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ROBOT INVESTMENT AND INCREASE IN TOTAL EMPLOYMENT

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ABSTRACT

Robots have the potential to radically transform industries and employment. In contrast to previous studies at the industry level that predicted dramatic employment declines, Studies found that investments in robotics are associated with increases in total firm employment. This implies decreases in the total number of managers, middle-skilled workers and production processes. Increases in employment for low-skilled and high-skilled workers and potentially changing managerial activities required by the firm. This paper also finds that robot investments are associated with an increase in the span of control for managers remaining within the organization. There are evidences that robot adoption is not motivated by the desire to reduce labour costs, but is instead related to improving product and service quality. With respect to organizational change, this paper shows that robots predict both the centralization and the decentralization of decision-making authority, but decision rights in either case are reassigned away from the managerial level of the hierarchy.

Keywords: Robots, Technology, Innovation, Employment, Skill, Task

INTRODUCTION

Employment and organizations have changed in response to robot adoption. As robotics and artificial intelligence (AI) become increasingly used by firms as the next engine of innovation and productivity growth, their effects on labour, firm practices and productivity have become a subject of growing importance. According to extensive anecdotal evidence in the media, robots reduce overall employment and exacerbate income inequality, as rapid advancements in vision, speech, natural language processing and prediction capabilities have achieved parity with or exceed human capabilities across a range of tasks. These technological advancements have shifted the comparative advantage from humans to machines for a growing list of occupations (Brynjolfsson and Mitchell 2017; Felten, Raj and Seamans 2019; Frey and Osborne 2017), potentially leaving human labour with substantially fewer activities that can add value (Brynjolfsson and McAfee 2014; Ford 2015). This technology-based labour substitution may displace a significant proportion of the overall workforce, despite generating productivity gains (Acemoglu and Restrepo 2020; Autor and Salomons 2017; Ford 2015). If true, robot adoption is likely to cause significant changes in how firms organize production activities and manage their human capital (Bidwell 2013; Puranam, Alexy and Reitzig 2014; Zammuto, Griffith, Majchrzak and, Dougherty 2007).

Comprehensive data on businesses in the Canadian economy from 2000 to 2015 to shows that robots are associated with increases in total employment, but the effect is not uniform across workers. Investments in robotics predict substantial declines in managerial employment, despite increases in non-managerial employment. This finding contrasts with prior IT that could not easily replace managerial and professional work (Autor, Katz and Kearney 2006; Autor, Levy and Murnane 2003; David and Dorn 2013; Dustmann, Ludsteck and Schönberg 2009; Murnane, Levy and Autor 1999). There is evidence that robots may affect managerial employment in two ways. First, robots may directly reduce the need to monitor and supervise workers, as they can substantially diminish human errors in the production process. Because worker supervision accounts for a substantial portion of work done by managers (Hales 1986), demand for managerial labour to supervise workers

may decline with robot adoption. Second, robots may also indirectly affect managerial employment by changing the types of workers needed. Although the total number of non-managerial employees increases with robot adoption, the study also found that robot investments predict decreases in the employment of middle-skilled workers and increases in the employment of low-skilled and high-skilled labour. These changes in labour composition may lead to a decrease in managers (Malone 2003; Mintzberg 2013). Consistent with the findings of an increase in non-managerial employees and a decrease in the number of managers, this study found that robot investments predicted an increase in the span of control for managers remaining within the organization.

With regard to the allocation of decision-making authority within organizations, it was found that robot investments predicted both the centralization and the decentralization of decision-making authority away from the managerial level of the hierarchy. This suggests that, not only has managerial headcount decreased, but their decision-making authority has also diminished. This is different from earlier studies that found that IT generally led to the decentralization of decision-making rights (Acemoglu et al. 2007; Bresnahan, Brynjolfsson and Hitt 2002). Results show that changes in employment are related to complementary changes in organizational practices that are critical to the effective use of robots. Some studies provide the most comprehensive evidence possible at the level of individual businesses on the employment and organizational effects of robot investments. Wide range of outcomes were examined□employment, labour composition, span of control, strategic priorities and allocation of decision-making rights□suggests that robots have a substantive effect on both employment and the organization of production in different ways than previous technologies.

Although the allocation of decision-making authority for all managerial tasks cannot be measured, these results suggest that the type of work managers are doing changes with robot adoption. The downsizing of managers represents not only a reduction in headcount, but also a change in their decision-making authority and the nature of tasks they perform. These results also suggest that robot adoption is also associated with fundamental changes in organizational design.

Robot Capabilities

Robotics are machines programmed by a computer that are capable of carrying out a complex series of actions automatically. It can be guided externally or controlled may be embedded within. It can also be used to replace human activities. Robots are becoming increasingly integrated into the workplace impacting organisations or structures and process and affection products and services created by these organisation. It is replacing human efforts. Artificial intelligence has become a buzzword that has permeated all our lives. AI and automation are transforming how businesses communicate with their clients and execute their operations. The transformation in the industry has also led to a change in skills requirements. Dixon (2020) found that robots were especially active in the automotive and machinery and equipment assembly sectors, as well as in the plastics processing, and minerals and metals manufacturing industries.

In automotive manufacturing, robots are usually organized along a structured assembly line to fetch and position parts; fasten, rivet or weld parts together; and apply coatings or paint to the assembled parts. Robots are also prominent in the electronics assembly industry, where □pick-and-place□ robots select circuits and place them on circuit boards or silicon wafers. They handle small, delicate parts with precision, selecting among different types and pressing them onto circuit boards. They can also visually inspect circuit boards, test the connections and etch circuit boards. Robots may also be involved in packaging finished products. In addition to improving quality, one of the main motivations for adopting robots in the electronics industry is the increase in flexibility they provide in serving different orders, as they can switch from large volume orders to smaller batches.

Robots are also used extensively in the processing of plastics, where they primarily perform secondary machine-tending roles. They also apply labels and move parts to other areas where they

are further modified or packaged for shipment. In the injection moulding of plastic parts and packaging materials, they are also used to select items and apply labels. Overall, in the plastics processing industry, robots can replace a substantial proportion of repetitive manual labour.
In minerals and metals manufacturing, robots are involved in loading and unloading metal blanks into computer numerical control machine tools, repositioning semi-finished parts during the machining process and deburring afterwards. A primary motivation for robot adoption by firms in die-casting industries is the improvement of worker safety. Foundries are dangerous work environments in which robots□or workers□are subjected to intense heat and toxic fumes. Once moulded, the parts then need to be cooled, modified and inspected. Robots can control for quality in all of these steps. When the quality of the moulded parts depends on the skill of individual workers, robots offer much greater consistency. Individuals working alongside robots are also able to work much more safely and efficiently.
In addition to these industry-specific applications, palletizing is a ubiquitous application that robots can facilitate across many industries. Robots can recognize, pick up, orient and stack packages on pallets. They can also move easily between various quantities of packages of different sizes and varieties. Combined with the ability to control for quality, robots can efficiently place items in packages and seal and label them with machine-readable codes. This not only increases efficiency and precision, but also reduces injuries associated with palletizing large objects.

HOW ROBOTS INCREASE EMPLOYMENT

According to the latest paper, employment was reduced by 7.5 percent following exposure to industrial robots. Labour force participation decreased by one percent. The researchers use the manufacturing firm Foxconn as a case study. For instance, while robots have displaced unskilled workers on assembly lines, they have also created new jobs for machinists, advanced welders, and other technicians who maintain the machines or use them to perform new tasks Industrial robots have helped to boost productivity, safety, and time savings. Robots are able to produce incredibly accurate, consistent, and high-quality work without needing breaks or holidays off. Industrial robots also help to remove workers from the hazardous environments and back breaking labour.
The benefits of robots in workplace can already be seen in various reports such as the International Federation of Robotics ones. What is a robot in workplace? Work robot□ is a colloquial term that is popularly used and usually refers to an industrial robot or a service robot.

The robotisation process is advancing and establishing itself in more and more industrial sectors, although the automotive industry is still at the head, accounting for around 30% of the total demand each year.
At every point in history, humans have developed the necessary tools to carry out their work. Now, mobile robotics is the key to Industry 4.0. It is no longer just about automating industrial processes, but about intelligent automation in which mobile robotics optimises production and profitability, and

makes tasks easier for employees. Robots in the workplace are not here to replace humans at all, but to provide better working conditions.

Benefits and advantages of working robots:

1. **Increased productivity:** An Autonomous Mobile Robot, AMR, can perform full shifts so that production runs 24 hours a day without interruption.
2. **Reduced accidents at work:** there are tasks that pose a risk to workers. For example, tasks in deteriorated environments with the possibility of collapse, work with toxic substances or handling very heavy loads. Robots can perform these tasks, increasing occupational safety for operators.
3. **Error reduction:** it is assumed that in every production line there is a percentage of errors. However, a robotic system has the precision to significantly reduce that percentage. This is one of the main benefits of robots in the workplace: the precision of a robot or mobile manipulator reduces the possibility of production errors and increases the quality of certain processes.
4. **Increased flexibility:** there are many types of robots in the workplace, therefore the number of tasks that a robot can do has also increased considerably. Within a single industry, robots can be adapted to various applications, thus increasing flexibility and cost-effectiveness.
5. **New job opportunities:** more and more people are required for designing, programming and manufacturing robots, as well as for different areas of research and technological development. Furthermore, as productivity increases, it is logical that the company will grow and require more staff.
6. **Betting on the future**: in today☐s highly competitive, demanding and globalised industrial landscape. Being at the forefront of technology is a matter of business development. Betting on intelligent automation through robotic systems is equivalent to building a solid foundation for a business to remain profitable, competent and sustainable.

Many of Robotnik☐s customers are opting for more intelligent robots, with more safety guarantees and more intuitive for end users. It is all about using the possibilities offered by technology to become more competitive.

However, some companies believe that there are obstacles. For example, bringing robots into the workplace requires a large infrastructure as well as a large investment. On the one hand, collaborative robots such as those manufactured by Robotnik are designed to operate with humans in the same workspace without the need for a safety perimeter, making them easy to deploy in any factory. Moreover, these systems are scalable: they can be tested in a given area and then expand their operating zone thanks to their capacity for mobility. The same goes for the number of units: it can be progressively expanded depending on the results.

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On the other hand, it is common to find new customers who think that if their company is an SME, they cannot afford to incorporate robots into the workplace, but this approach is wrong. There are currently more than 5,000 Robotnik mobile robots in the market, working in various industries and companies, which have seen how the investment in mobile robotics has had a return in the short-medium term. While there may be a negative effect on some labour segments, robots and automation **increase productivity, lower production costs, and can create new jobs in the tech sector**.

Theoretical review

Task Based Approach: Robots and total employment

Using a task-based approach that divided each occupation into a set of concrete tasks, Organisation for Economic Co-operation and Development researchers found that 70% of tasks performed by labour could be automated (Arntz, Gregory and Zierahn 2016). Other studies that used the task-based approach found that over 50% of work tasks were vulnerable to automation (Manyika et al. 2017), leading to both labour displacement and wage reductions (Bessen et al. 2019). Using a measure of robot penetration at the industry level in the United States, Acemoglu and Restrepo (2020) found that one robot could replace roughly six people. Graetz and Michaels (2018) used similar data on robot adoption for 17 countries and also found robot adoption to be associated with a reduction in work hours for low-skilled labour.

Conceptual Review

The adoption of general-purpose technologies (GPTs) is often associated with substantial and widespread productivity gains across different sectors of the economy (Bresnahan and Trajtenberg 1995). To maximize the value of GPTs, firms must substantially reorganize their work activities and change the nature of work and human capital requirements (Autor, Levy and Murnane 2003; Bresnahan, Brynjolfsson and Hitt 2002; Brynjolfsson, Rock and Syverson 2018). As a recent and rapidly proliferating GPT (Brynjolfsson, Rock and Syverson 2018; Cockburn, Henderson and Stern 2018), robots have the potential to transform employment, firm practices and the economy (Agrawal, Gans and Goldfarb 2018; McAfee and Brynjolfsson 2017).

The findings of these initial studies are in stark contrast with earlier generations of technologies that have been found to increase employment in conjunction with productivity, ultimately leading to labour□s share of productivity remaining constant. Instead of reducing employment, robots may positively affect employment through (1) productivity increases from labour substitution inducing demand for other goods and services that require non-automated tasks; (2) capital deepening that increases the effectiveness of robots, which can increase productivity without further reducing labour; and (3) the creation of new tasks or increased demand for existing tasks that are complementary to those of robots (Acemoglu and Restrepo 2018; Brynjolfsson, Rock and Syverson 2018). Initial results from surveys of Spanish manufacturing firms suggest that organizations that adopt robots experience both productivity and employment gains (Koch, Manuylov and Smolka 2019).

These differing results are attributable in part to difficulties in observing these countervailing effects in an entire economy using data at the industry and geographic region levels. Studies at these levels of analysis cannot clearly examine how firms use robotics to substitute or complement labour. As prior literature examining the link between IT and productivity has shown, analysis at more aggregated levels can often lead to markedly different conclusions from empirical studies conducted at the firm level (Bresnahan, Brynjolfsson and Hitt 2002; Brynjolfsson and Hitt 1996). These differences can arise from the substantial heterogeneity in productivity growth across firms that cannot be clearly observed at the industry level or other aggregated levels of analysis (Syverson 2004). For example, robot-adopting firms may experience productivity and employment gains while non-adopting firms in the same industry experience employment and productivity losses. If this is true, even if robots are observed to cause employment losses at the industry level, it remains unclear whether robots displace workers within robot-adopting firms or whether workers are instead displaced in non-adopting firms because of a decrease in competitiveness. Without a clear understanding of these underlying mechanisms, it is particularly challenging to make meaningful inferences, with similar empirical issues hampering early attempts to understand the effects of IT investment on organizations. Ultimately, it was critical to obtain more precise measurement of both IT and organizational capabilities at the firm level to resolve the IT□productivity paradox discovered by earlier studies and uncover the factors behind the heterogeneous effects of IT on firm outcomes (Brynjolfsson, Hitt and Yang 2002). This study uses a firm-level measure of robot investments for the population of firms in Canada to empirically investigate the competing hypotheses of whether robot-adopting firms increase or decrease employment in firms.

H1a: Robot investments are associated with increases in total employment.
H1b: Robot investments are associated with decreases in total employment.

Robots and non-managerial employment

Regardless of the effect on total employment, workforce composition is likely to change with robot adoption as demand for different skills changes within the firm. This is similar to what occurred in prior generations of skill-biased technological change. For example, the rise of IT in the late 1990s led to a reduction in the demand for low-skill and middle-skill occupations as routine tasks became automated, and a corresponding increase in demand for non-routine and cognitively challenging tasks, including managing employees (Autor, Katz and Kearney 2006; Autor, Levy and Murnane 2003; Card and DiNardo 2002; Murnane, Levy and Autor 1999). Similar to these studies, low-skilled workers were defined in this study as those working in occupations requiring a high school degree or less, middle-skilled workers were defined as those working in occupations requiring vocational or trades accreditation or an associate degree, and high-skilled workers were defined as those working in occupations requiring at least an undergraduate university degree. Although it has been argued that non-routine and cognitively challenging tasks are difficult to automate (Autor, Levy and Murnane 2003; Murnane, Levy and Autor 1999), the increasing sophistication of robots is likely to automate tasks that were previously unaffected by automation.

With advances in vision, speech and prediction capabilities, robotics has advanced beyond automating simple routine tasks, and robots have now become capable of performing more cognitively complex work, as well as tasks involving specific types of manual dexterity. Middle-skilled workers are more likely to perform these tasks that robots are becoming more able to automate. For example, in the health care and pharmaceutical industries, robots have been used to handle and prepare materials, follow complex protocols to prepare and analyze samples, and help coordinate patient care without human intervention (Gombolay et al. 2018). Firms with significant warehousing operations have also experienced similar effects. Robots have automated a large range of warehousing logistics activities by effectively transporting objects between locations without human intervention. By relieving humans of lifting and handling awkward, heavy objects during inventory management, robots not only avoid injuries but also provide consistency in product quality

and decrease overall delivery time. In manufacturing, industrial robots can substantially reduce variance in product quality. Machine vision enables robots in the automotive industry to consistently install and weld parts onto car bodies with a high degree of precision, minimizing errors in the production process. This can involve difficult manual manipulations such as 360-degree multi-arm rotations with many repetitions. Robots can be programmed to perform these tasks precisely over a long period of time. As a result, robots can substantially reduce both unintended human errors, such as those arising from fatigue, and deliberate actions, such as gaming production quotas, that have previously impeded productivity and effective management (Helper and Henderson 2014).
These illustrative examples suggest that robots can automate certain complex tasks that were primarily the responsibility of middle-skilled workers, including technicians, machinists and operations personnel from a variety of industries that are responsible for following complex protocols to ensure production quality. These tasks may also involve certain types of manual dexterity that require significant learning over time for humans. With robots, many of these tasks can be automated using algorithms, eliminating human errors and the need to provide training for these skills. By reducing production quality variance, robots can decrease the demand for middle-skilled work, as these tasks are vulnerable to robot-based automation.

H2: Robot investments are associated with decreases in middle-skilled employment.
However, investments in robotics may also create demand for human labour and tasks that complement robots. While demand for middle-skilled work may decrease through direct substitution, demand for complementary work□either lower or higher skilled□may increase with robot adoption. For firms that redesign their production processes to leverage the capabilities that robots can offer, productivity may increase, ultimately leading to increases in employment for specific types of workers. Despite recent technological advances, robots are often unable to fully automate most production processes. For many of these so-called residual tasks, human labour remains a more efficient and cost-effective solution (Autor, Levy and Murnane 2003; Brynjolfsson and Mitchell 2017). For example, Elon Musk famously scaled back investments in automation in the Tesla factory and reintroduced human workers after too much automation slowed the production of the Model 3 electric vehicle and delayed its market launch (Hawkins 2018). To use robots effectively, human capital must also be reorganized and reassigned to assist with production. For example, Amazon significantly redesigned work in its warehouses to use its Kiva Robotic systems effectively. As part of this redesign, robots are used to travel between locations within the warehouse, but human workers pick and pack the products delivered by the robots. In this case, instead of using middle-skilled workers to manage inventory by walking from shelf to shelf to examine and handle products, robots and algorithms can automate this process and bring inventory to human workers directly. These human workers then pick up the items and place them into shipping boxes. Researchers have also systematically matched occupations to what machine learning can do and found that many of the manual skills performed by low-skilled labour cannot be replaced easily with technology (Brynjolfsson and Mitchell 2017; Felten, Raj and Seamans 2019). While machine learning is not identical to robot technology, robotics relies heavily on machine learning to make inferences, which can be a useful indicator of the potential impact of robots on work.
Current evidence suggests that, although robots can increase manual dexterity for certain tasks, they cannot yet effectively perform many manual tasks that humans can do easily. As a result, productivity increases arising from robot investments will lead to increases in demand for low-skilled workers doing these residual tasks.

H3: Robot investments are associated with increases in low-skilled employment.
Demand for high-skilled workers may also increase with robot adoption. As illustrated in the example of how Amazon reorganized warehouse work activities after robot adoption, the majority of productivity gains from technology adoption come from the complementary redesign of work

(Bresnahan, Brynjolfsson and Hitt 2002; Hammer 1990). Implementing the necessary process improvements and work reorganization requires highly skilled professionals (Bresnahan, Brynjolfsson and Hitt 2002; Hammer 1990; Helper and Henderson 2014; Huselid and Becker 1997; Ichniowski, Shaw and Prennushi 1997), some of whom are needed to program, repair, customize and work with robots (Acemoglu and Restrepo 2020; Autor and Salomons 2018; Brynjolfsson and Mitchell 2017).

However, demand for high-skilled workers may also increase for those that do not work with robots directly, as automating certain routine tasks can free up resources to engage in more cognitively complex tasks. For example, when hospitals adopt robots to lift patients out of beds, nurses are not only relieved of the physical strain of tasks that are more likely to cause injuries, but are also given more time to interact with patients and participate in clinical treatment (Gombolay et al. 2018). Similarly, by algorithmically providing pills and other medications to patients directly (Bepko, Moore and Coleman 2009), nurses can spend more time ensuring compliance and making other clinical decisions. In the manufacturing sector, where a majority of the routine production process is done by robots and low-skilled labour, time and resources can be freed up for high-skilled professionals to design and market new products and optimize production processes (Felten, Raj and Seamans 2019). Programmable robots can also increase a firm□s flexibility to serve different types of orders and provide a greater range of products. This can further increase the demand for high-skilled workers who can design a wider variety of products.

Consistent with these findings, Autor and Dorn (2009) found that investments in computer technologies over the last several decades contributed to the widespread increase in high-skilled jobs involving creative, problem-solving and coordination tasks. Similarly, Felten, Raj and Seamans (2019) found that investments in AI were correlated with the increased employment of high-skilled workers such as software engineers. Therefore, the employment of high-skilled workers is also expected to increase after robot adoption.

H4: Robot investments are associated with increases in high-skilled employment.

While it is expected that the span of control for managing low-skilled workers will increase, this expected change is ambiguous when the subordinates in question are high-skilled workers. If workers require more advising and coaching from managers, managerial span of control may decrease (Malone 2003, 2004). It has also been argued that high-skilled workers pose unique challenges to the efficiency of organizational hierarchies because of their greater need for communication and conflict resolution, which can be mitigated by decreasing span of control (Bell 1967; Meyer 1968). However, the effective use of high-skilled labour often leads to granting them greater autonomy (Bresnahan, Brynjolfsson and Hitt 2002), potentially increasing the span of control (Simon 1946). Previous literature examining the relationship between skill composition changes and span of control in the presence of technology adoption has been limited, but the evidence that is available generally finds net positive effects on span of control (Scott, O□Shaughnessy and Cappelli 1994). If decreases in the demand for managerial labour arising from reduced monitoring requirements and skill composition changes dominate potential increases because of productivity gains, demand for managerial labour may ultimately decline. Based on these arguments, it is expected that managerial employment will decrease with robot adoption.

H5: Robot investments are associated with decreases in managerial employment.

Results

Firms are adopting robots to increase productivity. However, that does not appear to come at the expense of total employment. Results of the baseline tests of the relationship between robot investments and total employment Prior to robot adoption, shows no evidence of differences in total employment trends with non-robot adopting firms, but an increase in total employment occurring in the first year of robot adoption. The results of the relationship between robot investments and

non-managerial employment by different skill types showed that there is consistent evidence of a negative and statistically significant relationship with middle-skilled employment, which supports Hypothesis H2. There is also evidence of a positive and statistically significant relationship for both low-skilled and high-skilled employment, which supports hypotheses 3 and 4. Decreases in the demand for managerial labour arising from reduced monitoring requirements and skill composition changes has been found to have led to managerial employment decrease with robot adoption confirming hypothesis 5.

CONCLUSION

Fears of artificially intelligent machines have lingered in the human imagination for thousands of years. Recent breakthroughs in artificial intelligence have expanded the production potential of machines. At the same time, this has focused attention on the potential for robots to wreak havoc on labour markets. Machines imbued with humanlike judgment and flexibility threaten to displace human workers from many of the tasks they currently perform in the economy. However, it is possible that the impact of robots will not be very different from previous waves of automation that created enough tasks for humans to compensate for the workers that new machines displaced. Although switching workers to other tasks was often fraught and not all of them could benefit, past automation generated a roughly constant share of rapidly increasing output.

While the present analysis suggests that robot adoption is associated with the use of different types of labour, the associated implication for wages is also an important question. The extent to which wages may change depends on the types of jobs that are created and eliminated. Initial evidence suggests that, although labour cost reduction is not the primary reason for which firms adopt robots, the reduction in managerial and middle-skilled employment and increase in low-skilled and high-skilled employment ultimately predict an ambiguous result for average wages. However, complementing the finding of a decline in demand for middle-skilled employment, Dauth, Findeisen, Südekum and Woessner 2018 used industry-level robot investments to examine their effect on employee wages and found that robot adoption leads to substantial wage decreases for middle-skilled workers.

Changes in employee types and skills as a result of robot adoption would also lead firms to implement complementary work practices to accommodate this skill change, similar to earlier generations of skill-biased technological change (Bresnahan, Brynjolfsson and Hitt 2002; Murnane, Levy and Autor 1999). To understand these effects, the collection of microdata, especially at the firm level, is crucial. In addition, better data on robot investment in different contexts are critical to understand whether the observed effects on employment and work practices can be generalized to other economies (Buffington, Miranda and Seamans 2018; Frank et al. 2019).

RECOMMENDATION

Based on the nature and type of these jobs, here is a rundown of the jobs that AI machines are most likely to perform in the future and it is highly recommended that this generation have to prepare to be abreast of this wonderful evolution.

1. Customer service executives: Many companies would rely on AI to answer FAQs and customer support questions. Chatbots would not only become a significant part of customer interaction. They also would be supporting a lot of internal queries, among others.
2. Book-keeping and data entry: AI and ML (Machine Learning) would be introduced in the product cycle.
3. Receptionists. With auto check-ins in both large and small hotels and with AI□s introduction, there would be a good chance that robots would handle ordering and other related functions.
4. Proofreading: Detecting grammatical mistakes, sentence construction, and other errors would easily be automated through different apps. For example, Grammarly is one of the most famous apps that professionals use for this purpose.

5. Manufacturing and pharmaceutical work: This sector would probably the most extensive area where people are scared that AI will take over jobs. When the production process for most commodities produced today has been mechanized, the operational aspect can also be handled by AI.
Even in pharmaceutical labs, robots can work together with scientists providing a much safer environment. Scientists will no longer be putting their lives less at risk.
6. Retail services: Robots would replace retailer jobs in many shopping conglomerates to understand customers patterns. Moreover, the advanced data analysis of AI machines shows other products that customers might be interested in in the future.
7. Courier services: Drones and robots are already taking over courier services.
8. Doctors: Robotic doctors will make more accurate and effective treatments for the patients compared to their human counterparts. There is also less chance of infection due to more sterile measures and no room for human error.
9. Soldiers: Robots are significantly being used in military operations for various tasks such as surveillance, intelligence, and many more.
10. Taxi and bus drivers: Self-driving trucks could replace 1.7 million American truckers in the next ten years.
11. Market research analysts: AI-enabled robots are gaining popularity in this sector because of the comprehensive data that they provide.
12. Security guards: There is an 84% chance that AI will fully automate this sector in the future.
However, human creativity knows no limits. Strategic thinking, thought leadership, conflict resolution and negotiation, emotional intelligence, and empathy are qualities in jobs that AI **CANNOT** replace at any point in time. Following are some of the professions which would stand the test of time: Human resource managers, Writers, Lawyers, Chief executives, Scientists, Clergyman, Psychiatrists, Event planners, Graphic designers, Public relations managers, Software developers, Project managers, Future-proofing the jobs etc.

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