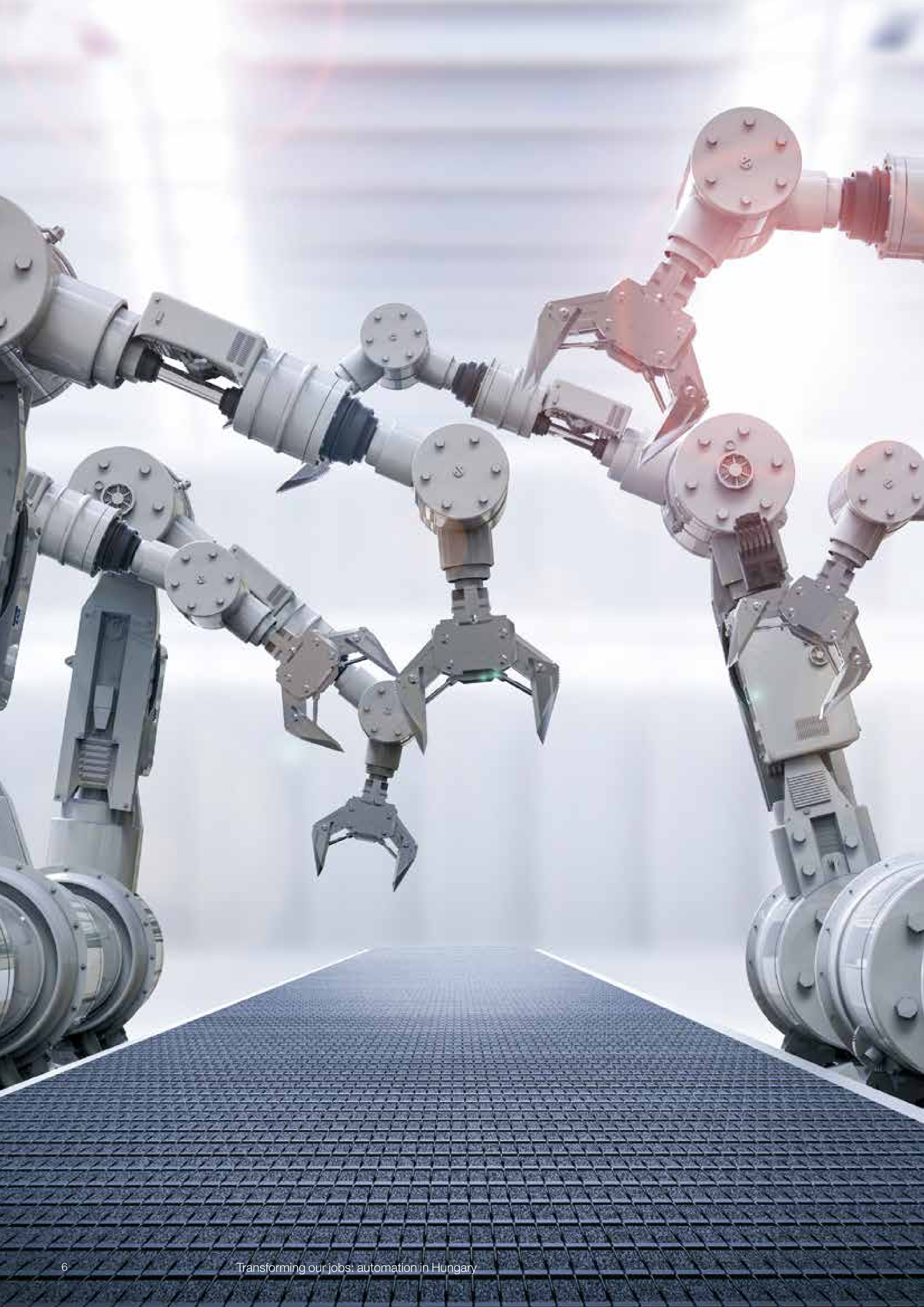
Table of Contents



Executive summary

Automation is radically transforming global economies and labor markets, with nearly 49 percent of current work activities technically automatable

New technologies that automate tasks traditionally performed by humans have been transforming jobs and improving people's lives since the industrial revolution. Recent advances in automation technologies are delivering another epic change to global labor markets, since automation can now be applied to complex cognitive tasks at vast scale and increasingly lower costs. While automated technologies are already reshaping global labor forces, McKinsey Global Institute (MGI) estimates that automation is more likely to transform human work than to replace it. Fewer than 3 percent of occupations could be fully automated with current automation technologies, although at least a third of the tasks involved in 60 percent of occupations could be automated.

> "Automation arrives at an opportune time for Hungary to achieve long-term productivity improvements that are indispensable to its economic competitiveness and ability to sustain growth."

Automation can drive Hungarian GDP growth by simultaneously raising productivity levels and addressing the labor shortage

Automation arrives at an opportune time for Hungary to achieve long-term productivity improvements that are indispensable to its economic competitiveness and ability to sustain growth. The immediate benefit of automation will be to reduce the growing labor shortage that is creating a bottleneck to economic growth.

While the 1989 transition caused GDP to drop and more than a million workers to lose their jobs, the economy rebounded with capital investments and productivity improvements of as much as 2.3 percent per year that fueled economic growth from 1995 to 2009. Since 2010, employment became the main driver of economic growth. The number of employed people grew from 3.73 million to 4.35 million over the past seven years thanks to increasing participation and employment rates. Employment growth is now reaching a limit, and productivity rates in some industries have declined. Automation has the potential to shift employment to higher productivity jobs and address productivity challenges if the appropriate actions are taken.

The pace of automation adoption will allow businesses, labor market and policy makers to adapt to the change and avoid major disruption

Despite its potential, automation poses social and economic challenges, not least of which is widespread social skepticism. According to a 2017 Eurobarometer poll, 38 percent of Hungarian citizens view automation negatively.[1] Their sentiments rank among the most negative of all the European Union (EU), likely due to memories of the transition to a market economy in the 1990s. Our analysis suggests that automation will not be as disruptive as many fear, for two reasons. First, automation will not happen immediately, since the pace of adoption depends on factors such as technical feasibility, societal and infrastructural readiness and the business case for automation. Companies will take time to first fill open positions using both human labor and automated machines, thus giving businesses, labor market and policy makers room to prepare for the disruption. Second, automation, and economic dynamism in general, will create new types of occupations and increase the added value of jobs, generating higher incomes and ensuring demand that results in additional jobs.

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[1] Special Eurobarometer 460: Attitudes towards the impact of digitization and automation on daily life, European Commission, 2017 – Based on QD10: Generally speaking, do you have a very positive, fairly positive, fairly negative or very negative view of robots and artificial intelligence?

1 million

We estimate that one million jobs in Hungary are likely to be transformed over the next 12 years.

The potential for Hungary is relatively high compared to most EU countries: assuming a moderate pace of adoption, one million jobs can be transformed by 2030

Our main finding is that automation could boost economic growth in Hungary by raising productivity growth rates by between 0.8 percent and 1.4 percent per year through the coming decades, depending on the pace of adoption. We estimate that 49 percent of Hungarian work hours could be automated with currently available technologies, which is in line with the estimated global average.

As in other countries, the potential for automated activities is highest in middle-income jobs that involve a higher share of predictable and repetitive tasks. Many activities in occupations requiring little formal education may also be automated depending on the technologies available and cost incentives.

Automation is also likely to trigger a significant increase in demand for high-quality services including in education, financial institutions, health care, and in hotel and food services. Quality delivery requires highly trained professionals and managers, as well as occupations with strong creativity, complex problem solving, and social and interpersonal skills. It will also create new occupations, especially ones pertaining to the application, development, and maintenance of automated technologies.

Although automation should result in pervasive real income growth, it could accelerate the wage gap between lower-middle income and higher income earners. Furthermore, since automation is capital intensive, capital may assume a greater role in value creation than labor. Policymakers must work with businesses and educational institutions to navigate these risks.

Hungary can become a center of automation if the necessary steps are taken

Automation is crucial for Hungary to increase its economic competitiveness in the region and globally by improving productivity. Proactively adopting an automation agenda could assist Hungary in attracting foreign investments that would generate a shift in labor force toward higher value-added jobs. Any automation agenda must also address an existing mismatch between labor skills currently offered and those in demand, as well as disincentives for businesses to automate due to Hungary's relatively low labor costs. To harness the most benefits of automation while meeting these challenges, businesses and policy makers need to act in the following areas:

- **Education and reskilling**

The availability of a technologically proficient labor force will be a determining factor for international companies in their investment decisions. As a first step in an automation agenda, policy makers should invest in education relevant to technology and skills trainings that are critical to corporate competitiveness, public sector performance, and the formation of an adaptable labor force.

Two types of skills are essential to start implementing and reaping the benefits of automation: the ability to utilize and adapt technology effectively, and the ability to work in teams. Children from the earliest ages should be familiar with technology and learn programming and computer science. At the same time, children must learn creativity, critical thinking, decision-making skills, empathy, problem-solving capabilities, and teamwork to manage technology effectively and perform tasks requiring interpersonal skills that robots are unlikely to ever perform.

Beyond primary and secondary education, corporations can play a pivotal role by partnering with tertiary universities and adult training institutions to design curricula and provide classroom and on-the-job training. Policy makers can collaborate with corporations and labor agencies to implement retraining programs that help current and imminent workforce participants transition to a more automated workplace. Labor agencies can help by monitoring training providers and measuring and communicating their trainees' success rates in finding employment.

- Innovation for Automation

In the private sector, policy makers could offer financial incentives such as innovation vouchers for research centers and small and medium-sized enterprises (SMEs) to pursue technology-based innovations. The creation of innovation hubs involving dense networks of local and multinational technology-oriented corporations and research institutions will also cultivate large-scale innovation. Policy makers can provide security and transparency to investors by tailoring regulations to address the unique characteristics of automated technologies, such as by devising new rules governing self-driving vehicles or drones.

To facilitate technological innovation, the government must lead by example by proactively digitizing and automating public services. Hungary's digitization of personal income taxation is a great step in this direction. To advance this effort further, data collection should be improved and made publicly available where possible, such as in "smart cities" that use elaborate data collection tools to provide insights on resource utilization, and in health care, where collected data is used to analyze health trends and design medications.[2] Data collection and providing broader access to it not only improves the performance of public sector services, but can catalyze innovation from the ground up by providing citizens and businesses with the means and skills to use data in new ways.

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[2] "Open data: Unlocking innovation and performance with liquid information," McKinsey Global Institute, October 2013, https://www.mckinsey.com/business-functions/digital-mckinsey/our-insights/open-data-unlocking-innovation-and-performance-with-liquid-information.

> "We believe that by harnessing the benefits of automation, Hungary can unleash higher productivity and set its economy on a new growth track."

The Hungarian opportunity in the global era of automation

We believe that by harnessing the benefits of automation, Hungary can unleash higher productivity and set its economy on a new growth track. This report demonstrates the potential of automation in Hungary and offers recommendations on how businesses, the labor market, and policy makers can use automation to drive the country's economy. The report is structured as follows: Section 1 offers an overview of global automation trends and their anticipated effects. Section 2 traces Hungary's recent economic growth trajectory by assessing trends in productivity and employment, and examines the potential impact that automation could have in these areas. In section 3, we employ McKinsey Global Institute's methodology to analyze the potential of automation in Hungary's labor market. We also discuss the factors that will determine the pace of automation. In section 4, we offer a list of broad recommendations on how businesses, the labor market, and policy makers can make automation work for Hungary.

Acknowledgments

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This report draws its findings from the MGI's research program on the impact of technologies, including automation, artificial intelligence, digitization, and robotics on the Hungarian and global labor markets and economies. The methodology used to model automation in Hungary is based on MGI's 2017 report, *"A Future that Works: Automation, Employment, and Productivity."* We received invaluable support from Michael Chui, a Partner at MGI. Gurneet Singh Dandona, an automation specialist with MGI, led the research and analytics for automation.

As with all McKinsey research, this work is independent and has not been commissioned or sponsored in any way by any business, government or other institution. While we are grateful for all the input we have received, the report and views expressed here are ours alone.

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Finally, we would like to thank executives from many businesses across Hungary and policy makers for sharing their perspective and for providing invaluable insights.


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The era of automation: The future is now

Since spinning mills began transforming cotton to apparel and steam engines lifted coal from pits, automation has been delivering economic value by raising living standards, improving working conditions and — in contrast to common belief — generating higher levels of employment and allowing people to pursue more creative, productive and rewarding work.

> "Recent advances in automation technologies have the potential to again revolutionize work."

Recent advances in automation technologies have the potential to again revolutionize work by shortening the time required to perform tedious tasks and creating space for more creative occupations. Modern automated machines can perform big data analysis, digitize paper work, and take on cognitive and non-routine tasks at a sizeable scale and increasingly lower costs. Robots, even those that can respond to emotions, are becoming a reality — although most experts believe that artificial intelligence (AI) will only be able to simulate learning and other aspects of human intelligence 30-50 or more years from now, if ever.[3]

Consider some common examples: In Japan, the sushi restaurant chain, Kura, employs robotic chefs and conveyor belts in place of staff in more than 250 restaurants.[4] The United States conglomerate Amazon uses robots and choreographed machines in key logistics centers and in brick-and-mortar stores.[5]

Since the fundamentals of robotics and artificial intelligence (AI) are applicable across many occupations, they will gradually transform the work of accountants, fashion designers, financial analysts, and taxi drivers. Even a fifth of the work performed by chief executive officers (CEOs), such as analyzing data and reviewing reports, can be automated.

Benefits of automation

Exhibit 1 illustrates the scope of four types of automation technology and techniques: AI, neural networks, robotics, and automation product categories. The list is not exhaustive. Automated machines drive vehicles, make tacit judgments, and sense emotions. In some activities, such as data gathering and sourcing, machines greatly outperform humans. Beyond the obvious productivity gains these machines provide, other benefits include:

- **Consistent Quality:** Automation can significantly decrease the number of errors made in quality or consistency checks. Since machines follow predefined rules and logic, they are less likely than humans to make errors when performing routine tasks. In hospitals, for example, robots dispense medicine more precisely than humans.[6] Machines also outperform humans in certain administrative tasks, such as closing or maintaining client accounts in banking, since they do not make human errors such as typos or clicking the wrong button on a computer.

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[3] Vincent C. Müller and Nick Bostrom, "Future progress in artificial intelligence: A survey of expert opinion," in Fundamental issues of artificial intelligence, Vincent C. Müller, ed., Springer, 2016.

[4] Japanese Sushi Restaurants Employ Robotics and Automation to Streamline Service, October 18, 2013 https://hospitalitytech.com/japanese-sushi-restaurants-employ-robotics-and-automation-streamline-service

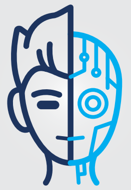
[5] Nick Wingfield, "As Amazon Pushes Forward With Robots, Workers Find New Roles," New York Times, September 10, 2017. https://www.nytimes.com/2017/09/10/technology/amazon-robots-workers.html

[6] "A Future that Works: Automation, Employment, and Productivity," McKinsey Global Institute, January 2017, https://www.mckinsey.com/global-themes/digital-disruption/harnessing-automation-for-a-future-that-works.

Exhibit 1: Artificial Intelligence technologies and techniques

In the coming years, new advanced technologies ranging from AI to robotics will be introduced and reshape the labor market and work activities in current jobs

AI: Field of computer science specializing in developing systems that exhibit “intelligence”.



Machine learning
Develops systems that “learn” i.e., practitioners “train” these systems rather than programming them

Supervised learning
Machine learning techniques that train a system to respond appropriately to stimuli by providing a set of sample input and desired output pairs (e.g. email spam detection)

Transfer learning
Machine learning developing systems that store knowledge gained while solving one problem and applying it to a different but related problem, e.g., recognizing tumors in radiology scans

Reinforcement learning
Machine learning developing systems that are trained by receiving virtual “rewards” or “punishment” for behaviors rather than supervised learning on correct input-output pairs, e.g., DeepMind’s AlphaGo system that defeated the world champion in the game of Go

Neural networks: Pattern recognition algorithms to cluster and classify data and to predict values based on experience

Artificial neural network
Systems based on simulating connected “neural units”, loosely modeling on the way that neurons interact in the brain

Deep learning
Use of neural networks that are many layers “deep” or a large number (millions) of artificial neurons

Convolutional neural network
Artificial neural networks in which connections between neural layers are inspired by organization of animal visual colas, the portion of the brain that processes images; well suited for perceptual tasks

Recurrent neural network
Artificial neural networks whose connection between neurons include loops; well-suited for processing sequences of inputs

Robotics

Soft robotics
Non-rigid robots constructed with soft and deformable materials that can manipulate items of varying size, shape, and weight with a single device

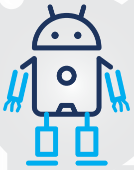
Swarm robotics
Coordinated multirobot systems, often involving large numbers of mostly physical robots

Tactile/touch robotics
Robotic body pails (often biologically inspired hands) with capabilities to exhibit dexterity, perform variety of tasks, sense, and touch

Serpentine robots
Robots with many internal degrees of freedom to thread through tightly packed spaces

humanoid robots
Robots physically similar to human beings with AI capabilities that are able to perform human tasks (e.g. object recognition, speech, emotion sensing)

Automation product categories



Autonomous cars and trucks
Wheeled vehicles capable of operating without a human driver

Unmanned aerial vehicles
Flying vehicles capable of operating without a human pilot; also known as drones

chatbots
AI systems designed to simulate conversation with human users, particularly those integrated into messaging apps

Robotic process automation
Class of software “robots” that replicates the actions of a human being interacting with the user interfaces of other software systems; enables the automation of many workflows without requiring expensive IT integration

Note: This exhibit is not comprehensive but illustrates some technologies and techniques enabling automation of work activities

SOURCE: McKinsey Global Institute analysis

> “Automated machines drive vehicles, make tacit judgments, and sense emotions.”

- **Quicker Research and Development (R&D) and Innovation Cycles:** Automation is especially efficient at developing and enhancing digital products and services. Online retail websites use automated monitoring to detect bugs and conduct software program updates without disrupting customer experience. This kind of automated activity allows a new code to be deployed in hours.[7]

- **Improvements to Occupational Safety:** In aircraft maintenance, robots can replace humans at dangerous worksites, such as fuel tanks.[8] Drones help firefighters track the spread and severity of forest fires.[9] Drones can even replace lifeguards in rescue missions by delivering lifeboats.

- **Problem-Solving Potential:** Chinese doctors and physicians use AI to help read computed tomography (CT) and other types of scans, as AI can recognize the signs of lung cancer earlier than doctors.[10]

- **Customer experience:** Companies also automate for better customer experience. For instance, banks reinvent and digitize some parts or the entire customer journey to serve their clients better and faster (see Box 2, “Digitizing the customer experience in banking”, on page 26).

Global potential and effects of automation

In its 2017 report, *“A Future That Works: Automation, Employment, and Productivity,”* McKinsey’s Global Institute (MGI) argues that current advances in automation have the potential to catalyze a new era of global economic growth by raising productivity and helping to offset the effects of aging populations in developed countries. Depending on the rate of adoption, automation could raise global productivity by 0.8 to 1.4 percent annually.

To estimate automation potential, MGI broke down all occupations into tasks and activities and estimated what ratio of those activities per different occupations could be automated. Based on this breakdown and the distribution of occupations in various sectors, MGI determined a sector’s automation potential. For example, assembly workers who comprise a large portion of manufacturing employment execute mostly predictable physical tasks that are highly automatable. Therefore, the automation potential of manufacturing is relatively high compared to the public sector. MGI’s analysis estimates that globally, as much as 49 percent of current work hours could be technically automated.

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[7] CompanyOliver Bossert, Chris Ip and Irina Starikova, “Beyond Agile: Reorganizing IT for Faster Software Delivery,” September 2015. https://www.mckinsey.com/business-functions/digital-mckinsey/our-insights/beyond-agile-reorganizing-it-for-faster-software-delivery.

[8] Ibid. A Future that Works: Automation, Employment, and Productivity

[9] Kate Baggaley, “Drones are fighting wildfires in some very surprising ways”, NBC, November 16, 2017. https://www.nbcnews.com/mach/science/drones-are-fighting-wildfires-some-very-surprising-ways-ncna820966

[10] Jennifer Kite Powell, “See How Artificial Intelligence Can Improve Medical Diagnosis and Healthcare,” Forbes, May 16, 2017. https://www.forbes.com/sites/jenniferhicks/2017/05/16/see-how-artificial-intelligence-can-improve-medical-diagnosis-and-healthcare/#1ae5fe646223


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MGI's research also indicates that less than 5 percent of occupations can be fully automated with current technologies.

However, our findings does not mean automated machines will replace 49 percent of jobs. MGI's research also indicates that less than 5 percent of occupations can be fully automated with current technologies, while a third of the activities in 60 percent of the occupations can be automated.[11] Although 75 million to 375 million workers are likely to switch occupational categories, history shows that technology, and the economy in general, will create more jobs to cope with this shift.

The changing demand for certain occupations and skill sets in response to automation has the potential to send shockwaves to labor markets. However, the effects will be both positive and negative. In the short term, many workers will need to be reskilled in their current occupations or given support to find new ones. Longer term, as automation drives productivity improvements and economic growth, the demand for both work and workers will naturally increase. In a best-case scenario, the adoption of new technologies will create higher value-added jobs, triggering a cascade effect that raises incomes, thereby generating higher consumption that then fuels more jobs in manufacturing and services. Investments that create jobs in infrastructure to accompany technology as well as to develop new technologies will also mitigate short-term negative employment effects.

"Future jobs will require advanced cognitive capabilities and creativity, higher educational attainment, and well-developed social and emotional skills."

The rate of adopting automated technologies depends on factors such as the availability of skills and technology, social attitudes toward automation, and the business case for the investment. Foreign investment in automation and the corresponding high value-added jobs will go wherever the environment is most favorable, which is determined by the availability of technology, regulatory and innovation schemes conducive to automation, and the willingness and preparedness of a skilled labor force. Future jobs will require advanced cognitive capabilities and creativity, higher educational attainment, and well-developed social and emotional skills. In this context, a wide-scale redistribution in labor markets can be expected — especially in the free labor market of the European Union (EU) — since the most educated, flexible and mobile workers will follow higher income jobs.

These trends are already underway in some countries and just on the horizon in others. While challenging, these trends present countries such as Hungary with an enormous opportunity to attract and capture higher value-added jobs that take their economies to new levels.

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[11] "A Future that Works: Automation, Employment, and Productivity," McKinsey Global Institute, January 2017, https://www.mckinsey.com/global-themes/digital-disruption/harnessing-automation-for-a-future-that-works.

Raising Hungary's economy to the next level of growth

In many Hungarian industries, automation is already well underway. Automotive manufacturers, for example, are employing collaborative robots to weld chassis and camera and sensor systems for automatic quality control. Shared service centers are increasingly automating back-office tasks such as account handling and data manipulation. But more companies in more sectors, especially higher value-added ones such as financial services and information and communication technologies (ICT), must embrace automation to raise productivity rates and keep Hungary's economy regionally competitive.

Automated technologies could also help companies in Hungary address challenges emerging in the labor market. For the past six years, an expansion in employment has largely fueled the country's economic growth. More recently, companies across all sectors have begun to have trouble filling jobs, partly due to a mismatch between workers' skills and those in demand. The adoption of automated technologies could help companies bypass some of this labor bottleneck.

> "Automated technologies could also help companies in Hungary address challenges emerging in the labor market."

By using automation to improve productivity and overcome the labor shortage, Hungary could sustain GDP growth necessary for economic convergence with the European Union. But to yield the highest possible gains from automation, authorities and companies have to step up their automation programs. Achieving stakeholder buy-in and creating a favorable business case for automation are particularly important to catalyze the adoption of automation technology. Hungary's relatively low labor costs compared to its European peers could dampen the immediate financial incentive to automate. An unprepared workforce and social resistance could also slow its adoption. Given that the automation revolution looming on the horizon, to seize the opportunity stakeholders need to start realizing the potential it holds, which we demonstrate below.

The bloom of the market economy after 1990

Hungary is no stranger to economic transformation. It has been less than three decades since the transition from a planned to market economy triggered a roughly 20 percent drop in GDP in just three years, causing more than a million people to lose their jobs.[12] Many of these workers never regained employment.

A combination of government policies and foreign direct investment helped to quickly reverse the decline. Rising productivity-driven by technological advances such as the spread of broadband internet and an increased use of machinery in manufacturing and agriculture — as well as a shift toward manufacturing of electronics and automobiles and the services sector, drove real GDP up by a rapid 3.1 percent a year from 1993 to 2008 on average. At the same time, the employed workforce grew to around 3.85 million (Exhibit 2).[13]

Although the global financial crisis wiped out some of these gains (GDP dropped by almost 7 percent and employment by 5 percent from 2008 to 2009), the effect was not long-lasting: Hungary has sustained steady gains of around 2 percent real GDP growth per year since 2010.

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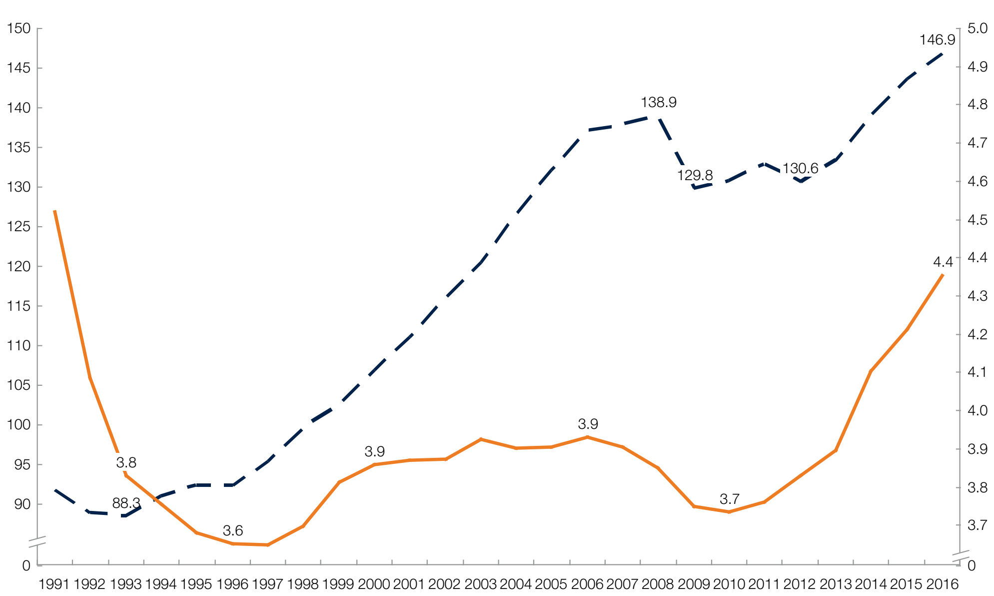
12 Magyarország 1989-2009: A változások tükrében, Központi Statisztikai Hivatal, 2010.

13 Ibid. Magyarország 1989-2009 – A változások tükrében

Exhibit 2: GDP and employment (1990 to 2016)

Hungary experienced a major drop in employment and GDP during the market economy transition, however, economic growth picked up rapidly

GDP and number of total employed people (aged 15-74), 2010, USD billion, million people



1 Estimated data until 1994, 1990 GDP data not available.

SOURCE: OECD; Hungarians working abroad are included in the data if they are part of a Hungarian household

Productivity gains helped fuel much of the growth, especially prior to 2010 as the economy shifted away from the public sector toward more productive service sectors. Since 2010, however, an increase in the number of employed workers has been the main driver of GDP growth. By 2016, Hungary's workforce totaled 4.4 million — a record high since the onset of the market economy in 1990.[14] The rise in employment allowed Hungary to achieve economic growth from 2010 to 2016 while experiencing a slight drop in productivity (Exhibit 3).

Recent growth model driven by employment

Increases in both participation and employment rates explain growth in employment. From January 2010 to September 2017, the participation rate rose from 55 to 62 percent while the employment rate increased from 89 to 96 percent, reducing the number of unemployed people by 280,000. These rates have now reached record highs, leaving limited room for future employment growth following the current trajectory (Exhibit 4).

Government policies have helped to raise both participation and employment rates. For example, reforms to retirement policies that raised the standard retirement age from to 62 years to 63.5 years since 2010, and tighter rules governing retirement due to disability, both added to the number of actively participating workers.

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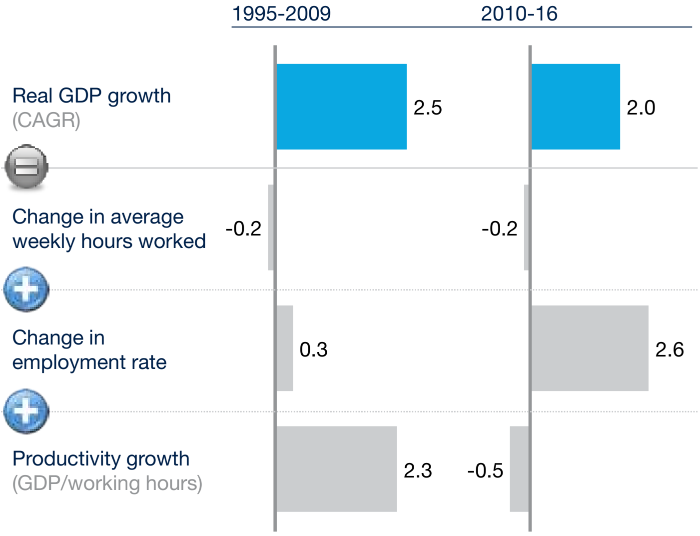
[14] This number is 530,000 fewer employees than in 1990, Ibid. Magyarország 1989-2009 – A változások tükrében

Exhibit 3: Employment and productivity components of GDP growth (1995 to 2009, and 2010–16)

Hungary's GDP growth has been driven by a unique economic model focusing on increasing employment since 2010

Compound annual growth rate, 1995 to 2009 and 2010–16, %, constant 2010 exchange rates



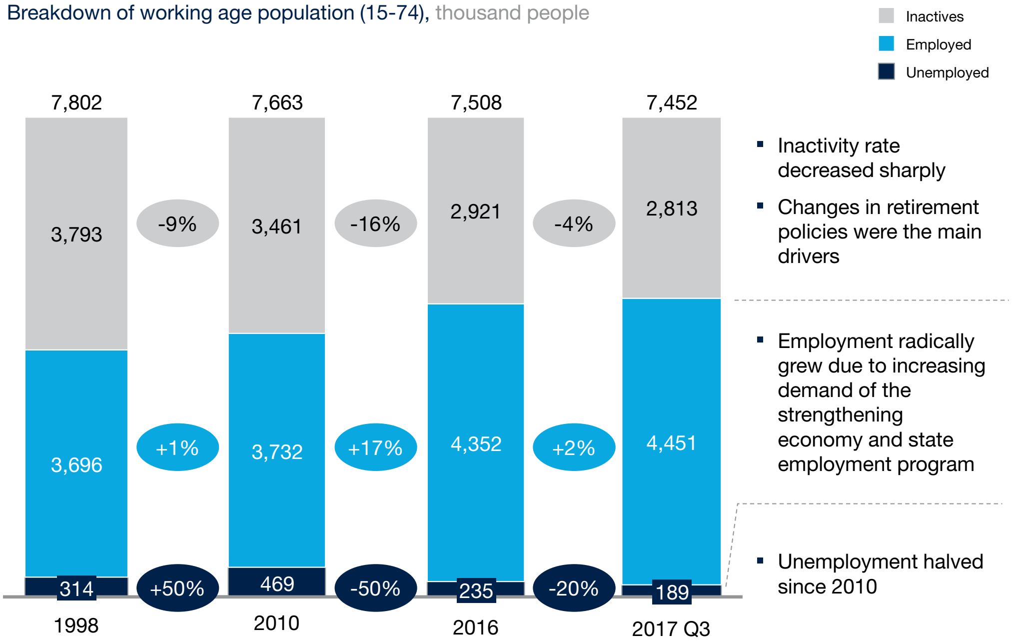
- Driver of GDP growth was productivity since 1995 until 2009
- Employment rate became the main driver after 2010
- Until 2009, Hungary walked a similar path as most EU countries, since then, it has been uniquely focusing on employment

NOTE: Numbers may not add up because of rounding
SOURCE: OECD

Exhibit 4: Change in participation and employment rates (1998 to 2017)

Higher activity and employment rates have fueled employment growth

Breakdown of working age population (15-74), thousand people



- Inactivity rate decreased sharply
- Changes in retirement policies were the main drivers

- Employment radically grew due to increasing demand of the strengthening economy and state employment program

- Unemployment halved since 2010

Note: Numbers may not add up due to rounding
SOURCE: Hungarian Central Statistical Office

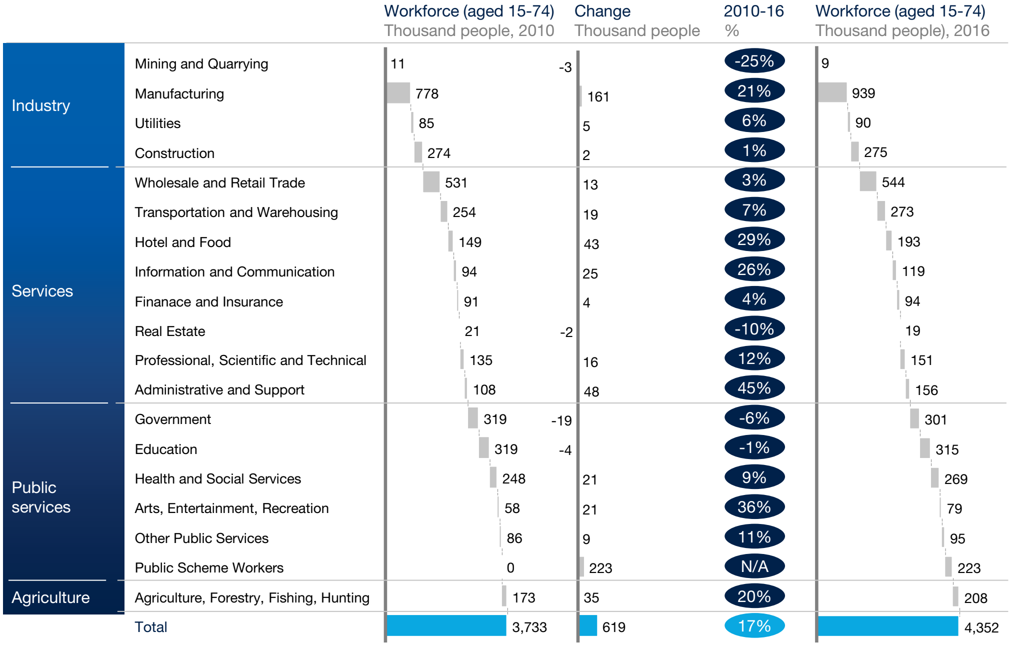
> “In the private sector, increasing foreign and national investment has been the driving factor behind employment growth.”

The introduction of the public work scheme in 2011 has had an even more profound effect, and accounts for roughly a third of new jobs created over the past six years. The public work scheme allows long-term unemployed jobseekers who meet specific criteria to find local, public sector jobs and thereby preserve or acquire marketable skills and earn a wage. While the scheme helps workers stay on the labor market, these jobs often have limited added value and have negatively affected total productivity of the labor market, as we demonstrate below.

In the private sector, increasing investment has been the driving force behind employment growth. The volume of foreign direct investment inflow multiplied by more than six times from 2011 to 2016, most of which targeted manufacturing and financial services, as multinationals moved assembly or back-office activities to Hungary to take advantage of lower labor costs. Until recently, this growth generated sufficient demand to absorb the rising number of participating workers. Manufacturing accounted for 26 percent of new jobs added from 2010 to 2016, while the service sector, particularly the administrative and support and hotel and food subsectors, accounted for 27 percent of new jobs (Exhibit 5).

Exhibit 5: Employment by sectors and new jobs added (2010–16)

Most new jobs were created in low to medium value-added sectors, such as the public work scheme and manufacturing



		Workforce (aged 15-74) Thousand people, 2010	Change Thousand people	2010-16 %	Workforce (aged 15-74) Thousand people), 2016
Industry	Mining and Quarrying	11	-3	-25%	9
	Manufacturing	778	161	21%	939
	Utilities	85	5	6%	90
	Construction	274	2	1%	275
Services	Wholesale and Retail Trade	531	13	3%	544
	Transportation and Warehousing	254	19	7%	273
	Hotel and Food	149	43	29%	193
	Information and Communication	94	25	26%	119
	Finanace and Insurance	91	4	4%	94
	Real Estate	21	-2	-10%	19
	Professional, Scientific and Technical	135	16	12%	151
	Administrative and Support	108	48	45%	156
Public services	Government	319	-19	-6%	301
	Education	319	-4	-1%	315
	Health and Social Services	248	21	9%	269
	Arts, Entertainment, Recreation	58	21	36%	79
	Other Public Services	86	9	11%	95
	Public Scheme Workers	0	223	N/A	223
Agriculture	Agriculture, Forestry, Fishing, Hunting	173	35	20%	208
	Total	3,733	619	17%	4,352

Note: Numbers may not add up due to rounding

SOURCE: Hungarian Central Statistical Office, Hungarian Ministry of Interior, McKinsey analysis

> “Productivity gains since 2010 have been more mixed.”

Productivity as an untapped growth opportunity

Productivity gains since 2010 have been more mixed (Exhibit 6). The manufacturing sector, for instance, experienced growth in both employment and productivity. Employment growth was also pronounced in the subsectors of administrative and support, and hotel and food services, but their overall productivity declined.

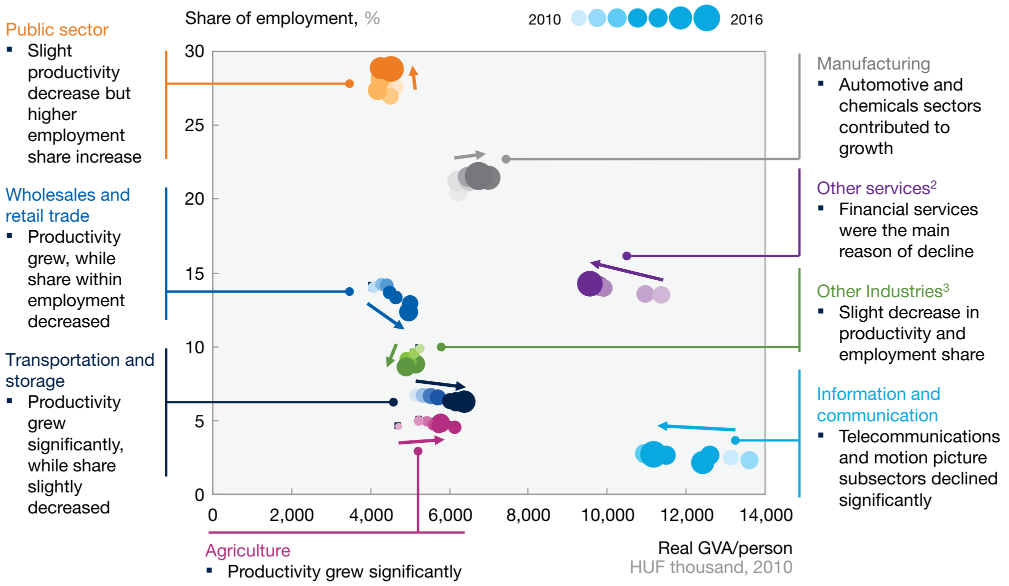
Decreasing productivity has been most significant in the ICT and financial services sectors, largely due to fallout from the 2008 global financial crisis. For example, the financial services sector faced stricter regulations and intensifying competition for customers. In the telecommunications industry, slow consumer growth following the financial crisis forced companies to cut prices to compete, but their employment numbers stagnated, leading to the decrease.

It’s important to note that some companies in these sectors have used automation technologies to recover. For example, a financial services institution based in Central Europe introduced automation to handle increasing request volumes and saw productivity improve as a result (see Box 1, “Regional financial institution automates for higher productivity”). More aggressive digitization will be paramount to achieve the productivity gains necessary for the entire ICT and financial services sectors to remain competitive.

Exhibit 6: Changes in employment and productivity by sector (2010–16)

While most sectors saw slight growth in productivity, it declined in several services sectors, especially information and communication

Apparent labor productivity (real GVA[1]/person employed) and share of employment by sector, 2010-16



Public sector
- Slight productivity decrease but higher employment share increase

Wholesales and retail trade
- Productivity grew, while share within employment decreased

Transportation and storage
- Productivity grew significantly, while share slightly decreased

Agriculture
- Productivity grew significantly

Manufacturing
- Automotive and chemicals sectors contributed to growth

Other services[2]
- Financial services were the main reason of decline

Other Industries[3]
- Slight decrease in productivity and employment share

Information and communication
- Telecommunications and motion picture subsectors declined significantly

1 Gross value added; Consumer Price Index adjusted. 2 Hotels and food, finance and insurance, real estate, professional, scientific and technical, and administrative and support
3 Mining and quarrying, utilities, and construction

SOURCE: Hungarian Central Statistical Office, Business Monitor, Eurostat

Box 1

Regional financial institution automates for higher productivity

A regional financial institution set itself an ambitious goal: it wanted to increase the productivity of its customer facing and internal operations centers while sustaining high customer satisfaction and full compliance with stricter regulatory requirements, in addition to coping with an increasing volume of incoming customer requests. To achieve this ambition, the institution deployed robotic process automation (RPA) for processes such as closing accounts, modifying contracts by updating customer data, providing quotations to own or third-party sales forces, and reconciling payments.

The company began to see positive results within two months of implementing the RPA processes. Throughput times for automated processes decreased by up to 70 percent, error rates were reduced, less time was spent on rework, and customer satisfaction increased. RPA processes resulted in significant productivity gains.

To further increase productivity, the company is currently rolling out and developing new RPA solutions to multiple processes via a designated cross-functional team.

Gains achieved via robotic automation processing

Case study: Companies that successfully automate at scale achieve competitive advantages

Lower costs
Savings of 30%+ in most transactional processes

Increased flexibility
Ability to operate 24/7 and scale with demand

Faster service
Processing times reduced from days to minutes

Deeper insights
View into how thousands of factors impact performance

Improved quality
From spot checking to 100% quality control

SOURCE: McKinsey Corporate and Business Functions Practice

Box 2

Digitizing the customer experience in banking

After noticing that their younger and growing customer segment was using bank services more intensively, a major Central European bank launched a digitization program to automate some of its processes. The bank aimed not only to appeal to tech-savvy clients but also to build trust with all clients by enhancing the customer experience on its digital platform and in local branches.

Initiatives included simplifying bank account opening, introducing an online application procedure for personal loans, and reducing manual inputs of customer-related data by connecting the bank's database with publicly available datasets.

The bank also introduced a partially automated solution for SMEs, and designed a platform enabling retail customers to easily tailor account settings according to their individual preferences and life circumstances.

In another initiative, the bank reached full automation in online application for personal loans for customers with permanent income transfers by linking the request automatically to their bank account.

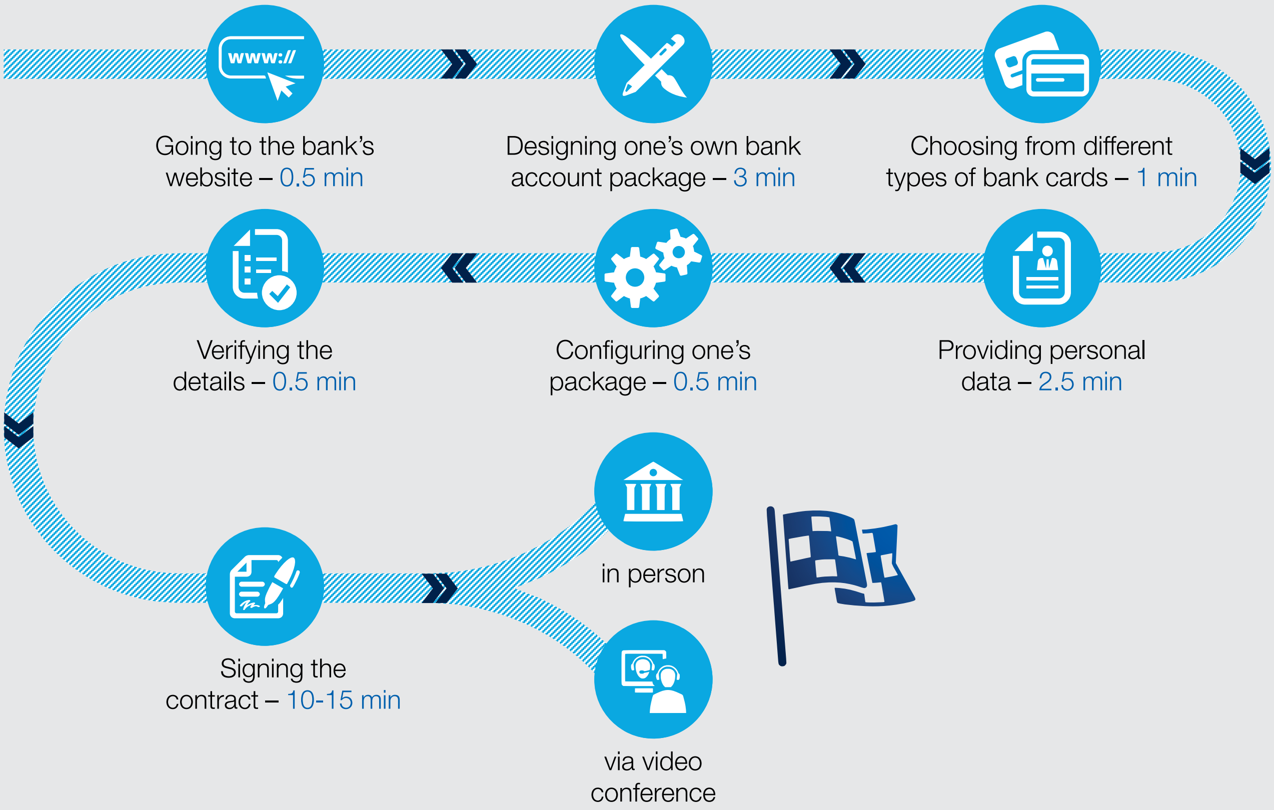
These digitized processes enable SMEs to open a new account five times faster than before, and retail customers can obtain a personal loan within minutes via online banking.

As of September 2017, the bank's loan contracts made via online banking had risen significantly, indicating the success of these initiatives. Aside from improving customer experience, digitization has helped to free up resources, eliminate human error, and reduce costs and paper usage for more complex customer needs and financial advisory.

One bank's online account opening customer journey

Case study: Digitization of bank account opening enhances customer experience

A significant share of the application process is digitized



SOURCE: McKinsey Financial Institutions Group Practice - disguised client example

Productivity gains have been more robust in the manufacturing, wholesale and retail trade, and transportation sectors, both due to increasing demand and to the adoption of newer technologies (Exhibit 6). For example, Daimler has invested in a highly robotized factory in Kecskemét, where car parts are transported by robots from the logistics zone to the assembly lines.[15] Chemicals manufacturing nearly doubled its productivity rate since 2010, partly due to investments in technology. BorsodChem, for example, has been continuously upgrading technology in new and existing plants.[16] Furthermore, Bonafarm in the agriculture sector invested in new food processing technologies with automated logistics system and aims to address the shortage of qualified workforce in hard physical jobs through robotics, for example, a packaging robot could offset 28 FTEs vacancies.[17]

“Our analysis indicates that companies across all sectors are having trouble filling jobs at all skill levels.”

Remedies for Hungary’s labor and productivity challenges

These examples notwithstanding, more companies across Hungary’s economic landscape must embrace automation technologies to address a growing labor shortage, raise productivity, and sustain growth. Our analysis indicates that companies across all sectors are having trouble filling jobs at all skill levels. Many corporations identify computer-related occupations such as software developers as critical areas in which they have trouble finding highly trained professionals. But even lower skilled jobs in assembly and manufacturing are becoming hard to fill. For example, as of Q3 2017, 17 percent of companies have trouble hiring untrained physical workers (Exhibit 7).

The bottleneck is particularly tight in the industrial, administrative and support, and health and social services sectors, which constitute 30, 12, and 11 percent, respectively, of open positions (Exhibit 8).

This problem can be addressed in multiple ways: companies can draw from untapped labor pools in both the active and inactive segments of the workforce; they can attract labor from abroad; and they can introduce or augment their use of automated technologies. One alternative does not preclude the other: introducing automation and drawing from untapped labor pools can work synergistically to help Hungary ignite economic growth.

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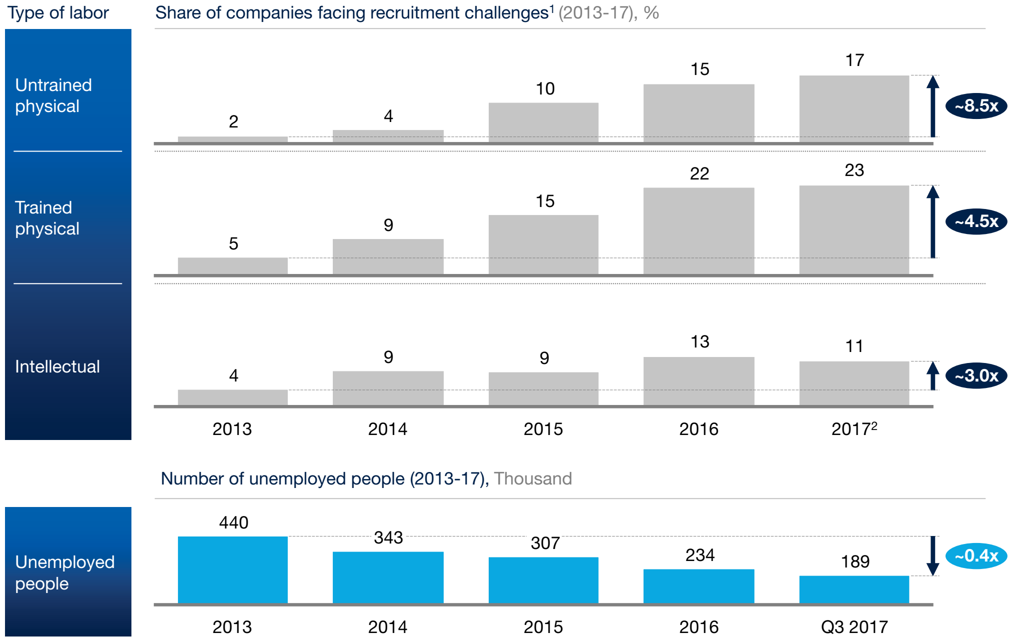
[15] “Óriási fejlesztések a kecskeméti Mercedes-gyárban,” Keol, May 6, 2017. http://keol.hu/kecskemet/oriasi-fejlesztesek-a-kecskemeti-mercedes-gyarban

[16] Kalocsai Zoltán,“Nem állnak le - óriás beruházással nyomul a BorsodChem,” Origo, October 5, 2016. http://www.origo.hu/ gazdasag/20161004-nagyon-kemeny-verseny-folyik-vilagszinten-a-vegyipari-oriasok-kozott-es-ebben-ott- van-a-borsodchem.html

[17] “200 hentest sarkallt hazatérésre a Bonafarm” Élelmiszeronline, January 10, 2018. http://elelmiszer.hu/gazdasag/cikk/200_hentest_sarkallt_hazateresre_a_bonafarm

Exhibit 7: Companies face increasing recruiting challenges

Jobs at all skill levels are hard to fill

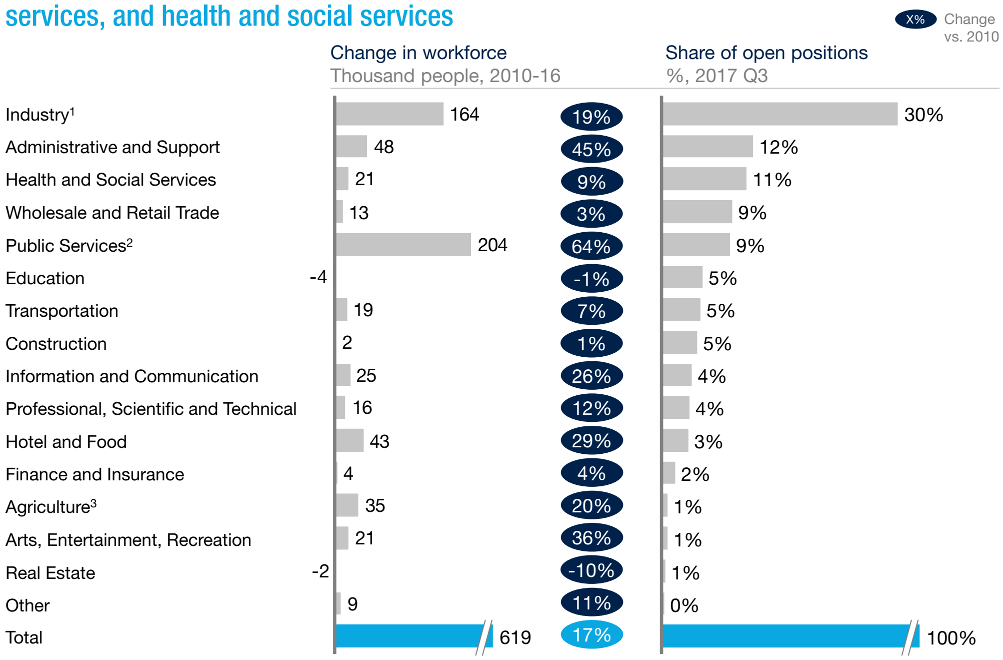


1 Sample includes ~4 400 companies
2 Survey on labor shortage done in September to October, 2017

SOURCE: Education policy experts; industry leaders; Hungarian Central Statistical Office; MKIK GVI

Exhibit 8: Labor shortage across industries

Labor shortage is especially prominent in manufacturing, administrative and support services, and health and social services



Note: Numbers may not add up due to rounding
1 Including manufacturing, mining and quarrying and utilities, and excluding construction 2 Including Public Work Scheme 3 Including forestry, fishing and hunting

SOURCE: Hungarian Central Statistical Office; Hungarian Ministry of Interior; McKinsey analysis

1.2 million

Hungary has labor reserve of 1.2 million people

Mobilization of untapped labor reserves[19]

Hungary has labor reserve of 1.2 million people, including:

- 360,000 in active groups currently working in public schemes or unemployed
- 840,000 in the currently inactive segments such as youth, women and people above the age of 60

Our analysis indicates that the number of employed people could increase by 840,000 if local and foreign companies drew further from inactive segments of the labor market (people not counted in the labor force), comparable to what businesses do in Sweden (Exhibit 9). These include significant numbers of youth, women, and older adults:

- Adults above 60 years (~320,000)
- Youth aged 15 to 24 years (~257,000)
- Women aged 25 to 59 years (~226,000)
- Men aged 25 to 59 years (~38,000)

"Alternative working methods and hours in Hungary are still below the EU average."

Employers are already recruiting from heretofore uninvolved segments of the workforce, such as mothers with young children, by providing more flexible job options and schedules. However, alternative working methods and hours are still below the EU average. Although the share of part-time work increased steadily from 2000 to 2012 to 7 percent, it declined to 5 percent in the past four years, and ranks among the lowest in the EU. In the EU 15 countries, the average of part-time employment is 24 percent and the gap to Hungary has widened since 2010.[18] Women tend to engage more in part-time work, but the share of part-time workers in the full Hungarian population is 5 percent versus 24 percent in the EU (7 percent versus 33 percent among women).[19] The gap in part-time employment among pensioners is less substantial, but there is room for improvement in better involving young people to the labor force through part-time work (Exhibit 10).

Labor market initiatives are needed to encourage part-time and flexible working schemes. The public sector can lead by example, such as by opening more part-time positions for nurses and teachers. Initiatives aimed at increasing the participation of women in the workforce would allow the Hungarian economy to tap into a reserve of 226,000 workers, while a program targeting both pensioners and youth could pull 577,000 workers from the labor reserve.

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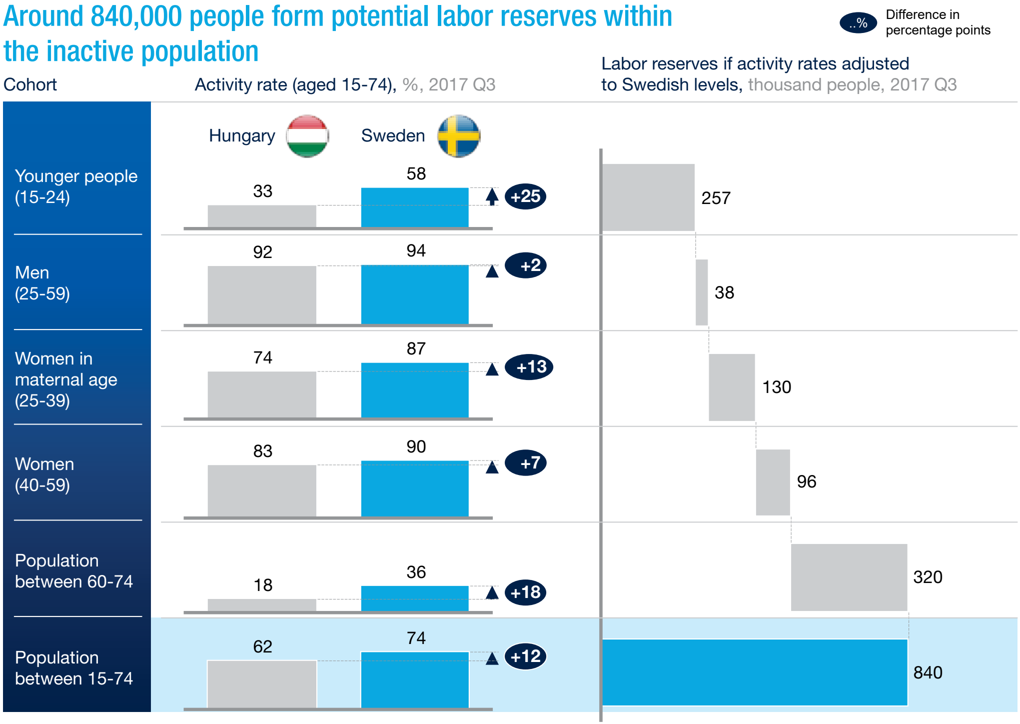
[18] Austria, Belgium, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Luxembourg, Netherlands, Portugal, Spain, Sweden, United Kingdom

[19] Eurostat.

Exhibit 9: Labor reserves within the inactive population

Around 840,000 people form potential labor reserves within the inactive population

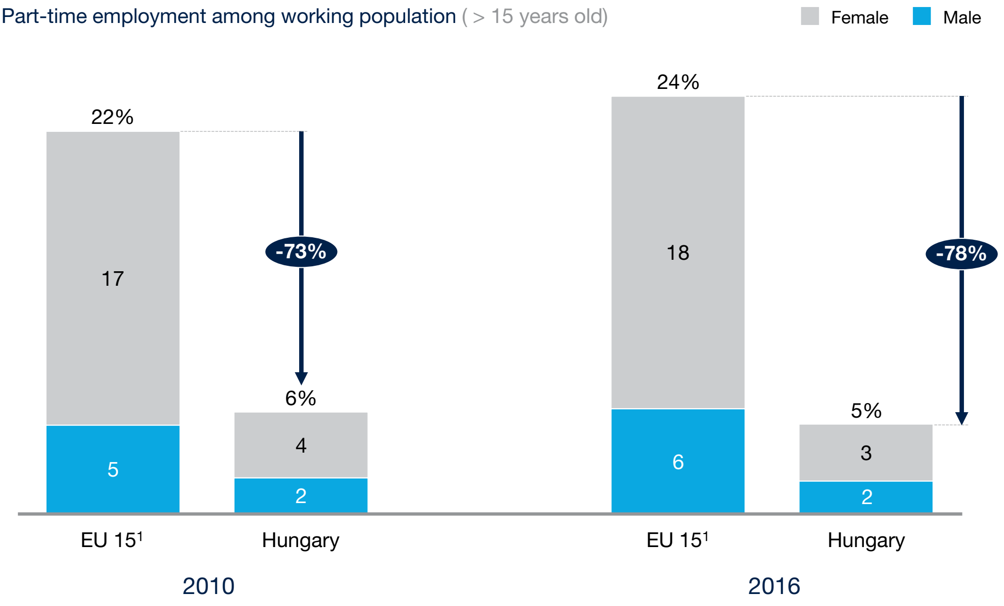


Note: Numbers may not add up due to rounding

SOURCE: Eurostat

Exhibit 10: Part-time employment trends (2010–16)

Part-time employment is significantly less prevalent in Hungary than in the rest of the European Union[1], and the gap is widening



[1] Including Austria, Belgium, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Luxembourg, Netherlands, Portugal, Spain, Sweden, and the United Kingdom

SOURCE: Eurostat

The remaining reserves of active segments of the labor force comprise 188,500 unemployed and 177,000 public scheme workers. Since most public scheme workers are supposed to return to employment after a period of public work, they form a reserve alongside unemployed people.

To be clear, even if companies tap the active labor reserves to fill gaps in their workforces, they must also address the problem of structural unemployment resulting from a mismatch between skills available and those that employers are seeking. Most unemployed people and public scheme workers lack marketable capabilities such as complex problem solving, leadership or technology skills. Furthermore, 51 percent of this combined segment has an elementary education, and 45 percent has a secondary level of education.[20] Among the broader population, there is particular shortage of trained professionals, such as information technology specialists and software engineers.

Reskilling must accompany any mobilization initiative to ensure that the new labor force offers marketable skills including the ability to use automated technologies. This case is true for both full- and part-time and flexible employment schemes, since most companies offering these types of employment schemes are multinationals that are at the forefront of automation adoption. As unemployment and public scheme workers are concentrated in eastern counties as well as in Baranya county, any mobilization and reskilling effort has to be tailored to the region.

> "Given the large role that industry plays in Hungary's economy, the potential for automation is relatively high and the productivity gains could be substantial."

Occupying unfilled jobs with robots

Automated technologies are another means by which employers can address the labor shortage, and they offer the added benefit of boosting productivity rates. Given the large role that industry plays in Hungary's economy, the potential for automation is relatively high and the productivity gains could be substantial (see Box 3, "Global automotive supplier automates to fill jobs")

Examples demonstrate how the adoption of automation technologies can help companies to fill jobs but may also require them to reskill existing employees and to hire new ones with skills specific to the development and deployment of automated technologies and interpretation of data analytics. Across the economy, skills related to science, technology, engineering and mathematics (STEM) will remain critical, but strong social skills will also be important for the management of new technologies, and as the labor market shifts toward service-oriented, "new collared" occupations that combine technical skills with knowledge acquired through higher education.[21] The introduction of automation will compound the importance of training and reskilling the labor force to address structural unemployment. It will also ensure that the labor force meets the demands of the new economy. Below, we explore the degree to which automation could affect Hungary's labor force.

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[20] Beszámoló a 2016. évi közfoglalkoztatásról, Ministry of Interior. https://kozfoglalkoztatas.kormany.hu/download/4/8e/e1000/Besz%C3%A1mol%C3%B3_2016_170713.pdf

[21] Ibid. A Future that Works: Automation, Employment, and Productivity

Box 3

Global automotive supplier automates to fill jobs

A global automotive supplier that has been operating in an Eastern European country for more than 20 years was planning to expand operations. Given the country's relatively low labor costs, the company lacked a strong financial incentive to use automation technologies to expand. However, over the past two years the company had a harder time finding suitable labor to fill jobs and employee turnover rates were rising. In this context, the company decided to embark on an Industry 4.0 transformation program, driven by widespread automation, machine connectivity and advanced analytics, equipped with the latest automation and data exchange technologies.

The plant utilizes digital performance management with real-time views on performance. For example, a camera system automatically performs quality checks, including picture recordings, before sending parts to customers.

Automation of tasks previously performed by humans has enabled more consistent and accurate quality checking. What's more, the company has realized productivity improvements of around 30 percent in some areas due to the introduction of automated technologies. They have consequently embarked on a new automation initiative that involves more than 170 robots. Although this has significantly reduced their reliance on manual labor in the areas involved, they did not need to lay off any employees. By improving their cost position through automation, they managed to acquire new businesses, and more than double their production volumes, while retaining the earlier level of employment.

Automation effort of the global automotive company

Case study: Automation effort is driven by the challenges of finding skilled labor rather than cost advantages

Second floor ceiling for storage: Efficient usage of area above shop floor

Fully automated warehouse: Automated retrieval and storage of palettes

AGV[1]: Material delivery to machine and warehouse

Picking robots: Error free picking in dedicated area

Swarm AGV: Provide goods to man delivery in difficult-to-maneuver locations

Mobile marketplaces: Store and refill material dynamically when and where needed

Pick to light: Assisted picking in edge cases where human involvement is required

Advanced sorting system: Optical recognition of products for material routing

RFID[2]: Continuous and automatic tracking of all material flow

IT integration: Fully integrated warehousing management software with integrated and automatic production planning

TOTAL PRODUCTIVITY IMPROVEMENT POTENTIAL: ~30%

1 Automated Guided Vehicle   2 Radio Frequency Identification

SOURCE: McKinsey analysis

Measuring the potential for automation in Hungary

The extent to which automation fills jobs and boosts productivity depends on how quickly and how comprehensively Hungary can adopt and integrate the new technologies. Our analyses indicate that the potential for automation in Hungary is at the global average, but higher than the EU average.

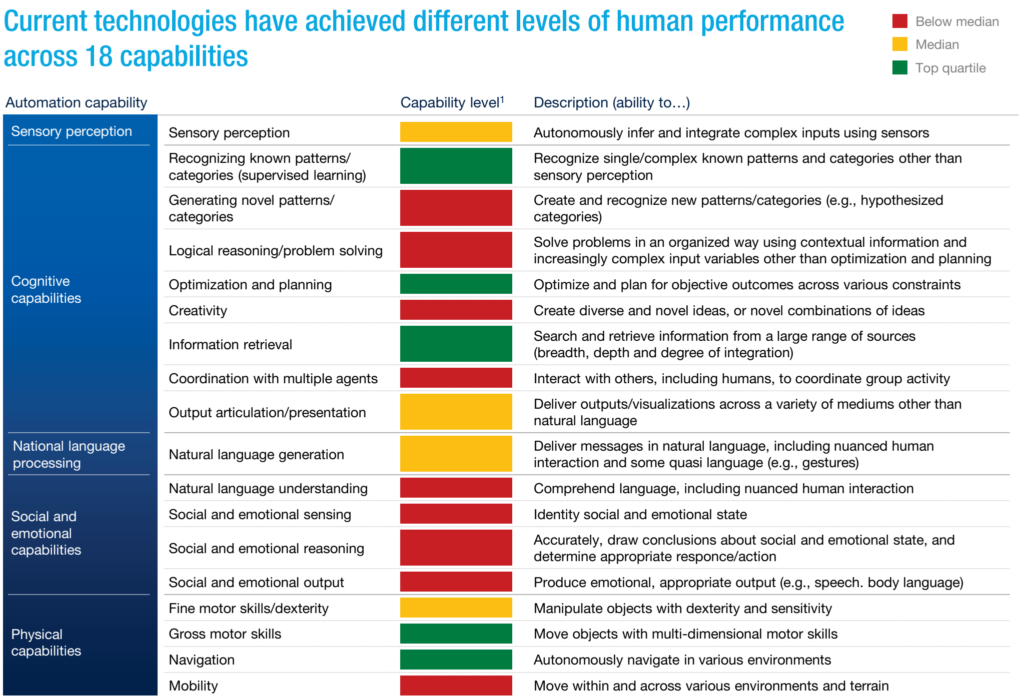
Methodology

To estimate Hungary's automation potential, we relied on the methodology developed by MGI to compare automation potential across countries. This approach focuses on automation's impact on work activities rather than on occupations per se, which permits a more granular understanding of automation's potential impact in the workforce.

Humans perform a wide range of tasks, from cutting trees, to extracting and analyzing data, to making executive decisions. Each of these actions require a combination of capabilities ranging from sensory perception to creativity and social and emotional reasoning.

MGI developed a framework identifying 18 technical capabilities that can be partially automated. These are grouped into five categories: sensory, cognitive, language, social and emotional, and physical (Exhibit 11).

Exhibit 11: Automation technologies' 18 levels of human capabilities



Current technologies have achieved different levels of human performance across 18 capabilities

🟥 Below median
🟨 Median
🟩 Top quartile

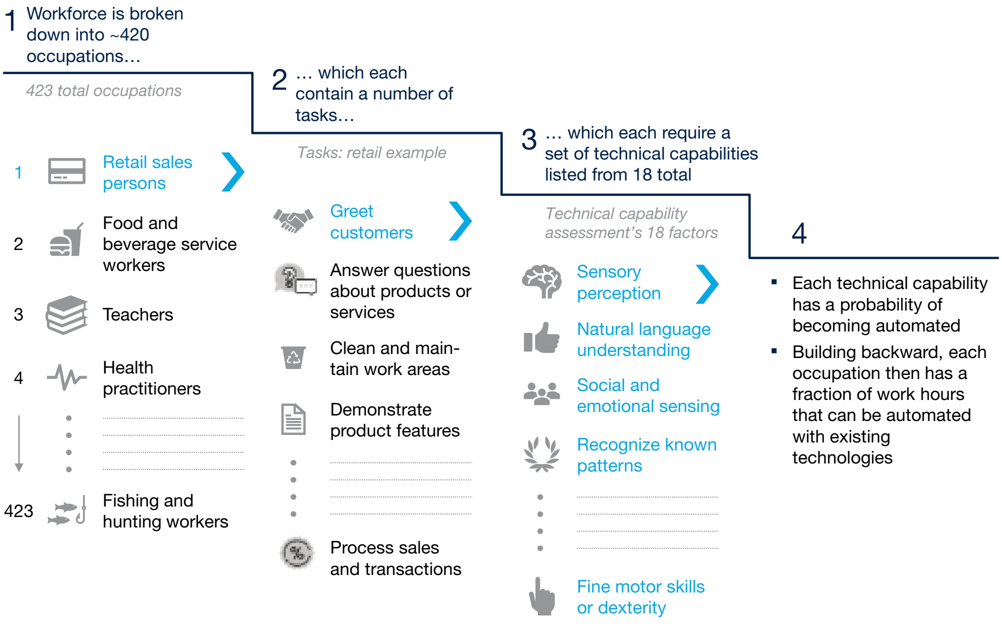
Automation capability		Capability level[1]	Description (ability to…)
Sensory perception	Sensory perception	🟨	Autonomously infer and integrate complex inputs using sensors
Cognitive capabilities	Recognizing known patterns/ categories (supervised learning)	🟩	Recognize single/complex known patterns and categories other than sensory perception
	Generating novel patterns/ categories	🟥	Create and recognize new patterns/categories (e.g., hypothesized categories)
	Logical reasoning/problem solving	🟥	Solve problems in an organized way using contextual information and increasingly complex input variables other than optimization and planning
	Optimization and planning	🟩	Optimize and plan for objective outcomes across various constraints
	Creativity	🟥	Create diverse and novel ideas, or novel combinations of ideas
	Information retrieval	🟩	Search and retrieve information from a large range of sources (breadth, depth and degree of integration)
	Coordination with multiple agents	🟥	Interact with others, including humans, to coordinate group activity
	Output articulation/presentation	🟨	Deliver outputs/visualizations across a variety of mediums other than natural language
National language processing	Natural language generation	🟨	Deliver messages in natural language, including nuanced human interaction and some quasi language (e.g., gestures)
Social and emotional capabilities	Natural language understanding	🟥	Comprehend language, including nuanced human interaction
	Social and emotional sensing	🟥	Identity social and emotional state
	Social and emotional reasoning	🟥	Accurately, draw conclusions about social and emotional state, and determine appropriate responce/action
	Social and emotional output	🟥	Produce emotional, appropriate output (e.g., speech. body language)
Physical capabilities	Fine motor skills/dexterity	🟨	Manipulate objects with dexterity and sensitivity
	Gross motor skills	🟩	Move objects with multi-dimensional motor skills
	Navigation	🟩	Autonomously navigate in various environments
	Mobility	🟥	Move within and across various environments and terrain

1 Assumes technical capabilities demonstrated in commercial products, R&D, and academic settings; compared against human performance

SOURCE: Digitally-enabled automation and artificial intelligence: Shaping the future of work in Europe's digital front-runners, McKinsey & Company, October 2017.

Exhibit 12: Analytical framework to assess automation's potential across tasks

McKinsey's analytical framework assesses the potential for automation at task and technical capability levels



1 Workforce is broken down into ~420 occupations…

423 total occupations

1 Retail sales persons

2 Food and beverage service workers

3 Teachers

4 Health practitioners

423 Fishing and hunting workers

2 … which each contain a number of tasks…

Tasks: retail example

Greet customers

Answer questions about products or services

Clean and maintain work areas

Demonstrate product features

Process sales and transactions

3 … which each require a set of technical capabilities listed from 18 total

Technical capability assessment's 18 factors

Sensory perception

Natural language understanding

Social and emotional sensing

Recognize known patterns

Fine motor skills or dexterity

4

- Each technical capability has a probability of becoming automated
- Building backward, each occupation then has a fraction of work hours that can be automated with existing technologies

SOURCE: McKinsey Global Institute analysis

2.2 million

Our core finding is that 49 percent of work hours in Hungary can be automated based on existing technologies, which is equivalent to the work of about 2.2 million people

Using this methodology, we disaggregated Hungary's labor force into roughly 450 occupations involving about 2,000 tasks and considered the time spent on each task. Each task requires a combination of 18 technical capabilities to execute, thus enabling us to assess the task's automation potential. From there, we worked backward to estimate the fraction of hours in each occupation that can be automated by adapting existing technologies (Exhibit 12). This basis is for estimating the automation potential of the ~420 occupations and allows us to analyze automation potential from a range of perspectives, including by industry, occupation, and salary level.

Core findings on potential for automation in the labor market

Our core finding is that 49 percent of work hours in Hungary can be automated based on existing technologies, which is equivalent to the work of about 2.2 million people (Exhibit 13). Merely possessing automation potential does not mean that it will be realized. As we describe below when discussing the pace of change in Hungary, a midpoint scenario suggests that only 24 percent of current working hours will be automated by 2030.[22] The exhibits and analyses in this section illustrate technical potential and not actual adoption.

Hungary's automation potential is the same as the global average and similar to regional peers, including the Czech Republic and Poland, but it is higher than the EU average of 44 percent (Exhibit 14).

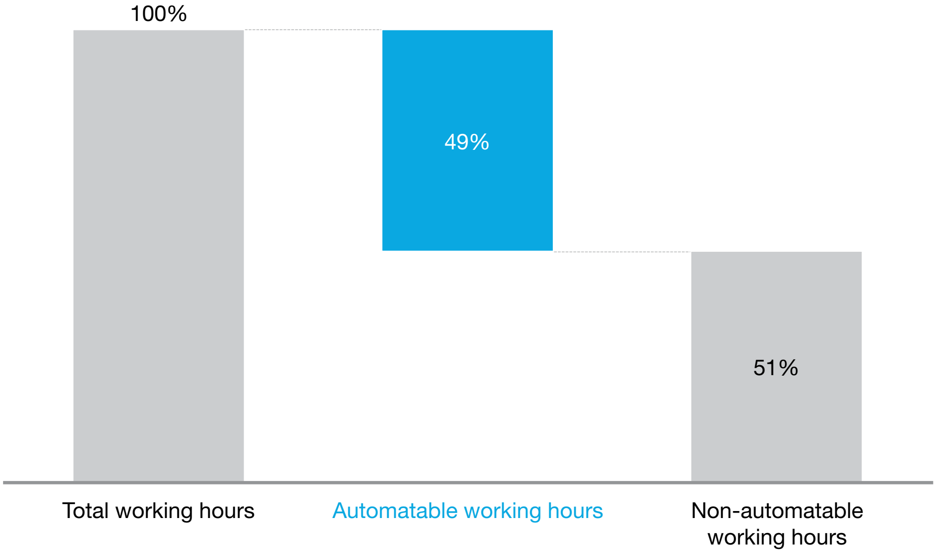
---

[22] Based on 47% automation potential in early scenario and 1% automation potential in late scenario

Exhibit 13: Current automatable working hours in Hungary

49% of work activities have the technical potential to be automated in Hungary

Working hours by technical automation potential for Hungary[1], 2016



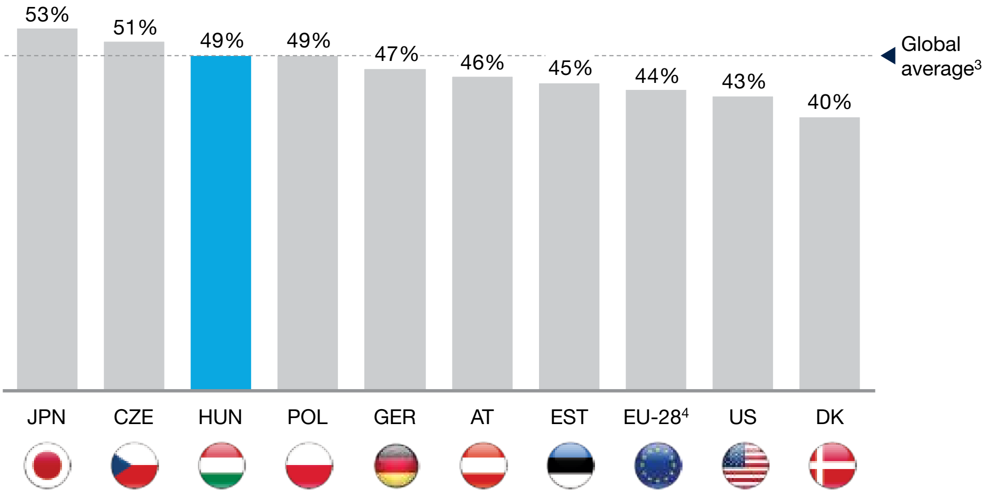
1 We define automation potential by the work activities that can be automated by adapting currently demonstrated strategy

SOURCE: Hungarian Statistical Office; Hungarian National Tax and Customs Administration; McKinsey Global Institute analysis

Exhibit 14: Comparison of automation potential in select countries

Hungary is among the countries with the highest automation potential in the European Union, similar to Visegrad Four[1] peers

Aggregated technical automation potential of countries, % of working hours[2]



1 Including Czech Republic, Hungary, Poland and Slovakia
2 We define automation potential by the work activities that can be automated by adapting currently demonstrated technology
3 Average of 52 countries, including Hungary, with approximately 80 percent of jobs globally
4 Includes Austria, Belgium, Bulgaria, Croatia, Cyprus, the Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, the Netherlands, Poland, Portugal, Romania, Slovak Republic, Slovenia, Spain, Sweden and the United Kingdom

SOURCE: Hungarian Statistical Office; Hungarian National Tax and Customs Administration; McKinsey Global Institute analysis

The reason for the variance lies mostly in the sectorial distribution of the economies. The highly automatable industrial sector's share in Hungary and its peers ranges from 31 to 39 percent, which is significantly more than the EU average of 25 percent. However, public services, which are less prone to automation, play a smaller role in the Visegrad Group's economies than in the European Union (Exhibit 15).[23]

60%

Similar to MGI's findings globally, about 60 percent of current jobs in Hungary have at least 30 percent technical automation potential

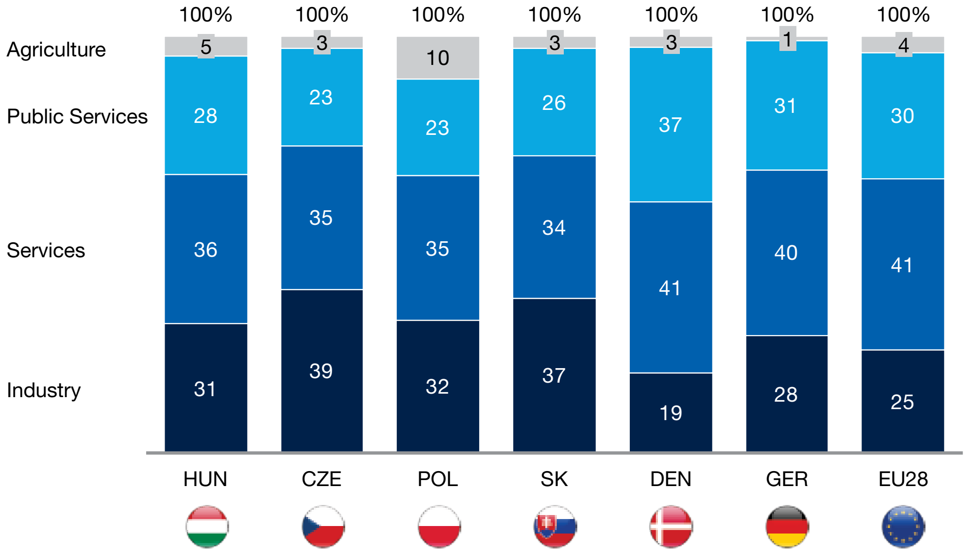
Although the full technical potential of economies is significant, most occupations are only partially automatable. Similar to MGI's findings globally, about 60 percent of current jobs in Hungary have at least 30 percent technical automation potential, while fewer than 3 percent of occupations could be fully automated (Exhibit 16).

Repetitive and highly predictable tasks are the most prone to automation. For example, a significant share of current working hours is spent on activities such as collecting and processing data, and on predictable physical tasks. More than 65 percent of the time spent on these activities can be automated, which would equate to USD 39.3 billion savings in wages (Exhibit 17).

Exhibit 15: Sector share of employment: Hungary and selected EU countries (2016)

Share of industry is high in Hungary compared to European Union and OECD average, and slightly below of local peers

Breakdown of employment by sectors, % of total employment



SOURCE: McKinsey Global Institute analysis

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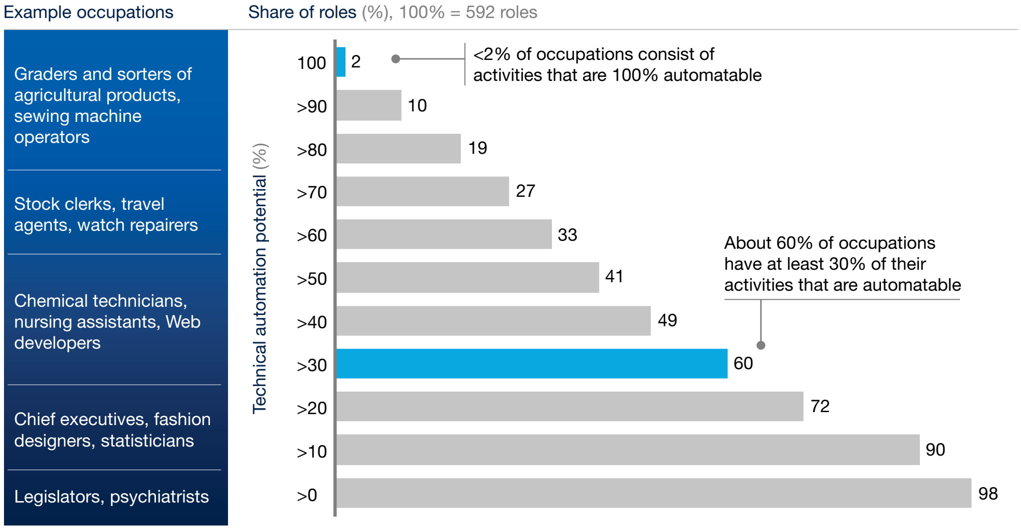
[23] The Visegrad Group, which comprises the Czech Republic, Hungary, Poland, and Slovankia, is also known as the Visegrad Four.

Exhibit 16: Share of tasks technically automatable within occupations

While few occupations are fully automatable, 60 percent of all occupations have at least 30 percent technically automatable activities

Automation potential based on demonstrated technology of occupation titles in Hungary (2016, cumulative)[1]



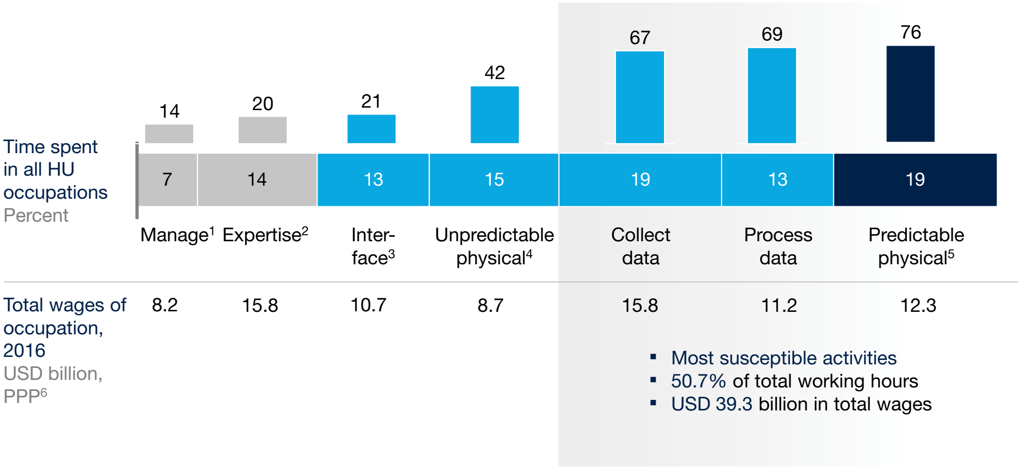
1 We define automation potential according to the work activities that can be automated by adapting currently demonstrated technology
Note: Labor data are for 2014 and are assumed to be constant in the model

SOURCE: Hungarian Statistical Office; Hungarian National Tax and Customs Administration; McKinsey Global Institute analysis

Exhibit 17: Time spent on occupational categories and automation potential

51% of working hours are spent in collecting data, processing data, and doing predictable physical work - all having at least 60% automation potential

Time spent on activities that can be automated by adapting currently demonstrated technology, 2016, %



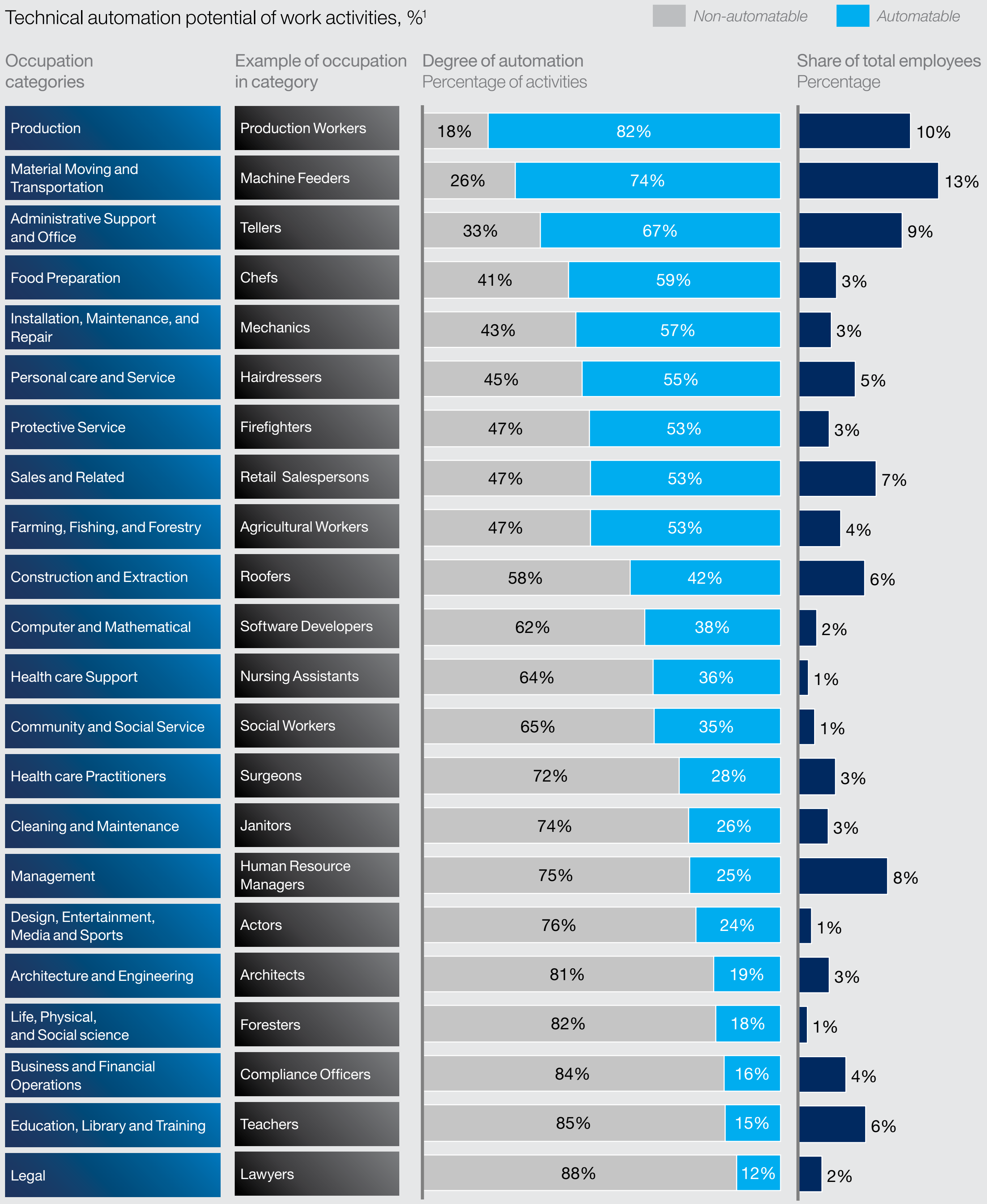
1 Managing and developing people.
2 Applying expertise to decision making, creative tasks and planning.
3 Interfacing with stakeholders.
4 Performing physical activities and operating machinery in unpredictable environments.
5 Performing physical activities and operating machinery in predictable environments.
6 Purchasing power parity
Note: Numbers may not sum due to rounding; labor data for 2014 and are assumed to be constant

SOURCE: Hungarian Statistical Office; Hungarian National Tax and Customs Administration; McKinsey Global Institute analysis

Exhibit 18: Automation potential by occupational category

Occupations with high predictability, such as production and operating machinery, have the largest proportion of activities with automation potential. Meanwhile, jobs requiring expert and interpersonal activities, such as teaching and architecture, rely on soft skills and are less prone to automation

Technical automation potential of work activities, %[1]



1 We define automation potential by the work activities that can be automated by adapting currently demonstrated technology

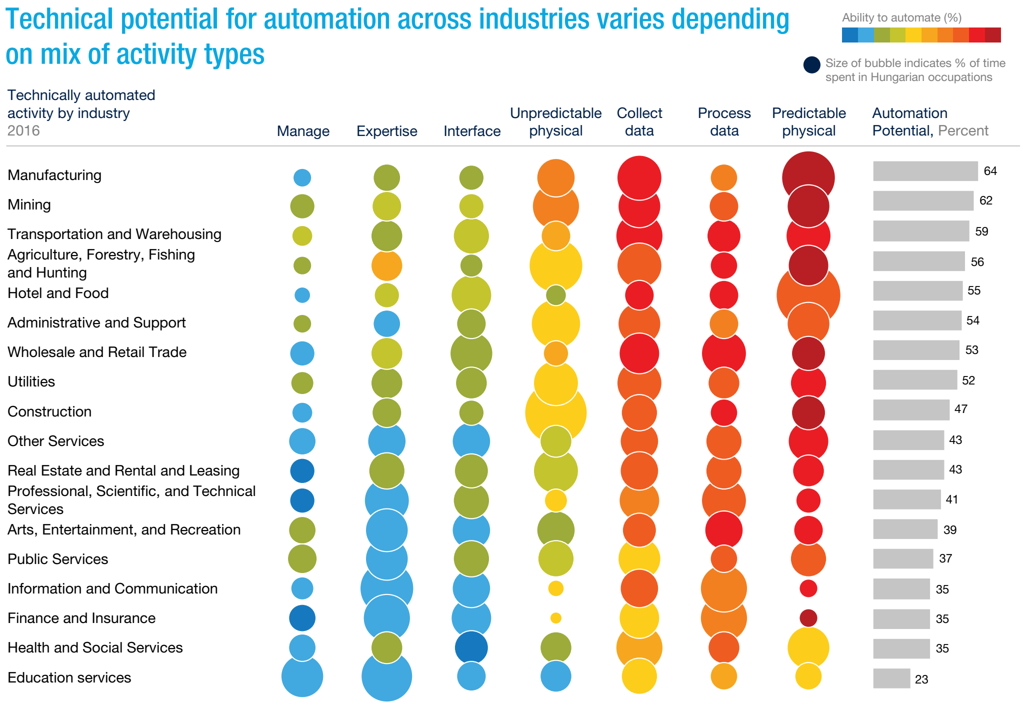
SOURCE: Hungarian Statistical Office; Hungarian National Tax and Customs Administration; McKinsey Global Institute analysis

> "Automation's ability to relieve humans of performing repetitive tasks could allow workers to concentrate on more value-added activities."

Automation's ability to relieve humans of performing repetitive tasks could allow workers to concentrate on more value-added activities that require essential human skills, such as creative thinking, complex problem solving and social skills. These skills will be more important in the future labor market. Occupations relying on these abilities, such as architects, lawyers and teachers have 12 to 19 percent automation potential. In contrast, automation potential ranges from 82 percent for the 10 percent of Hungary's labor force that works in production and 74 percent for the 13 percent working in material moving and transportation, mainly performing predictable physical functions, to 67 percent for the 9 percent of workers involved in administrative occupations and office support, such as bank tellers, performing data collection, and processing (Exhibit 18).

Given Hungary's sectoral composition and the mix of activities involved in each sector, agriculture, manufacturing, mining, transportation and warehousing, where predictable physical activities dominate, are most susceptible to automation (Exhibit 19). Education and health and social services jobs have the least potential to be automated since they involve significant customer interaction and require particular expertise.

Exhibit 19: Automation potential by industry and mix of activities



Technical potential for automation across industries varies depending on mix of activity types

Note: Numbers may not sum due to rounding; labor data for 2014 and are assumed to be constant in the model

SOURCE: Hungarian Statistical Office; Hungarian National Tax and Customs Administration; McKinsey Global Institute analysis

Assessing automation potential according to employment numbers also indicates that manufacturing, public services, trade and transportation will experience the greatest impact from automation. Even in construction, in which a high proportion of physical work is not predictable, up to 122,000 jobs could be automated with existing technology. In wholesale and retail trade, both customer-facing and warehousing activities are prone to automation, such as the adoption of application-based logistics or self-service checkout systems (Exhibit 20).

USD 1,143

In Hungary, workers earning less than the monthly average gross wage of USD 1,143 are the most exposed to automation

While there are clear connections between occupations and sectors and their respective automation potential, salary levels are not an absolute predictor of automation potential: jobs at all income levels are prone to automation. However, occupations at the lower middle of the income spectrum have the highest share of automatable activities. In Hungary, workers earning less than the monthly gross wage of USD 1,143[24] are the most exposed to automation, with around 50 to 60 percent of current working hours considered automatable (Exhibit 21).

Though, workers earning more than USD 1,477[25] in monthly gross income have jobs with less than 30 percent potential for automation. Automation potential is higher in lower middle-income occupations because they consist largely of routine tasks, whereas higher income positions involve a larger share of non-routine cognitive tasks (Exhibit 21).

The education level required for a particular occupation also correlates with automation potential. For example, jobs that require only primary or high school education face 56 to 64 percent of automation potential, while only 19 to 23 percent of occupations requiring university degrees can be automated (Exhibit 22). Nevertheless, several skills currently taught at higher education levels are also prone to automation, such as data collecting and processing.

> "In terms of geographic impact, automation will affect the entire country."

In terms of geographic impact, automation will affect the entire country. The maximum difference in automation potential between municipalities is only 12 percentage points. That said, Hungarians in some areas will feel the impact more than others. For example, workers in Budapest are likely to feel less impact from automation adoption since these areas host fewer assembly and automotive factories and more organizations related to the professional, scientific and technical services, public services and finance and insurance. Counties where more than 30 percent of the labor force works in manufacturing have at least 51 percent potential (Exhibit 23).

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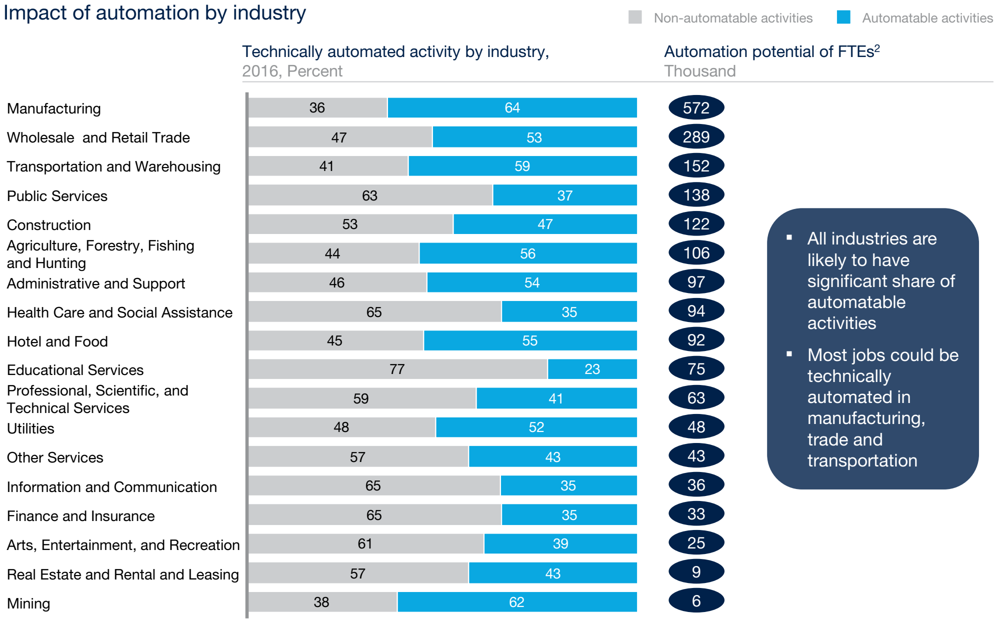
[24] Equals to HUF 290,000; exchange rate as of April 5, 2018 – USD to HUF: 253.82

[25] Equals to HUF 375,000; exchange rate as of April 5, 2018 – USD to HUF: 253.82

Exhibit 20: Automation potential by industry

Among the industries, administrative and support, government, manufacturing, and retail trade, are most susceptible to automation

Impact of automation by industry



- All industries are likely to have significant share of automatable activities
- Most jobs could be technically automated in manufacturing, trade and transportation

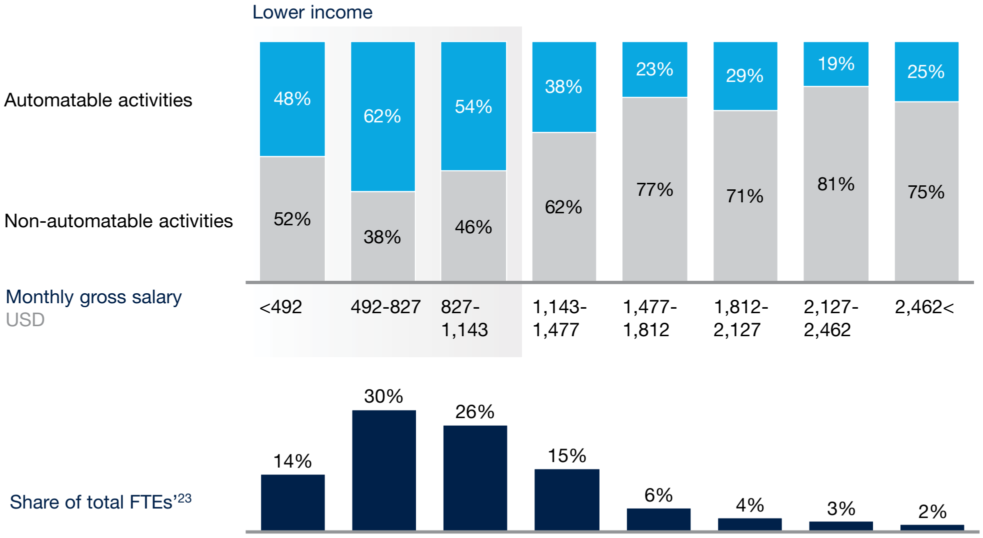
NOTE: Numbers may not sum due to rounding. Labor data is for 2014 and are assumed to be constant in the model
2 Full Time Employees

SOURCE: Hungarian Statistical Office; Hungarian National Tax and Customs Administration; McKinsey Global Institute analysis

Exhibit 21: Time spent on occupational categories and automation potential

Jobs of all income levels are prone to automation, as salary level alone is not a strong predictor of automation potential

Technical automation potential of work activities by monthly salary, %[1]



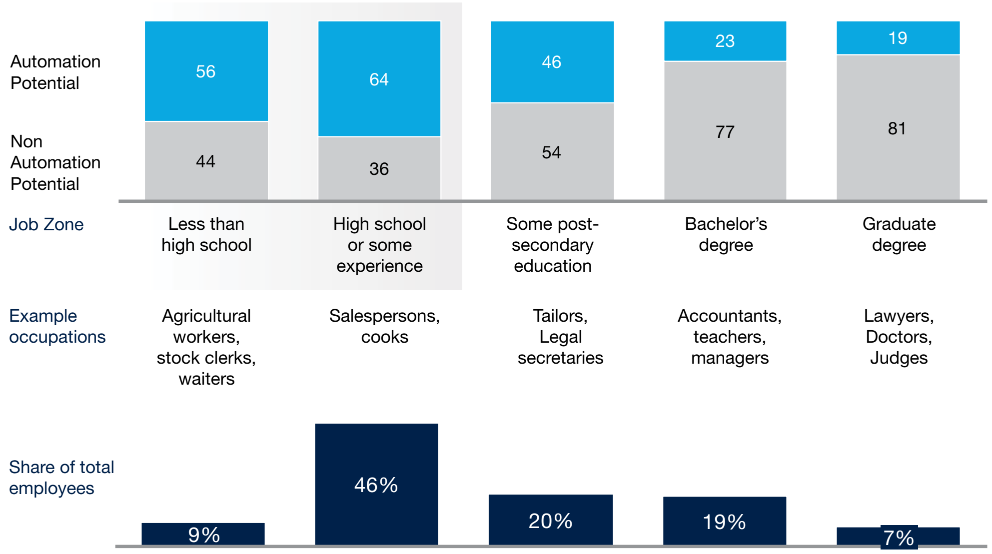
1 We define automation potential by the work activities that can be automated by adapting currently demonstrated technology
2 Calculated as sumproduct of automatable potential and share of employees in each income group
3 Full-time Employees

SOURCE: Hungarian Statistical Office, Hungarian National Tax and Customs Administration, McKinsey Global Institute analysis

Exhibit 22: Automation potential of jobs based on required education level

Automation potential is inversely proportional to education levels and is expected to significantly affect workers with lower education levels

Technical automatability by job zone,[1] 2016, %



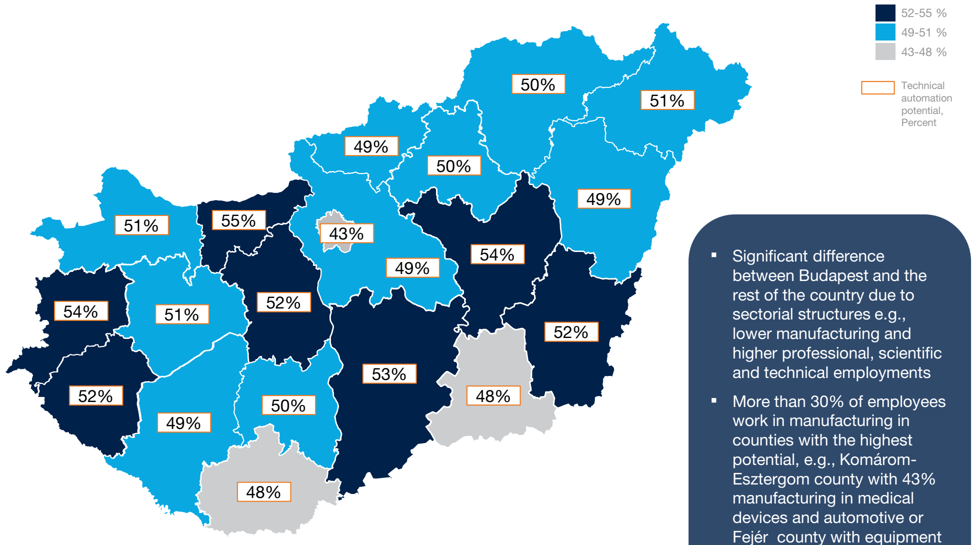
[1] Job zone is based primarily on education required and adjusted for experience required

Note: Numbers may not sum due to rounding; labor data for 2014 and are assumed to be constant in the model

SOURCE: Hungarian Statistical Office; Hungarian National Tax and Customs Administration; McKinsey Global Institute analysis

Exhibit 23: Automation potential by county

Automation potential is the highest in counties with large manufacturing and trade industry, while Budapest is less prone to automation



- Significant difference between Budapest and the rest of the country due to sectorial structures e.g., lower manufacturing and higher professional, scientific and technical employments
- More than 30% of employees work in manufacturing in counties with the highest potential, e.g., Komárom-Esztergom county with 43% manufacturing in medical devices and automotive or Fejér county with equipment production

SOURCE: Hungarian Statistical Office; Hungarian National Tax and Customs Administration; McKinsey Global Institute analysis

Spillover effects of automation

In total, 60 percent of Hungary's labor force is likely to be significantly affected by the automation process, with around 49 percent of their current working hours technically automatable. As machines occupy an increasing proportion of work-related tasks, they will help to create more capital that can be reinvested to generate new and more rewarding jobs. For instance, workers freed from performing repetitive and dangerous tasks could move into jobs requiring higher skill levels, which are usually better by measure of working conditions and salaries. There will also be increasing demand for professionals who can design and manage automated technologies.[26] In addition, although automation will replace some jobs, the technology is more likely to complement most occupations. For example, manufacturing plants already commonly employ "cobots," which are robots meant to interact with people in a shared workspace. These machines help humans perform their work more efficiently, for example, by sorting material more quickly and precisely than humans.

> "Policy makers can hasten the adoption of automated technologies by digitizing more public sector services and by implementing education and skills training curricula that prepare workers for the demands of the new economy."

This is not to deny the potential negative effects of the transition to a more automated economy. As machines assume more of the work traditionally performed by humans, capital will assume a greater role in value creation. In addition, competition for lucrative jobs could intensify, with highly skilled workers spending more of their time on value-added activities and thus further enhancing their skills. Meanwhile, those with less marketable skills could fall into a vicious cycle of fewer work and training opportunities, further dampening their ability to acquire saleable skills. Rural and suburban areas of Hungary may experience these effects more than Budapest, since they host a higher concentration of manufacturing and retail businesses.

The pace of the transition to a more automated economy will depend largely on the actions of policy makers and businesses. Policy makers can hasten the adoption of automated technologies by digitizing more public sector services and by implementing education and skills training curricula that prepare workers for the demands of the new economy. Large businesses and multinationals can participate in this effort, while SMEs should proactively seek financial and organization support to effectively compete in the new automated economy. We will explore these recommendations in greater detail in Section 4. But even with these steps, the pace of automation adoption is likely to be slower than what is possible, as we explain below.

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[26] Digitally-enabled automation and artificial intelligence: Shaping the future of work in Europe's digital front-runner countries, McKinsey & Company, October 2017.

Core findings on the pace of change

MGI has developed two scenarios for the adoption of new automation technologies. The "early scenario" in Hungary assumes that 47 percent of current work activities will be automated by 2030, which is equivalent to the work of about 2 million people.

The "late scenario" assumes 1 percent adoption by 2030, equivalent to the work of 44,000 people (Exhibit 24).

Based on these, a "midpoint scenario" (the average of the two scenarios) assumes a 24 percent adoption, equaling to the work of about 1 million people.

Since several factors affect the pace of adoption, the rhythm of change is uncertain. However, in Hungary and elsewhere, three broad factors will determine the pace of adoption: technology feasibility and integration possibilities, regulatory and social acceptance and most importantly, the business case for automation.

3

Three broad factors will determine the pace of adoption: technology feasibility and integration possibilities, regulatory and social acceptance and most importantly, the business case for automation.

Technical feasibility of automation technology integration in Hungary

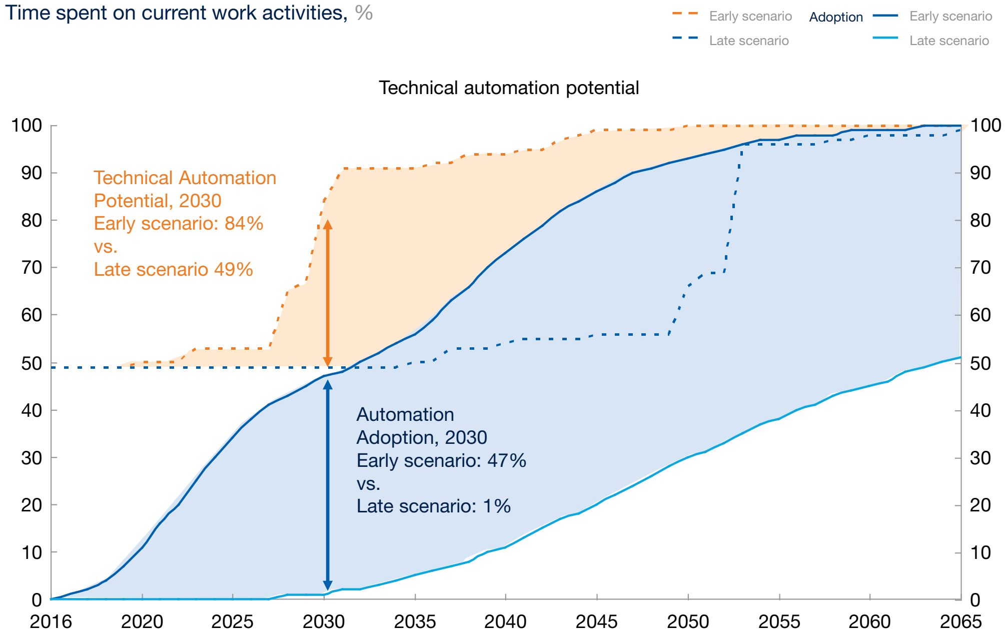
Hungary already has many of the building blocks needed to effectively integrate automation into key industries such as manufacturing or ICT. It has achieved high scores in digital dimensions like connectivity, human capital and internet usage. However, as we've mentioned, the workforce needs to develop capabilities such as software development expertise to manage and maintain new automation technologies.

Additionally, the level of public sector digitization in Hungary is below the EU average (Exhibit 25). A digitized public sector can both broaden social adoption of automation technologies and catalyze innovation by demonstrating productivity gains and endowing civil servants with relevant technological skills who can transfer these skills to the private sector. A national network of digitally available data sources and IT technologies is critical for more widespread automation integration across the Hungarian economy. The government can take immediate steps to spearhead this effort, helping to place Hungary at the forefront of the automation revolution, at least among regional peers.

Exhibit 24: Adoption scenarios

Automation adoption will progress gradually

Time spent on current work activities, %



NOTE: Numbers may not sum due to rounding. Labor data is for 2014 and are assumed to be constant in the model

SOURCE: Hungarian Statistical Office; Hungarian National Tax and Customs Administration; McKinsey Global Institute analysis

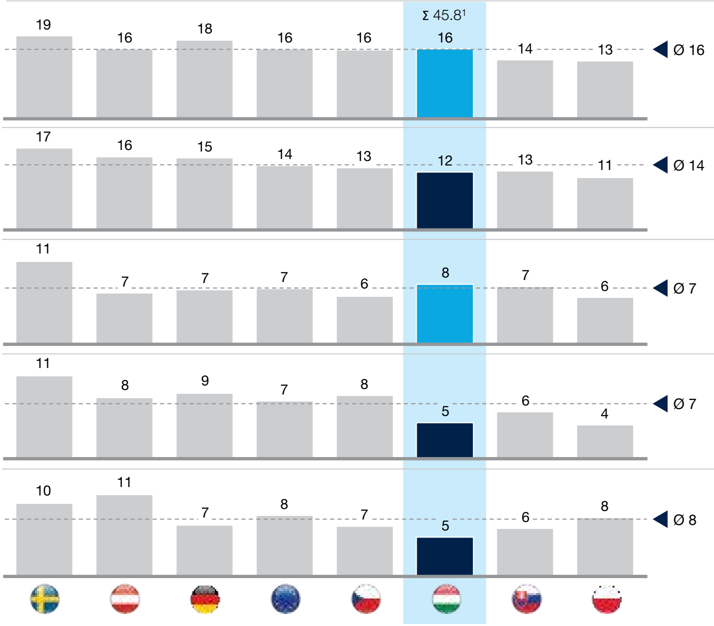
Exhibit 25: Digital infrastructure by country

Hungary lags behind in digital public services and digital integration, but ahead of EU average in connectivity and internet usage

Above or slightly below EU28 average

Below EU28 average

Digital Economy and Societal Index of selected EU member states, 2017



Comments

1. Connectivity (fixed broadband, mobile broadband, broadband speed and prices): Hungary has made progress. NGA coverage and take-up are above EU average. 4G availability is also high, but mobile broadband penetration is not yet accelerating
2. Human capital (basic skills and internet use, advanced skills and development): There has been a large increase in internet users, but digital skills levels remain below the European average
3. Use of internet (citizens' use of content, communication and online transactions): Hungarian internet users are particularly active on social networks, reading news, and making video calls. At the same time, they are less engaged in undertaking transactions, such as online banking and shopping
4. Integration of digital technology (business digitization and ecommerce): More Hungarian businesses use social media, invoices, cloud and e-commerce. However, the business sector is not exploiting the opportunities offered by digital technology as much as other countries do
5. Digital public services (e-government): Despite minor improvements in the online provision of public services, Hungary ranks 27th, scoring below EU average in all aspects.

1 DESI score, measured on a scale of 0-100

SOURCE: McKinsey Global Institute analysis

Social attitudes toward automation

Cultivating social acceptance presents another challenge for policy makers. The European Commission's 2017 Eurobarometer found that 38 percent of Hungarians view automation negatively.[27] The poll asked participants whether they had very positive, positive, negative, or very negative views on robots. Among the 28 countries of the European Union, Hungary ranks 25th by measure of attitudes toward automation (Exhibit 26). This result may be explained partially by the large numbers of workers in industry, and especially manufacturing, who are anticipating or already feeling disruption due to automation. Other factors may also play a role in shaping attitudes, such as a general wariness toward economic change given the upset caused by Hungary's transition to a market economy less than 30 years ago. Until 1997, real per capita incomes declined by 17 percent due to a general real wage reduction, the drop in employment, and sudden increase of pensioners.[28]

> "With the understanding that adoption will take time, businesses, labor and research institutions, and policy makers across Hungary have an opportunity to manage the process of automation adoption to herald a new era of economic growth."

The business case for automation adoption

While targeted government policies and awareness campaigns can help overcome some of the physical and social challenges to adopting automation, building a more favorable business case for automation presents a thornier challenge. Developing automation technologies requires significant initial capital investments to acquire the hardware and labor that make automation work, although software solutions involve smaller investments. Over time, the returns conferred by using automated machines to perform tasks – such as increased throughput and improved safety and quality – are likely to exceed the costs of labor substitution, especially if hardware and software costs decline over time.

Since the cost of new automation technologies is still relatively high, technically feasible solutions are implemented based on shorter-term investment needs and expected returns, in addition to capital availability. In countries with high labor costs, companies have stronger incentives to substitute human labor with machines. These countries will be more incentivized to adopt automation more quickly than a country such as Hungary, whose labor costs are relatively low compared with those in Western Europe (Exhibit 27).

Even when conditions for technological adoption are favorable, full adoption across an entire sector takes years. In reviewing the historical rate of adoption of earlier technologies, MGI found that the timeline from commercial availability to a 90 percent adoption rate ranges from eight to 28 years (for an adoption rate of 50 percent, the range is five to 16 years).

With the understanding that adoption will take time, businesses, labor and research institutions, and policy makers across Hungary have an opportunity to manage the process of automation adoption to herald a new era of economic growth. But they must start now in order to seize this opportunity. Below, we offer recommendations on why these stakeholders should act urgently, and how to proceed.

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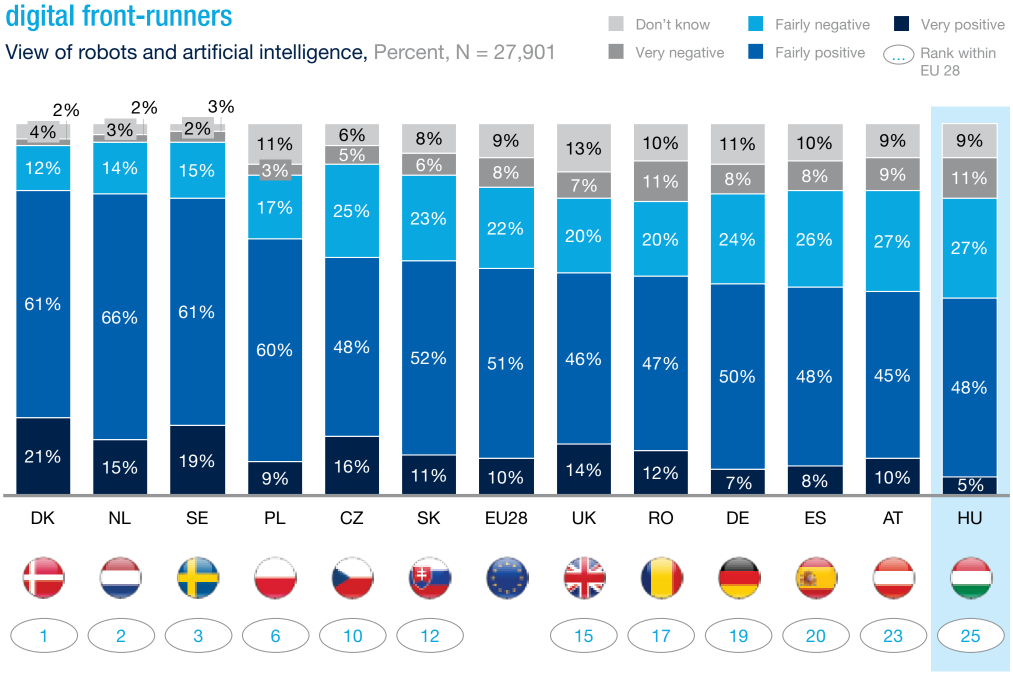
[27] Ibid. Special Eurobarometer 460: Attitudes Towards the Impact of Digitization and Automation on Daily Life

[28] Ibid. Magyarország 1989-2009 – A változások tükrében

Exhibit 26: Views of robots and artificial intelligence: Hungary vs. EU Peers

The population has a fairly negative view on automation compared with digital front-runners

View of robots and artificial intelligence, Percent, N = 27,901

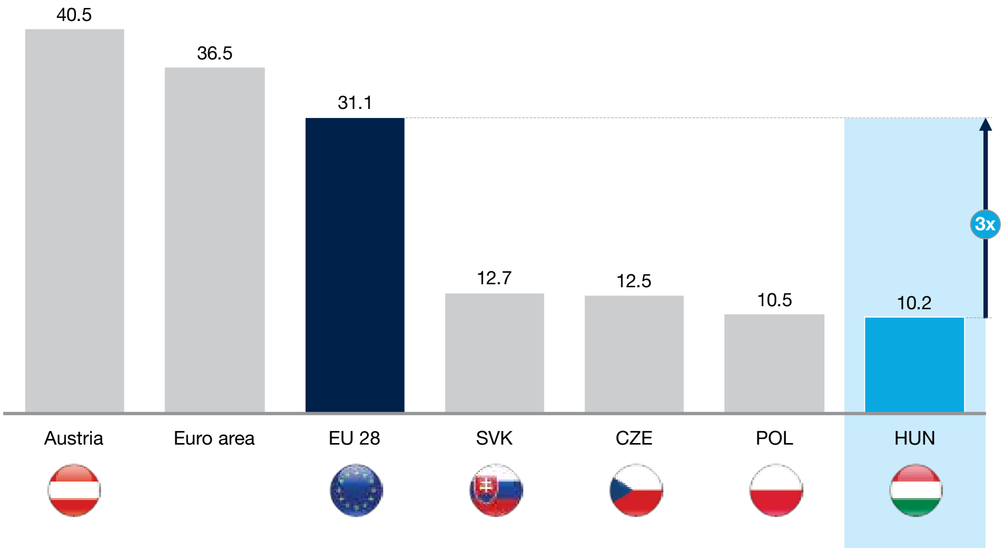


SOURCE: Special Eurobarometer 460: Attitudes towards the impact of digitization and automation on daily life, European Commission, 2017

Exhibit 27: Short-term business case for automation adoption appears weak based on relative labor costs

Due to relatively low labor costs in Hungary, economic incentives for automation are lower in Hungary

Hourly labor costs by country[1], USD[2], 2016



[1] Excluding public administration, defense and compulsory social security sectors
[2] Original analysis in EUR; exchange rate as of April 5, 2018 – USD to EUR: 0.8172

SOURCE: Eurostat

Becoming a center of automation

> “Timely adoption of automation is crucial for the economy to increase its competitiveness by raising productivity and gaining first mover advantages.”

Timely adoption of automation is crucial for the economy to increase its competitiveness by raising productivity and gaining first mover advantages. These automation steps include the formation of innovative ecosystems that attract and cultivate highly skilled workers and positively shift the economy toward higher value-added jobs and sectors, thus securing a more competitive foothold in the regional and global economies (Exhibit 28).

For example, the current added value of Hungary’s manufacturing sector characterizes its contribution to the economy as a medium value-added sector. Greater use of automation technologies in manufacturing could bring more value to the sector and generate higher value-added jobs.

Our analysis indicates that if all sectors achieved relatively rapid adoption of automation, they could help boost Hungary’s GDP growth by 1.4 percent per year over the next four decades through gains to productivity. In contrast, a slower adoption rate would dampen Hungary’s regional and global competitiveness by resulting in slower productivity growth.

Recommendations

To achieve the benefits that accompany automation, businesses and policy makers need to work on educating and reskilling the current and future workforce, and on creating an innovation friendly environment for automation.

Exhibit 28: Benefits of early adoption of automation technologies

Rapid automation can put Hungary on a robust economic growth track

	Productivity	Labor market	Results
Positive scenario center of automation	▪ Investment growth in technology and automation ▪ Productivity improvement	▪ High value-added job creation ▪ Increase in wages ▪ Talent pull from international markets	▪ Robust regional and global economic growth fueled by productivity improvement, and demand growth
Negative scenario economic stagnation	▪ Decline in foreign investment, especially in technology ▪ Stagnation of productivity	▪ Stagnating incomes ▪ Most apt and mobile labor force moving abroad ▪ Remaining jobs are low- or medium-value added	▪ Economic stagnation lacking productivity increase and internal demand

SOURCE: McKinsey Global Institute analysis

> “Hungary’s education curricula should emphasize two types of skills development to take advantage of this phenomenon: those targeted at using and sustaining automation and technology, and those that emphasize effective social skills.”

Early Education to Foster Proficiency and Adaptability with Technology

Children as young as five years old are now digital “natives”, sometimes handling automated technologies with more ease than their adult minders. Hungary’s education curricula should emphasize two types of skills development to take advantage of this phenomenon: those targeted at using and sustaining automation and technology, and those that emphasize effective social skills.

Beginning in primary school, children should learn skills such as software programming, computer and data science, and other digital skills that enable them to effectively interact with machines, just as they learn a second language. In Estonia and the United Kingdom, for instance, early primary education teaches coding through the introduction of fundamental concepts, such as knowledge of algorithms, as well as technical skills, such as debugging and the creation of simple programs.[29] Acquiring these skills at a young age fosters a natural digital literacy and forges a future-ready workforce.

Similarly, since humans and not robots will occupy jobs requiring soft skills that automated technologies do not possess, children should develop strong skills related to adaptability, creativity, decision making, empathy, and reasoning. These skills are particularly relevant to the type of teamwork characteristic of today’s organizations, and alongside adaptability, play an increasingly prominent role in the making of a work-ready labor force.

Adult Education to Train Workforce Participants

In adult education, immediate and large-scale retraining programs are necessary to help current and imminent workforce participants transition to a more automated economy. Large enterprises can play a pivotal role by designing curricula and providing classroom and on-the-job training that endow workers with skills needed in the automated economy. Some Hungarian companies are already taking action on this front. For example, Audi Hungária Zrt. sponsors a joint scholarship program for vehicle engineers at Széchenyi István University.[30] Audi also develops curricula used by five academic departments at the university, and offers training to eligible students. Similar partnerships could be implemented nationwide to expand the pool of employment-ready talent. Transparent measuring of the outcomes of adult trainings (for example proportion of people employed after six months of completing the program) and clarity about employment opportunities with the qualifications and skills acquired through those trainings can also enhance the effectiveness.

Since SMEs have fewer resources to train workers, the government can offer them financial incentives and programs that promote SME consortia to collaborate on innovative solutions in their respective sectors, together with educational institutions, and government and labor agencies. This collaboration could also involve on-the-job training and informal learning options that are especially relevant for SMEs (see Box 4, “Corporate cooperation for an automation-driven paradigm shift”).

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29 Beth Gardner, Adding Coding to the Curriculum, New York Times, March 23, 2014.
https://www.nytimes.com/2014/03/24/world/europe/adding-coding-to-the-curriculum.html

30 https://audi.hu/osztondij/

Box 4

Corporate cooperation for an automation-driven paradigm shift

A group of Eastern European companies representing more than 100,000 employees in the automotive, steel industries, and white goods has joined forces to build a Digital Knowledge Center, including a model factory, to help their employees better understand and effectively use new technologies.

Since all members of the group face the same challenges of applying technologies toward digital transformations, and of understanding how technologies can replace or can be integrated into their existing manufacturing processes, the group developed a common training curriculum on the various ways automation, machine connectivity and advanced analytics can be used. In addition, the Digital Knowledge Center's model factory demonstrates cutting-edge technology use cases via two production lines related to production processes and product selection.

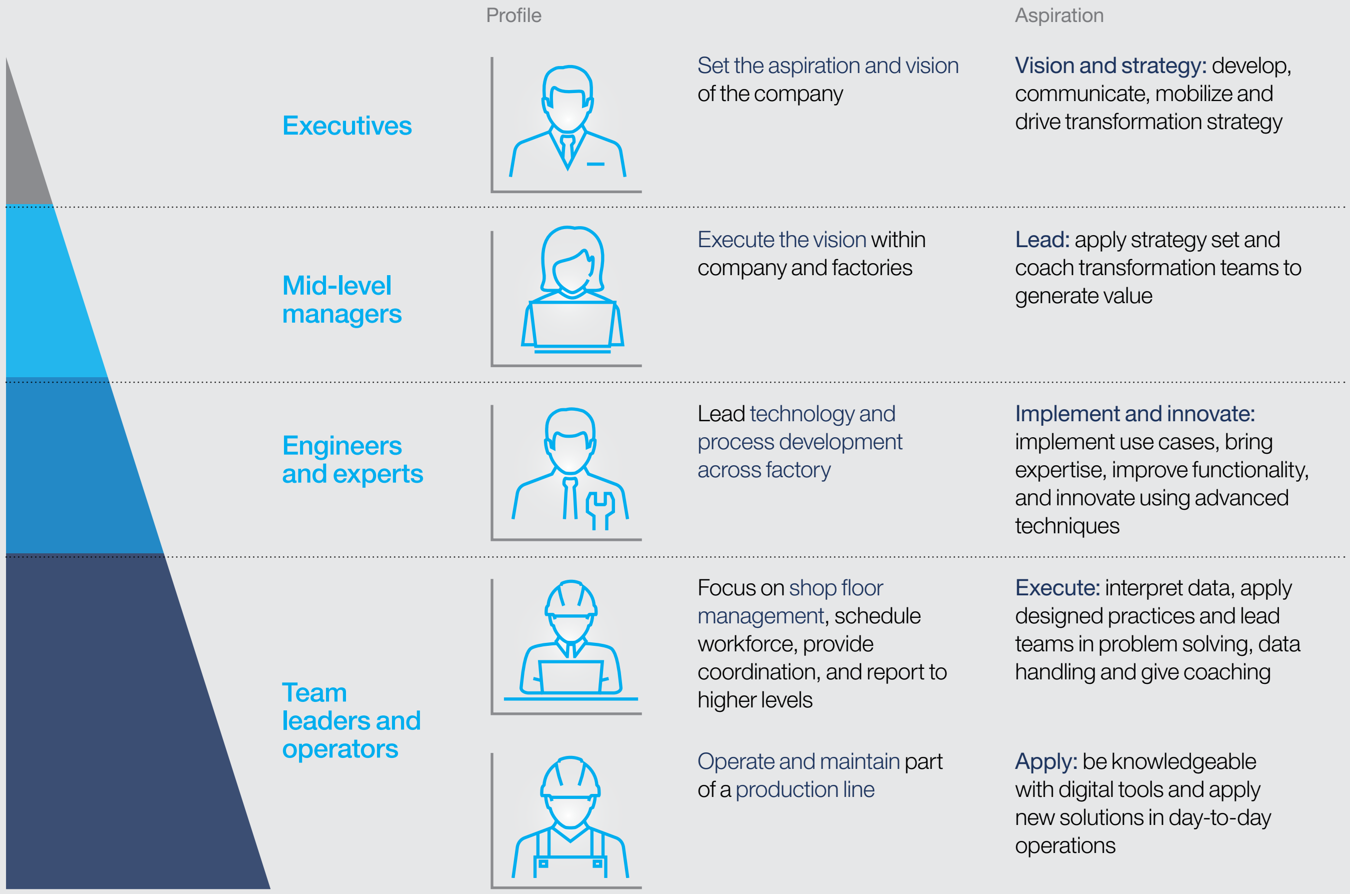
All curricula targets identified skill needs and operational processes involved in implementing an Industry 4.0 transformation program, and addressing stakeholders at four levels of companies' organizations, such as executives, experts, managers, and shop floor employees.

This high-level cooperation of the companies has facilitated the digital knowledge center's success despite high operating costs due to continuous development needs and significant coordination efforts. The group intends to teach over half of its combined workforce in the next three years, with the aim of achieving a complete paradigm shift in the industries represented.

Digital knowledge center's education program

Case study: Cooperation to educate across four levels of organization for successful automation program

Capability building within every level in an organization is equally critical for transformation success.



	Profile	Aspiration
Executives	Set the aspiration and vision of the company	**Vision and strategy:** develop, communicate, mobilize and drive transformation strategy
Mid-level managers	Execute the vision within company and factories	**Lead:** apply strategy set and coach transformation teams to generate value
Engineers and experts	Lead technology and process development across factory	**Implement and innovate:** implement use cases, bring expertise, improve functionality, and innovate using advanced techniques
Team leaders and operators	Focus on shop floor management, schedule workforce, provide coordination, and report to higher levels	**Execute:** interpret data, apply designed practices and lead teams in problem solving, data handling and give coaching
	Operate and maintain part of a production line	**Apply:** be knowledgeable with digital tools and apply new solutions in day-to-day operations

SOURCE: McKinsey Global Institute analysis

Labor agencies and trade associations can help identify skill needs and training gaps in each sector. Labor agencies can also help connect jobseekers with independent training providers and incentivize training that meets corporate demand by assessing service providers' ability to provide training resulting in productive employment. For example, the Swiss government provides a so-called "QualiCarte" to companies so that they can self-assess quality of training and determine areas to improve.[31] Switzerland also requires job training providers to acquire a quality license to operate, and local government inspectors monitor the quality of training through interviews with trainees and employers. This kind of continual monitoring of skills training initiatives helps businesses, governments, and individuals fine-tune skills training programs and adapt them to the rapidly changing demands of the labor market.

> "Monetary support in the form of targeted subsidies and tax allowances for companies to invest in automation technologies could improve the business case for adoption."

Public and Private Schemes to Incentivize Technological Innovation

The government can sponsor private sector innovation through the use of vouchers that provide financial incentives for research centers and SMEs to explore new ways to apply AI and other automation technologies and to enhance digitization. Monetary support in the form of targeted subsidies and tax allowances for companies to invest in automation technologies and human capital (e.g., retraining programs) could improve the business case for adoption. Since these subsidies could result in downsizing, they could be conditional on the retraining of workers or the creation of new jobs.

The government might also consider using financial incentives to attract foreign investment to establish innovation hubs that feature the use of automated technologies. Examples of innovation hubs range from Silicon Valley to Belgium and Israel, where local and multinational companies have established collaborative networks with financial institutions, government agencies, research institutions and universities, and build on the synergies created by access to strong talent pools and financing to push their innovative ideas to the next level. Such an innovation hub could be created in Hungary by providing tax incentives for companies to establish technology-based research and development operations, and by simplifying the work visa and residence process for non-EU professionals.

Policy makers could also consider pilot programs that allow companies to test automation-driven innovations without risking penalty for not complying with existing regulations. One such initiative is the "Regulatory Sandbox" that the National Bank of Hungary seeks to implement to encourage testing in the financial technology industry.[32] In such a scheme, financial technology start-ups would be encouraged to pilot their product and process ideas on real customers for a limited time – such as offering loans based on "big data"-driven analyses of customers' spending habits – without having to abide certain regulations that would inhibit the testing and implementation of new initiatives. Another program aimed at fostering development of automated products and processes is the track near Zalaegerszeg built to test and develop programming for self-driving vehicles.[33]

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[31] Qualité de la formation professionnelle, http://www.berufsbildung.ch/dyn/4742.asp

[32] Innováció és stablitás fintech körkép Magyarországon, Magyar Nemzeti Bank, December 2017, https://www.mnb.hu/letoltes/konzultacios-dokumentum.pdf

[33] Egy év múlva üzemelhet a zalaegerszegi tesztpálya, Portfolio.hu, July 27, 2017 https://www.portfolio.hu/vallalatok/egy-ev-mulva-uzemelhet-a-zalaegerszegi-tesztpalya.257809.html

Yet another program is a cooperation between Facebook and Magyar Telekom to test a new 5G wireless technology called Terragraph, in Budapest.[34] Such schemes not only incentivize innovation, they also help policy makers to devise regulations that effectively manage the new technologies.

To facilitate all of these efforts, policy makers will need to identify areas where regulations might be tailored or enacted to address the unique characteristics of automation technologies. For example, if a self-driving car causes an accident, does responsibility lie with the owner, the manufacturer, or the algorithm designer? As automation technologies progress, these and other questions will arise and require the persistent attention of policy makers.

To demonstrate the benefits of automation and advance its adoption in the private sector, the government should lead by example by actively promoting the digitization and automation of the public sector. Hungary currently ranks 27th in the European Commission's Digital Economy and Society Index.[35] Our analysis indicates that 37 percent of Hungary's public sector activities can be automated. Accelerating and digitizing data collection and making it publicly available not only broadens social acceptance of the technologies, it enables corporations, research institutions, developers, and innovative individuals to use data sets and digital technology for their own research and innovation.

Hungary's digitization of personal income taxes in 2017, whereby the Hungarian tax authority prepared digital tax reports for 3.8 million people,[36] is a step in the right direction. Policy makers could pursue additional digitization programs by following the best practices exemplified by Estonia, where 99 percent of public services are available as e-services. Indeed, Estonia's use of digital for citizen solutions is extensive: the health data of all citizens are available online for the citizens and doctors; businesses can make online tax payments in three to five minutes, or obtain "e-Residencies," a government-issued digital identification, which streamlines the start-up and running of digital business in the EU; emergency services have employed elaborate IT tools that have greatly reduced accidental deaths; and in 2005, Estonia became the first nation to introduce internet voting in a national election. Estonia's government continues to innovate and is currently working on initiatives such as the data embassy, which is a data bank developed outside of the country to ensure service continuity in times of crisis, as well as a digital transformation in education.[37]

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[34] "Sajtóközlemények," Magyar Telekom, https://www.telekom.hu/rolunk/sajtoszoba/sajtokozlemenyek/2018/februar_26_1

[35] European Commission, Digital Economy and Society Index (2017), http://digital-agenda-data.eu/charts/desi-composite#chart={"indicator":"DESI_SLIDERS","breakdown":{"DESI_1_CONN":5,"DESI_2_HC":5,"DESI_3_UI":3,"DESI_4_IDT":4,"DESI_5_DPS":3},"unit-measure":"pc_DESI_SLIDERS","time-period":"2017"}.

[36] "Négymilliárd forintba kerult az e-szja kifejlesztése," Portfolio, June 22, 2017. https://www.portfolio.hu/users/elofizetes_info.php?t=cikk&i=254419.

[37] https://e-estonia.com/solutions

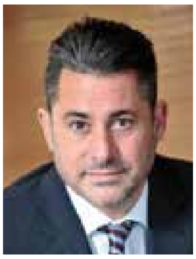
Conclusion

With the arrival of the automation era, governments and businesses face a new, albeit challenging, opportunity to accelerate economic growth. At a global level, automation has the potential to create value at a time when productivity is weakening and the working-age population is shrinking. In Hungary, automation offers a remedy for the rising labor and productivity challenges. At the same time, automation's ability to disrupt labor forces, and the complexities involved in implementing automated technologies, could hamper its adoption.

This report attempts to demonstrate that the gains Hungary can derive from the adoption of automation technologies will outweigh potential negative effects. Productivity improvements and a shift toward higher value-added jobs will create new economic value that raises Hungary's economy to a new level of sustained and robust long-term economic growth.

History shows that Hungary's economic, political, and social fabric is resilient in the face of economic change. It is this ability to adapt and grow from change that will enable Hungary's companies, labor, and policy makers to take the steps necessary to capture the opportunities of the automation era.

Authors



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