Major Research Project on

"Effects of Artificial Intelligence and Robotics on Jobs"

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Student's Declaration

This is to certify that I have completed the Project titled "**Effects of Artificial Intelligence and Robotics on Jobs**" under the guidance of "Dr. Shikha N Khera" in the partial fulfillment of the requirement for the award of the degree of "Masters in Business Administration" from "Delhi School of Management, Delhi Technology University, Delhi."

It is also certified that the project of mine is an original work and the same has not been submitted earlier elsewhere.

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MBA, Semester 4

Certificate from Faculty Guide

This is to certify that the project titled "**Effects of Artificial Intelligence and Robotics on Jobs**" is an academic work done by "Mayank Chandra" submitted in the partial fulfillment of the requirement for the award of the degree of "Masters in Business Administration" from "Delhi School of Management, Delhi Technological University, Delhi" under my guidance and direction.

To the best of my knowledge and belief the data and information presented by him in the project has not been submitted earlier elsewhere.

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Abstract

Technological change is a key driver of economic growth. However, the invention, diffusion and effective use of new technology are in turn likely to be influenced by other factors, including economic conditions, institutions, and social conditions. For example, the adoption of labor-saving technology in the first industrial revolution may have been driven by the specific economic conditions of 18th century. Moreover, sociological research has shown that patterns of work organization vary across countries even between establishments that use very similar technologies.

It is broadly accepted that the first industrial revolution eventually led to improving standards of living in society and in particular for the working class, but there is evidence to suggest that it took some time for these improvements to materialize.

In the context of the first industrial revolution, technological change was also linked to changes in the nature of work: the mechanization of textile production involved work moving from artisans' homes to the factories, from rural to urban areas, and from independent work often filling downtime in rural work to full-time, predictable work in a hierarchical structure.

Recent automation does not seem to have led to overall decline in employment levels but there have been income losses for low-educated workers employed in the manufacturing sector. Employment losses in manufacturing have typically been compensated by increasing employment in services, leading to stable or growing overall employment levels. It is not clear from the literature included in this review whether the aggregate figures conceal employment losses for specific demographics and how the new service jobs compare to the manufacturing jobs lost in terms of opportunities for progression, security, quality of working environment.

In this review, we examine evidence from a wide a range of disciplines to inform the discussion on the impact of AI on work. The report:

- Draws insights from earlier periods of technological change and the more recent evidence on the impact of digital technology
- Presents **what** claims have been made about the potential consequences of AI for the future of work, and
- Analyses **why** and **how** such claims have been made with a focus on which frameworks have been used, and what assumptions (implicit or explicit) any conclusions rest on.

1. INTRODUCTION

In the past, many jobs have already been automated but they've tended to be more manual jobs and physical labour type jobs or the kinds of jobs where you're literally standing on an assembly line doing the same thing again and again or very narrow computational jobs in terms e.g. calculating numbers. But what we see now is that this technology is much broader, it's beginning to displace cognitive capability or even intellectual capability.

We've got learning machines that are making decisions and solving problems and that's going to ultimately impact a lot of white-collar work, and certainly more routine things like for example the kind of office worker that creates the same kind of report over and over again or the same kind of quantitative analysis. All of that is going to definitely be increasingly susceptible to automation and the same thing among blue collar jobs that require more dexterity or more visual perception. Those jobs are also increasingly going to be impacted.

The point is that a larger and larger fraction of jobs is going to be susceptible. Of course, there will be new jobs created. That's one thing that people will always point out.

1.1 What is artificial intelligence?

The name behind the idea of AI is John McCarthy, who began research on the subject in 1955 and assumed that each aspect of learning and other domains of intelligence can be described so precisely that they can be simulated by a machine Even the terms 'artificial intelligence' and 'intelligent human behaviour' are not clearly defined, however.

Artificial intelligence describes the work processes of machines that would require intelligence if performed by humans. The term 'artificial intelligence' thus means 'investigating intelligent problem-solving behaviour and creating intelligent computer systems'.[3]

There are two kinds of artificial intelligence:

- Weak artificial intelligence: The computer is merely an instrument for investigating cognitive processes – the computer simulates intelligence.
- Strong artificial intelligence: The processes in the computer are intellectual, self-learning processes. Computers can 'understand' by means of the right software/programming and are able to optimise their own behaviour on the basis of their former behaviour and their experience.[4] This includes automatic networking with other machines, which leads to a dramatic scaling effect.

1.2 Effects of automation on jobs

That's true but the question is how many of those new jobs are going to be there and will those new jobs really be a good match for the people who are going to need jobs. Because if all the new jobs you're creating are for robotics engineers and A.I. researchers and data scientists then those are not jobs that can be done by people that are now flipping hamburgers or driving a taxi in most cases. That does create a problem.

An industrial robot is defined as "an automatically controlled, reprogrammable, multipurpose manipulator programmable in three or more axes, which can be either fixed in place or mobile for use in industrial automation applications" (International Federation of Robotics 2016). Following this definition, a classification test would have required a clear answer to the following three questions:

- Does it have multiple purposes?
- Can it be reprogrammed to perform another task?
- Does it require a human control for performing its task?

While our coffee machine or the elevator at our home building does not pass this classification test, fully autonomous machines that do not need a human operator and that can be programmed to 126 GEORGIOS PETROPOULOS perform several manual tasks such as welding, painting, assembling, handling materials or packaging are classified as industrial robots.

Figure 1 presents the number of operational industrial robots per thousands of workers in China, the EU and the US. The EU so far has been the region with the most robots in operation, followed by the US while China is behind.

Source- https://www.plantautomation-technology.com/articles/top-10-countries-with-highest-industrial-robots-density

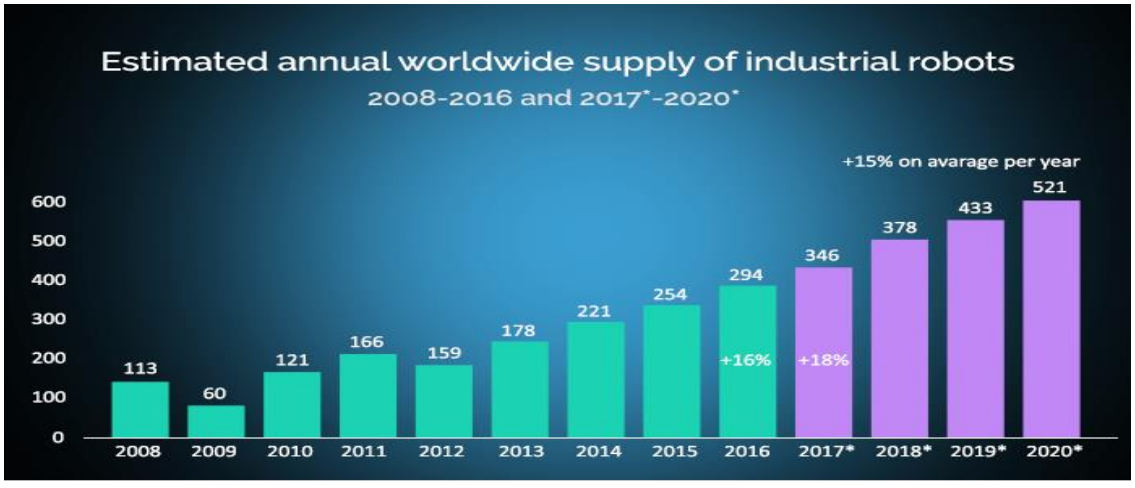


Figure 1 Estimated annual worldwide supply of industrial robots.

Shows how the operational industrial robots per thousands of workers are distributed in different sectors in EU countries. So far, the EU automotive industry has introduced by far the most industrial robots in its production process, followed by the plastic and chemicals sector.

I estimate that between 1990 and 2005 the price of industrial robots in six major developed economies fell by approximately one-half or one-fifth if we adjust for the quality of robots. Moreover, between 1993 and 2007, the stock of robots per million hours worked increased by more than 150%, from 0.58 to 1.48, in 17 countries of the sample, leading to significant productivity gains. The study also finds that in these countries increased use of robots per hour worked from 1993 to 2007 raised the annual Figure 1 Robot density in China, EU and US. Source: Data from International Labour Organisation (2017), IFR (2016). THE IMPACT OF ARTIFICIAL INTELLIGENCE ON EMPLOYMENT 127 growth of labour productivity by about 0.37 percentage points. When considering an industry-country panel specification, they find that robots appear to reduce the share of hours worked by low skilled workers relative to middle-skilled and high-skilled workers, they do not polarise the labour market, but appear to hurt the relative position of low-skilled workers rather than middle-skilled ones. Nevertheless, the use of robots per hour worked appears to boost total factor productivity and average wages. No significant impact on labour shares is found.

1.3 Jobs That Artificial Intelligence Will Create

The threat that automation will eliminate a broad swath of jobs across the world economy is now well established. As artificial intelligence (AI) systems become ever more sophisticated, another wave of job displacement will almost certainly occur.
It can be a distressing picture.

But here's what we've been overlooking: Many new jobs will also be created — jobs that look nothing like those that exist today.

More specifically, our research reveals three new categories of AI-driven business and technology jobs. We label them trainers, explainers, and strainers. Humans in these roles will complement the tasks performed by cognitive technology, ensuring that the work of machines is both effective and responsible — that it is fair, transparent, and auditable.

Looking at the labour displacement and productivity effects of AI on employment, the author argues that middle-level jobs that require routine manual and cognitive skilled are the ones that are most at risk. In the long run, initial labour displacement effects of jobs with routinized manual or cognitive skills, as in previous industrial revolutions, will be compensated for by the growth in non-routine jobs at the high and low end of the economy.
However, the speed of change today is significantly faster than it was in the past. The author focuses on the growth of machine learning and improved machine performance and explains how these advancements are produced through the development of so called 'deep neural networks' that are inspired by the architecture of the human brain. Although these are still very far from achieving the level of complexity associated with the human brain, on very specific tasks machines have outperformed humans.

It draws attention to the nexus between what is possible, and which firms will be willing to invest to implement these technologies. The introduction of multifunctional robots has been most extensive in the EU, followed by the US and China. The sectors that have adopted these with the greatest enthusiasm include car production, and plastic and chemical production, where job displacement effects will be felt the most.

Policymakers will need to develop a framework of rules for the operation of machines and AI systems. This should involve collective consultation with affected parties and experts, and a comprehensive debate on the regulation of the liability, safety, security and privacy of these technologies, alongside the updating of relevant skills and training programmes working with these new technologies.

1.4 Current State of Artificial Intelligence

Research in Artificial Intelligence began in the 1950s, though major breakthroughs, especially in the production of applied technology was not widespread. As a result of a series of milestones since 2012, including facial recognition software outperforming humans, investment into the field has increased tremendously (Andrade, 2014). Subsequent accomplishments such as AlphaGO beating the world's best human player at GO, further have spurred interest in the field, attracting the attention of researchers and investors (Burgess, 2016). Google, Microsoft, Amazon, and Apple have been on acquisition sprees to own the producers of the most advanced AI programs (Newman, 2017).

The successes in AI have been the result of a series of favourable circumstances that have enabled rapid development. First, the availability of Big Data, which is data that is of high volume, velocity, and variance, enabled by the advent of social media and massive data collection, provides researchers with a plethora of resources to train new programs (*From not working to neural networking*, 2016). Second, the falling cost of computing technology, and the advancements in hardware quality, such as the introduction of the Graphics Processing Unit in the 2000s, have given researches more room to experiment with AI (Tilley, 2016). Finally, the milestone achievements mentioned earlier have drawn media attention which further encourages investment in the field.

This new research paradigm attempts to mimic the patterns of mental thought, which unlike the computers that preceded, are capable of employing tacit knowledge, meaning they can

understand how to complete a task by observation and adaptation, similar to human learning (Autor, 2015). A number of significant technologies within Artificial Intelligence provide an underlying architectural system for mass scale implementation. A few key areas of AI: Machine Learning, a process by which algorithms learn by training sets how to solve problems without explicit rules; Computer Vision, by which technology can mimic human level navigation, such as in self-driving cars; and Natural Language Processing, such as the virtual assistants in smartphones that can process human languages, are leading the investment wave. Each has its own shortcomings currently, with an example being the failed Microsoft chat-bot that sparked criticism for learning from racist inputs (Waters, 2017).

Source: https://www.businessinsider.com.au/people-optimistic-ai-despite-thinking-will-take-jobs

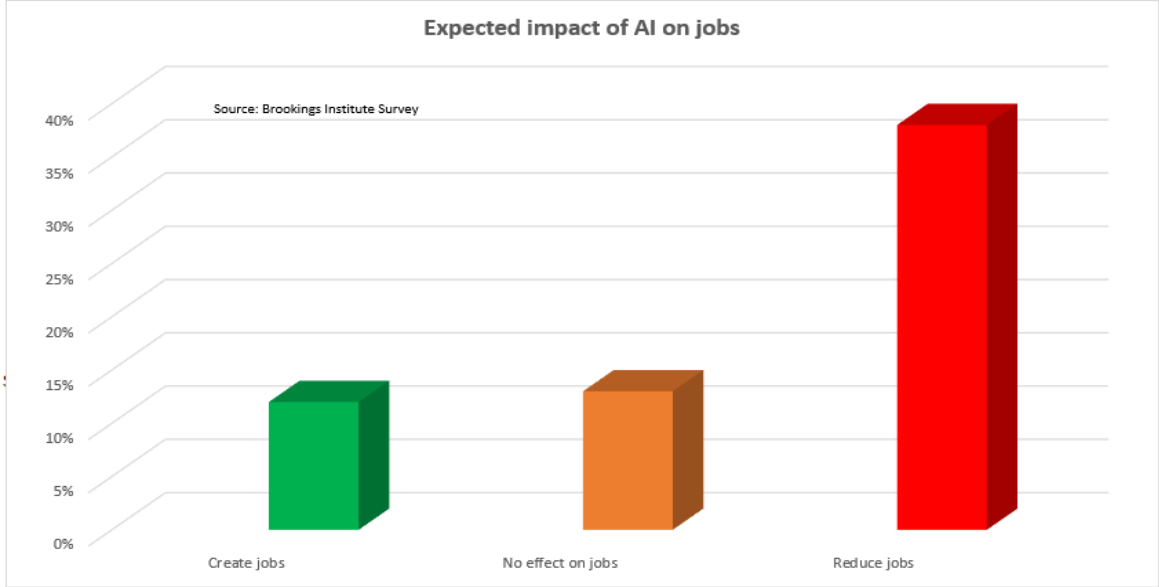


Figure 2- Expected Impact of AI on jobs

Advances in artificial intelligence (AI) are happening rapidly. There are new applications in finance, healthcare, transportation, national security, criminal justice, and smart cities, among other areas. Yet at the same time, there are questions about negative impacts on jobs and personal privacy.

Nonetheless, these technologies have already started to make their way into the everyday lives of consumers, altering their interaction with the world. Facebook algorithms use Machine Learning to cater news feeds to user interests; Netflix powers recommendations through analysing your preferences in ways that allow it to gather details about your movie tastes too difficult to spot simply by genre or other features; and advertisers have been able to better target their products to the wants and desires of consumers (Adams, 2017).

While most of the current uses of AI have been in consumer technologies, investment and research has gone into applying them into the medical, industrial, and transportation sectors, among others, as a result of their abilities to mimic human capabilities. Though products in these other domains are not currently prevalent, the underlying technologies to produce them is the same as what has gone into the consumer sphere. As a result, AI in its current state already has the potential to integrate into almost every aspect of our lives.

2. THEORETICAL BACKGROUND

2.1 Impact of automation on labour demand

How does a change in machine productivity affect the firm's demand for human labour by occupation?
First, consider a setup in which there is a single occupation with two tasks, only one of which can be automated. There are two levels of demand to consider: the firm's demand per unit of output, and the total units of output demanded by consumers. As machine productivity increases, the firm's demand for human workers per unit of output will unambiguously decrease. The human workers will be fully displaced from the automatable task; to the extent the two tasks are substitutes, fewer human workers will be demanded to perform the non-automatable task too.

However, this automation reduces the cost of the final good, and hence its price, leading consumers to demand more of it. This increase in final demand offsets the reduction in per-unit labour demand, and could even lead to a net increase in labour demand. This scenario has been developed in detail in the literature. For example, Bessen (2015) argues that ATMs, which automate some of the tasks of bank tellers, increased demand for that occupation by reducing the cost of opening new bank branches. While bank tellers per branch decreased, banks opened sufficiently many new branches that the overall number of tellers increased.

To bring an additional channel into focus, consider a setup with two occupations, in which each occupation consists of two tasks. In the first occupation, one task can be automated, while the other can only be performed by a human. In the second occupation, neither task can be automated.

Most exposed occupations	Least exposed occupations
Clinical laboratory technicians	Animal caretakers, except farm
Chemical engineers	Food preparation workers
Optometrists	Mail carriers for postal service
Power plant operators	Subject instructors, college
Dispatchers	Art/entertainment performers

Table 1- Occupations with highest and lowest exposure to artificial intelligence.

2.2 Problems with automation

In the past few years, artificial intelligence has advanced so quickly that it now seems hardly a month goes by without a newsworthy AI breakthrough. In areas as wide-ranging as speech translation, medical diagnosis, and gameplay, we have seen computers outperform humans in startling ways.
This has sparked a discussion about how AI will impact employment. Some fear that as AI improves, it will supplant workers, creating an ever-growing pool of unemployable humans who cannot compete economically with machines.
This concern, while understandable, is unfounded. In fact, AI will be the greatest job engine the world has ever seen.
On the one hand, those who predict massive job loss from AI can be excused. It is easier to see existing jobs disrupted by new technology than to envision what new jobs the technology will enable.

But on the other hand, radical technological advances aren't a new phenomenon. Technology has progressed nonstop for 250 years, and in the US unemployment has stayed between 5 to 10 percent for almost all that time, even when radical new technologies like steam power and electricity came on the scene.

But you don't have to look back to steam, or even electricity. Just look at the internet. Go back 25 years, well within the memory of today's pessimistic prognosticators, to 1993. The web browser Mosaic had just been released, and the phrase "surfing the web," that most mixed of metaphors, was just a few months old.

If someone had asked you what would be the result of connecting a couple billion computers into a giant network with common protocols, you might have predicted that email would cause us to mail fewer letters, and the web might cause us to read fewer newspapers and perhaps even do our shopping online. If you were particularly farsighted, you might have speculated that travel agents and stockbrokers would be adversely affected by this technology. And based on those surmises, you might have thought the internet would destroy jobs.

Another problem for developing countries such as India, Thailand or China is the lack of social security systems. Possible mass unemployment could lead to human catastrophes and a wave of migration. Accordingly, the same rule applies to developing countries as to developed countries: jobs with low or medium qualification requirements will be eliminated in the end. The only difference is that in developing countries there will be more routine jobs with lower or medium qualification requirements. About 47 per cent of total US employment is at risk, whereas 70 per cent of total employment in Thailand or India is at risk.

But now we know what really happened. The obvious changes did occur. But a slew of unexpected changes happened as well. We got thousands of new companies worth trillions of dollars. We bettered the lot of virtually everyone on the planet touched by the technology.

2.3 How bad is it going to be?

The concern of Artificial Intelligence (AI) taking over everyone's jobs is becoming increasingly urgent as recent AI breakthroughs (like Alpha Go, IBM Watson, self-driving cars, and many more) attract public attention. As AI progresses, some believe that it will steadily and inevitably take over large sectors of the workforce and will bring mass-scale unemployment and social unrest. One widely cited estimate, from a 2013 study, is that as much as 47% of current US jobs are at risk of automation.

I describe how jobs that we thought must require a human touch and are therefore safe from AI aren't so immune after all. A quick example should convince you how a number of AI-based technologies can unwittingly collude to make this possible: driverless cars, robotics, payment systems, vision, and natural language understanding for a start. These form a synergistic continuum that, in the restaurant experience alone, can eliminate the parker (valet), barker (doorman), greeter, checker (coat and hat), sweater, order-taker, server, sommelier, manager, entertainer, cleaner, and cashier. Let's not forget, tucked away in the kitchen, possibly robotic cooks. Let's face it, fast food burgers don't require a 5-star chef, do they?

All this is widely available on search engines for your reading pleasure (or agony, depending on your viewpoint). But what you won't see as much is the bigger revolution in jobs that I think is inevitable, whether one likes it or not, a revolution that will take place quietly at first, and then with increasing impact.

This revolution will have a much deeper impact than the mere (!) loss of jobs, devastating as job losses can be. After all, unemployment is nothing new. Anyone remember the following industries? Buggy whip makers, switchboard operators, or lift operators? How about knocker-uppers, aka wake-uppers: people whose job was to knock on the outside of your window to wake you up at a specified time in the morning; seriously, that used to be a job 100 years ago before the widespread use of the alarm clock!

Except for the most ardent Luddites, all reasonable people accept this as the price of progress and adapt in their own way. This adaptation is possible mostly because of the disruption caused by automation generally takes a long time to make a whole industry totally extinct.

Here is what I believe about AI and job loss:

Q: Will automation, specifically AI-driven automation, eliminate jobs?

A: Yes. Lots of them and in the most unexpected ways and at an unexpected pace.

Q: Will lost jobs be replaced by other jobs, just as it happened so far throughout history?

A: Only to a limited extent; there will be a massive net loss of jobs. I know many scientists and thought-leaders whom I respect a lot are predicting a huge increase in AI-related jobs to more or less compensate for the losses. I think this time they are wrong. When jobs were lost to mechanization, jobs for the mind opened up.

What will happen when jobs for the mind become unnecessary or uneconomical?

Let's step back for a second and look at this objectively. The reason we need jobs is so we can pay our bills, buy things, and fulfill our desires. What we really want aren't jobs but the income that jobs bring us. What we need is work (not jobs) for self-fulfilment, and therein lies an enormous difference.

What proportion of workers can truly claim that they love their jobs? Talk is cheap. The acid test is this: If you were to win a lottery jackpot worth several millions, would you continue to work at your current job, perhaps for free? I suspect that even those who claim that they really, really love their jobs would re-examine their options if they hit the jackpot. People may continue working, but they wouldn't hanker after paying jobs, especially not jobs that are ridden with stress, abuse, harassment, and office politics.

Isn't this the promise of automation? Let's take a walk down a path that admittedly stretches our credulity. Imagine a future where most of the work is automated, thanks to AI. This would include farming, transportation of goods, personal transportation, maintenance of roads, generation of power, manufacturing, custodial services, interaction services (for example, customer service and in restaurants), medical care, elderly care, schooling, and so on.

I'm not saying humans will be—or even could be—completely eliminated from the equation, only that their role will become either minimal or move up the cognitive scale; they would function as casual supervisors or auxiliary helpers when things get really tricky, and that too on very reduced work hours.

When AI eliminates jobs (more accurately, the need for them), there is the obvious loss of income. This means less disposable income and reduction of spending on nice-to-have goods and luxuries. Less demand forces prices to drop. If prices drop below a level where commodity margins are threatened, the company and eventually the industry, will fold.

Prices of necessary goods (generally, commodities) will continue to drop, but shrinking margins are somewhat offset by decreasing operational costs (thanks to AI-driven automation). Food prices, for example, could go down. Remember that the sinister food cartels that we fear (whether truly sinister or not) cannot keep charging seemingly high prices because consumers' inability to pay cannot sustain high prices in the long run.

Rather than outright and widespread job loss, what I think will happen is a gradual lessening of work hours, eventually moving employees from full-time to temp. But, if all things go well, the loss in pay need not pinch because there will be a corresponding decrease in costs for all types of goods.

People will slowly come to the realization that total income is less important than relative income. Indeed, income that is measured relative to one's neighbour is even less important than measuring against its economic power. Would you lose much sleep if your six-figure salary got cut in half if home prices were also slashed to a fifth, a pound of filet mignon cost $1.50, and a

10-lb bag of potatoes cost 10 cents? Would you really care if the richest person on the planet makes one hundred million times more income than you do under these conditions?

I don't think people would worry so much about the end result if all things go well. The problem is in the transition, of course. Not all things go well all the time. But the general direction will be towards less job-related work without any corresponding reduction in the quality of life (and perhaps an overall improvement in the quality of lifestyle). This progress will obviously not happen in a straight, happy path, but will meander agonizingly, causing considerable distress, backtracking, and excitement along the way.

In truth, I suspect that there will be plenty of advance notice of impending job loss. A few hundred thousand truck drivers aren't going to show up for work one morning only to be told that they have all been replaced overnight by driverless trucks. Drivers' ed instructors will not be completely blindsided to find one day that they have no students because everyone switched over to driverless cars. The entire DMV staff isn't going to be laid off on the same day because autonomous vehicles and block chains put them out of business overnight.

2.4 Corrective treatments

I study the kinds of individuals who work in occupations that are highly exposed to each technology. I find that individuals with less than high school education, and in low-wage occupations, are most exposed to robots. Men under age 30 are most exposed, consistent with robots 'substituting for what might be termed "muscle" tasks. For software, exposure is decreasing

Since the second half of the 1990s, productivity growth has accelerated in the US due to the Information Technology (IT) Revolution. However, the productivity effects of traditional types of IT were exhausted by mid-2000 (e.g. Fernald 2015). Today, the impacts of artificial intelligence (AI) and robotics―referred to as the Fourth Industrial Revolution―on the future economy and society is attracting attention, and many speculative arguments have arisen regarding the possible effects of the Fourth Industrial Revolution. In particular, the substitution of human labour by AI and robots is being hotly discussed.

The Japanese government has begun efforts to develop and diffuse AI and robotics technologies. The Robot Revolution Initiative Council was established in 2014 and has published a report, New Robot Strategy, which includes a five-year action plan to realise the robot revolution. The Artificial Intelligence Research Centre was established in the National Institute of Advanced Industrial Science and Technology (AIST) in 2015 to promote development of AI-related innovations. The Japan Revitalization Strategy 2016, which is the core growth strategy of Bionomics, places the Fourth Industrial Revolution at the top of the growth policy agenda.

There have been numerous studies on the complementarity/substitutability of IT and the skills of workers. Earlier studies have presented evidence based on the skill-biased nature of IT that indicate skilled labour and IT are complementary, but that unskilled labour and IT are

substitutes. More recent studies have shown that IT substitutes for routine tasks conducted by middle-skilled workers, which results in the polarisation of the labour market. Although the discussion about the impact of AI and robotics on employment is a natural extension of the studies on the relationship between IT and labour, quantitative evidence on this issue has been scarce.

The estimation by Frey and Osborne (2013) of the number of jobs at risk to be replaced by future computerisation, including advances in machine learning and mobile robotics, has attracted attention of the media and policy practitioners. According to their study, roughly 47% of total US employment is at risk from computerisation.

On the other hand, Mokyr et al. (2015) survey the historical lessons learned since the Industrial Revolution in the late 18th century and argue that computers and robots will create new products and services and that these product innovations will result in unimaginable new occupations. However, we cannot deny the possibility that the impact of the Fourth Industrial Revolution is different from the past innovations.

3. LITRATURE REVIEW

3.1 "Artificial Intelligence: the impact on employment and the workforce"

By George Krasadakis

Although Artificial Intelligence dramatically improves our world in many ways, there are notable concerns regarding the forthcoming impact of A.I. on employment and the workforce.

There are predictions talking about millions of unemployed people in the next decades — primarily due to the impact of Intelligent Automation and A.I. systems.

In any case, the entire socioeconomic system is entering a phase of accelerating transformation: markets, businesses, education, government, social welfare, and employment models will be severely impacted.

Tasks that are monotonous, can be easily automated; this can gradually make certain roles obsolete. For instance, tasks and activities related to customer care/call center operation, document classification, discovery and retrieval, content moderation are more and more based on technology and automation and less on human work. The same is true for roles related to operation and support of production lines and factories: humans are being replaced by smart robots that can safely navigate the space, find and move objects (such as products, parts or tools) or perform complex assembling operations.

A.I. proves to be very effective in handling even more complex activities — those requiring processing of multiple signals, data streams and accumulated knowledge in real-time. A characteristic case is the autonomous vehicles that can capture and 'understand' the environment and its dynamics; they can 'see', decide and act in real-time, towards well-defined optimization objectives.

3.2 How will automation impact jobs?

By John Hawksworth, Chief UK Economist, PwC United Kingdom

AI, robotics and other forms of smart automation have the potential to bring great economic benefits, contributing up to $15 trillion to global GDP by 2030 according to PwC analysis. This extra wealth will also generate the demand for many jobs, but there are also concerns that it could displace many existing jobs.

We have analysed in detail the tasks involved in over 200,000 existing jobs across 29 countries to assess what the potential for automation may be at various points over the next 20 years.

During the first wave, we expect relatively low displacement of existing jobs, perhaps only around 3% by the early 2020s. But job displacement could increase in later waves as these technologies mature and are rolled out across the economy in increasingly autonomous form.

By the mid-2030s, up to 30% of jobs could be automatable, with slightly more men being affected in the long run as autonomous vehicles and other machines replace many manual tasks where their share of employment is higher. During the first and second waves, however, women could be at greater risk of automation due to their higher representation in clerical and other administrative functions (see chart).

These estimates are median values across 29 countries, with the UK being very close to the average. Long-term automation could be lower at only around 20-25% in Asian and Nordic countries, but could be higher at over 40% in some Eastern European countries according to our analysis. Explore the results further for your country using our data analysis tool. You can also download the full report for more detailed analysis and commentary.

In the short term, the impact of automation may be low for workers of all education levels, but in the long run our estimates show that those with lower education levels could be much more vulnerable to being displaced by machines (see chart).

Governments and business need to work together to help people adjust to these new technologies through retraining and career changes. A culture of adaptability and lifelong learning will be crucial for spreading the benefits of AI and robotics widely through society, particularly with an ageing population where we need people to be able to work for longer.

Improved STEM skills will be important in allowing people to take the high technology jobs that will arise out of AI and robotics, but soft skills will also be important in making people adaptable and employable throughout their working lives.

3.3 The Impact of Artificial Intelligence – Widespread Job Losses

By Calum McClelland

There's no question that Artificially Intelligence (AI) and Automation will change the way we live; the question isn't if, it's how and when. In this post, I'll be exploring both optimistic and pessimistic views of how artificial intelligence and automation will impact our future workforce.

Technology-driven societal changes, like what we're experiencing with AI and automation, always engender concern and fear—and for good reason. A two-year study from McKinsey Global Institute suggests that by 2030, intelligent agents and robots could replace as much as 30 percent of the world's current human labor. McKinsey suggests that, in terms of scale, the automation revolution could rival the move away from agricultural labor during the 1900s in the United States and Europe, and more recently, the explosion of the Chinese labor economy.

Source- https://web.stanford.edu/~mww/webb_jmp.pdf

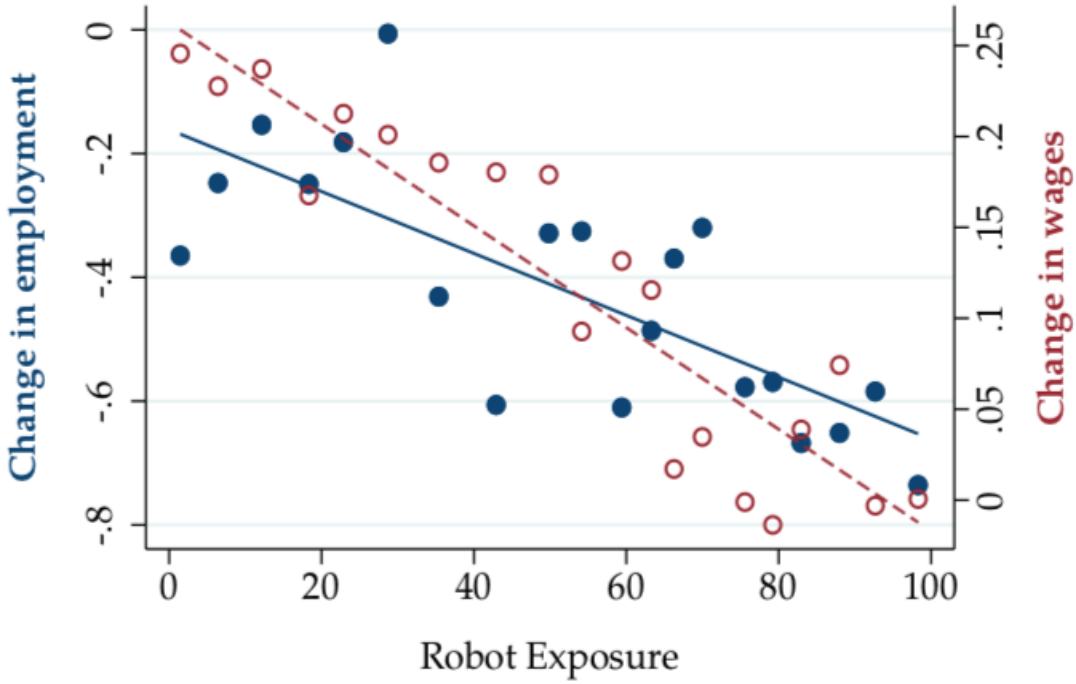


Figure 3- Change in employment and wages 1980-2010 by exposure to robots.

McKinsey reckons that, depending upon various adoption scenarios, **a**utomation will displace between 400 and 800 million jobs by 2030, requiring as many as 375 million people to switch job categories entirely. How could such a shift not cause fear and concern, especially for the world's vulnerable countries and populations?

The Brookings Institution suggests that even if automation only reaches the 38 percent means of most forecasts, some Western democracies are likely to resort to authoritarian policies to stave off civil chaos, much like they did during the Great Depression. Brookings writes, "The United States would look like Syria or Iraq, with armed bands of young men with few employment prospects other than war, violence, or theft." With frightening yet authoritative predictions like those, it's no wonder AI and automation keeps many of us up at night.

3.4 Research Shows How AI Will Impact the Workforce

By RBR Staff

A pair of new studies announced today show how the impact of artificial intelligence into the workforce will affect employees, their jobs, and what companies are doing to prepare for this new world.

The first study, from the MAPI Foundation, said that the introduction of AI into the manufacturing value chain will create new hybrid roles, where humans enable machines, and AI augments human capabilities. The second study, sponsored by Genesys, shows that jobs in the manufacturing, retail, telemarketing, and data entry space are most likely to shrink due to AI expansion, yet most respondents said they are not afraid that AI/bots will replace their own jobs within the next 10 years.

Manufacturing impact

In the first study, "How AI Will Transform Manufacturing and the Workforce of the Future", authors Robert Atkinson and Stephen Ezell from the Information Technology and Innovation Foundation (ITIF) said that within the next five years, manufacturers will see significant growth in AI through machine vision, intelligent products, machine learning, and cobots – both within factories and throughout the supply chain. They said this will lead to "a myriad of new types of AI-related jobs in manufacturing."

In a survey of U.S.-based manufacturers, almost three-fourths of them have not introduced new types of AI-related jobs into their companies, and only 20% have comprehensively re-evaluated job roles, titles, levels, and pay scales, in recognition of the need to attract employees with AI skills. But the authors note that this is changing quickly.

New roles in manufacturing include 'data quality analyst' and 'machine learning engineer', according to a new survey.

The study said more than 40% have created "data scientists/data quality analysts" in their workforces, and 35% said they expect to do so within the next five years. Manufacturers are also creating "machine learning engineers or specialists" (33% today, 70% within five years), "collaborative robotics specialists" (29% today, 27% within five years), and "data-quality analysts" and "AI solutions programmers/software designers" (26% today, 40% within five years).

"Manufacturing is already facing a working shortage, and advanced technologies create additional technical and workforce challenges to find and retain talent with the necessary digital skills," said Stephen Gold, president of the MAPI Foundation. "Companies that acquire and cultivate new digital-related skills will have a distinct advantage as AI reshapes the industry, including identifying new roles for AI-focused jobs, such as leading AI strategy and supervising implementations."

3.5 The Impact of AI on Inequality, Job Automation, and Skills of the Future.

By Michael Burkhardt

The basic reality is that the vast majority of people on planet Earth really only have one thing of value and that is the value of their labor. The vast majority of people even in countries like the United States, which is obviously a very wealthy country, really don't own much in the way of property. The number of people that own enough capital that would sustain them, so that they do not have to work is very small, and if you look throughout the whole world globally, it is even smaller.

Most people rely on the value of their labor and what's going to happen as a result of advancing artificial intelligence and robotics is that a lot of that labor is going to be devalued and this labor is simply not going to be worth as much because technology is going to be able to do a lot of the routine, repetitive, predictable type of jobs and tasks that people are now paid to do.

Maybe within 10 or 15 years, it will be quite obvious what's happening and that is going to be an enormous challenge for our society in terms of figuring out how to structure our economy and change things around so that we can all continue to thrive in that world.

10 to 15 years is not very distant into the future. What makes you certain that the advancements are happening at such a rapid pace?

10 to 15 years is a guess and it certainly could turn out to take longer than that. The main point is that I think it's inevitable and it really does not matter too much whether it's 10 years or 20 years or even 30 years. Ultimately it's something that we're going to have to deal with.

3.6 THE IMPACT OF ARTIFICIAL INTELLIGENCE ON EMPLOYMENT

By Georgios Petropoulos

Technological development, and in particular digitalisation, has major implications for labour markets. Assessing its impact will be crucial for developing policies that promote efficient labour markets for the benefit of workers, employers and societies as a whole. Rapid technological progress and innovation can threaten employment. Such a concern is not new but dates back at least to the 1930s, when John Maynard Keynes postulated his 'technological unemployment theory' – technological change causes loss of jobs (Keynes 1937).

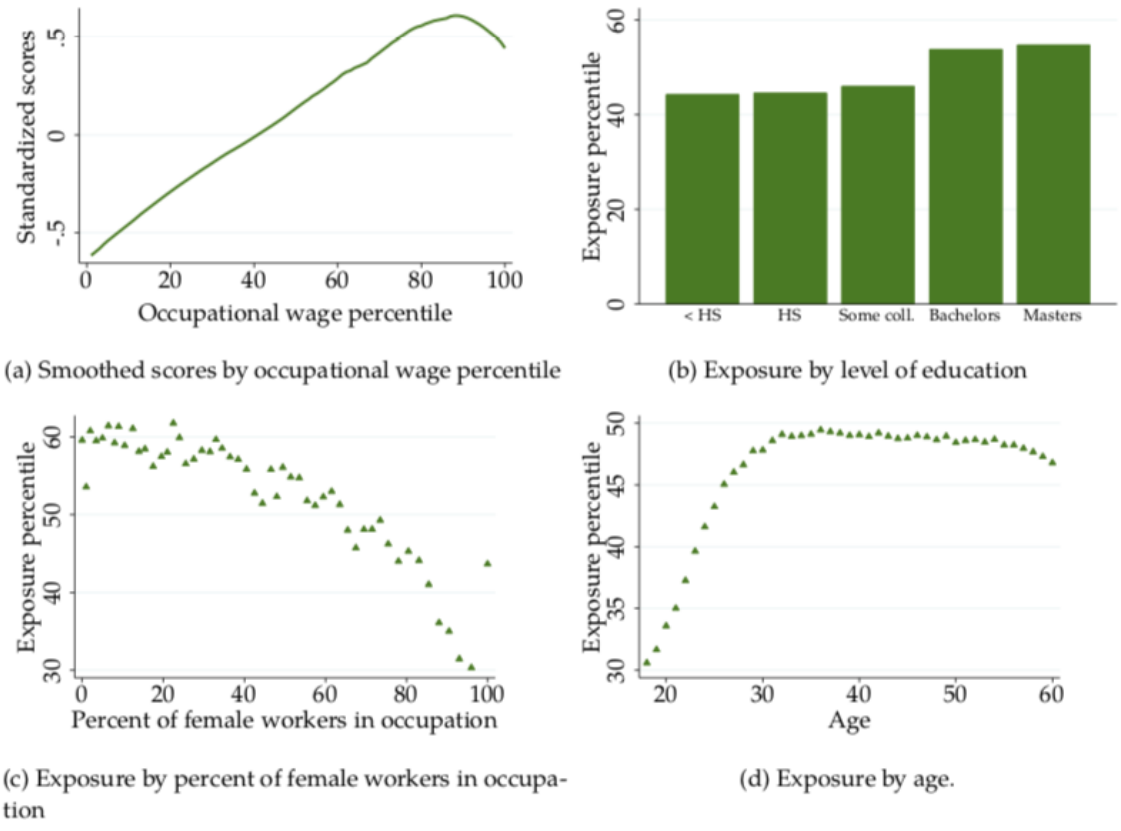
Technological innovations can affect employment in two main ways:

- By directly displacing workers from tasks they were previously performing (displacement effect)

• By increasing the demand for labour in industries or jobs that arise or develop due to technological progress (productivity effect).

Autor, Levy and Murnane (2003) stress that technology can replace human labour in routine tasks, whether manual or cognitive, but (as yet) cannot replace human labour in non-routine tasks. Goos THE IMPACT OF ARTIFICIAL INTELLIGENCE ON EMPLOYMENT Georgios Petropoulos1 120 GEORGIOS PETROPOULOS and Manning (2007) argue that the impact of technology leads to rising relative demand in well-paid skilled jobs, which typically require non-routine cognitive skills, and rising relative demand in low-paid, least-skilled jobs, which typically require non-routine manual skills.

Source- https://web.stanford.edu/~mww/webb_jmp.pdf



(a) Smoothed scores by occupational wage percentile

(b) Exposure by level of education

(c) Exposure by percent of female workers in occupation

(d) Exposure by age.

Figure 4- Exposure to AI by demographic group

At the same time, demand for 'middling' jobs, which have typically required routine manual and cognitive skills, will fall. The authors call this process job polarisation. Acemoglu and

Autor (2011) found similar results for the US, while Darvas and Wolff (2016) report such developments for a selection of EU countries: France, Germany, Italy, Spain, Sweden and the UK.

In all these countries, the number of high-education jobs such as managers, engineers and health professionals is growing, while the number of middle-education jobs (clerks, machine operators, assemblers) is declining. By contrast, the number of low-education service occupations, such as shop workers, which are non-standard and difficult to replace by automation, is growing.

A key conclusion is that technology was incorporated into the subset of core job tasks previously performed by middle-skill workers, causing substantial change. The quality of human capital also plays a crucial role.

The ability of individuals to use the technological advances for the benefit of their work requires developing particular digital skills through well designed policies. This underlines the importance of using appropriate instruments to ensure that workers are well prepared to harness the disruptive forces of digital technologies.

3.7 Evidence on AI from theoretical economic models

Recent theoretical work in economics aims to provide a framework to specifically understand the impact of AI on employment, including both its immediate, first- order effects, and following, second-order effects. The main findings from this literature suggest the following:

- A number of factors can counterbalance initial declines in labour demand due to automation. As automation increases productivity (leading to better or cheaper products), increasing consumer demand, greater investment, and innovation can lead labour demand to rise.
- In the short term, it is not clear whether countervailing effects will be sufficient to offset potential job losses from automation. Even if they are, transitions could be challenging. But new jobs could be generated, in principle, in the same industries where automation is taking place.
- In the long term, as production processes are re-organised, countervailing effects are expected to become stronger and fully compensate the initial decline in work demanded by businesses that have adopted AI to automate production. However, workers who have been directly displaced could experience a fall in their earnings relative to other workers (and potentially in absolute terms). This would increase inequality if the displaced group is mostly composed of low earners.

- The competitiveness of product and labour markets is important to drive better outcomes for workers. The results above typically assume that product and labour markets are competitive, that is, consumers can choose between different products and workers can choose between different employers. This is not always the case, as acknowledged in some of this literature. In particular, lack of competition in labour markets would mean that productivity benefits from automation flow into greater profits rather than into higher wages. There is some concern that digital technology may enable large firms to increase and maintain their market power. There is on-going research on this but evidence is still limited.

These models suggest that automation can lift living standards for all, but this is not necessarily true in the short term, and even in the long term inequality may increase as some workers benefit more than others. This is a departure from earlier economic theory, where technological progress was typically seen to benefit all workers under a broad set of conditions. It is worth noting that the nature of these models is to consider second-order effects of automation driven by price changes (the 'productivity effects' and impacts on 'consumer demand' mentioned above), but not to consider possible social or institutional changes and the effect these may have, in turn, on economic outcomes.

3.8 Evidence on the adoption of AI

This review has identified limited evidence on the adoption and diffusion of AI, though it has been noted that neither AI or other forms of digital technology appear to have led to significant productivity improvements in recent years. However, surveys of business leaders and predictions consider the following drivers of business adoption of AI:

- The profitability of investing in AI: technical feasibility will be a necessary condition, but AI will only be adopted when the expected revenues exceed the costs from adoption;
- The ability to re-shape organisations and processes in the ways needed to take advantage of the new technology;
- Regulatory enablers and constraints: adopting AI in a way that would ensure compliance with relevant regulations may not be possible; vice versa, regulation may enable adoption, for example by setting necessary standards;
- Social attitudes and preferences over the role of machines. In many settings, people may require interaction with a human even where a cheaper automated alternative could be available. This could be the case, for example, in the case of health and social care work.

The role of social factors in influencing the development and adoption of AI has been given less consideration compared to drivers of business adoption. But, insights from sociological research caution against considering technology as an autonomous force driving economic and social change. Research on earlier technological development suggests that social and technical factors are closely linked. For example, the choices around specific technical solutions depend on whether those solutions will be accepted by relevant social groups.

3.9 Quantified predictions about potential job losses and gains related to AI

Several studies aim to estimate the proportion of current jobs that could technically be automated in the future. These estimates aim to provide a sense of the scale of potential transformation that could be enabled by technology – specifically, the proportion of current employment for which the immediate, first-order effect of AI adoption could be radical transformation or displacement. This research relies on a small number of assessments of the technical automatability of existing work tasks, coupled with data analysis to investigate which job characteristics (for example, a requirement to interact with customers) are correlated with the assessed automatability. Two of these assessments are based on expert opinion, and a third uses a questionnaire disseminated on a crowdsourcing platform to score work tasks in terms of their suitability for machine learning, against pre- determined criteria.

There is significant uncertainty around when the potential automation described in this literature would be technically feasible and widely adopted.

Foresight exercises suggest that a number of trends could generate sufficient job creation to compensate for first-order job destruction linked to automation – even in the absence of any job creation from automation. However, the 'new jobs' may not have the same characteristics or emerge in the same places as the 'old' that are destroyed, and therefore adjustments may be challenging. The literature in this area suggests that occupations that are likely to grow between now and 2030 are disproportionately high-education, although some middle-education occupations are also likely to grow.

Evidence from the application of digital technology in specific settings and industries suggests that this is leading to changes in the organisation and quality of work:

- There are reasons for concern (e.g. potential loss of autonomy for many workers) and for optimism (e.g. automation of hazardous tasks);
- Evidence on the likely balance between the two is limited – outcomes are also likely to depend on the actions of employers, workers, governments, and other stakeholders.

4. Objectives and Hypotheses

4.1 Objectives

3.1.1 General Objective

To analyze the effect of Artificial Intelligence and Robotics on Jobs

3.1.2 Specific Objectives

1. To find the impact of automation on employees demand
2. To determine how dependable is artificial intelligence.
3. To determine the impact of AI on business and employment
4. To examine the transformation in skills required
5. To evaluate the cost of robots and AI vs regular workforce

4.2 Hypotheses

H_0 – There is no significant effect of automation on employment
H_1 – There is a significant effect of automation on employee demand

H_0 – There is no significant dependence on artificial intelligence totally
H_1 – There is significant dependance on artificial intelligence

H_0 – There is no significant change in work process.
H_1 – There are significant changes in way we work because of automation

H_0 - There is no significant upgradation required to meet the upcoming job requirements
H_1 – There is a significant upgradation required to meet the upcoming job requirements

H_0 - There is no significant change in cost because of artificial intelligence and robotics
H_1 – There is a significant change in cost because of artificial intelligence and robotics

5.RESEARCH METHODOLOGY

5.1 Introduction

This chapter describes the procedures that were followed in conducting the study. The research methodology dealt with research design, which was used to conduct the study. It covered the population of the study, the sample, sampling techniques, data collection instrument, data collection procedures and data analysis procedures. The section is a plan or a structure conceived to aid the researcher in answering the raised research questions.

5.2 Purpose of the study:

This research is conducted with the main purpose is to find out effect of automation and robotics on employment

To conduct any research, a scientific method must be followed. The universe study is very large in which it is difficult to collect information from all the employees. So the stratified random sampling method has been followed for the study, the analysis is based on primary data.

5.3 Research Objectives of the study:

Aim is to analyze the effects of automation and robotics on employment

5.4 Research Methodology of the study:

Research is something that people undertake in order to find out things in a systematic manner, thereby increasing their knowledge. It is noted that this definition captures two significant phrases: "systematic way" and "to find out things". "Systematic" suggest that research is based on logical relationships and not just beliefs (Saunders and Thornhill, 2009). It portrays the exact idea the researcher is carrying out (William, 2001). "To find out things" suggests that, there are multiple possibilities or purposes for your research. These may include describing, explaining, understanding, criticizing, and analyzing. Research methodology can be described as the framework associated with a particular set of assumptions that can be used to conduct research (O"Leary, 2004). Research methodology also involves considering the methods of data collection and the theories and concepts underpinning the research topic.

5.5 Research Design

Research can be characterized as exploratory, descriptive and explanatory (Saunders, Lewis & Thornhill, 2007). An exploratory study seeks to establish what is happening and explanatory study seeks to establish casual relationships between variables while a descriptive study seeks to portray an accurate profile of person, events or situations (Robinson, 2002). The descriptive research design attempts to describe, explain and interpret conditions of the present. It is a method of research which concerns itself with the present phenomena in terms of conditions, practices beliefs, processes, relationships or trends invariably. According to Aggarwal (2008), descriptive research is devoted to the gathering of information about prevailing conditions or situations for the purpose of description and interpretation. A descriptive research is concerned with conditions, practices, structures, differences or relationships that exist, opinions held and processes that are going on or trends that are evident (Aggarwal, 2008). The study employed descriptive research design to obtain information concerning the current status of the phenomena and to describe what existed with respect to variables or conditions in a situation. The study also adopted correlational type of descriptive research design which comprised of collecting data to determine whether, and to what extent, a relationship existed between talent management strategies and competitive advantage. The qualitative data collected was analysed thematically and conclusions drawn based on a common theme.

Research design which produces the least margin of error in experimental research can be touted as the best. The essential elements of research design are:

1. Accurate purpose statement of research design
2. Techniques to be implemented for collecting details for research
3. Method applied for analyzing collected details
4. Type of research methodology
5. Probable objections for research
6. Settings for research study
7. Timeline
8. Measurement of analysis

5.6 Sample unit

Employees from various organizations served as sample unit.

5.7 Sample Size:

54 Respondents Are Covered in this Research.

5.8 Sampling Method:

The research tool used for data collection was questionnaires. The questionnaire covered all the necessary information needed for the study. The developed questionnaires were distributed to and retrieved from the respondents through LinkedIn.

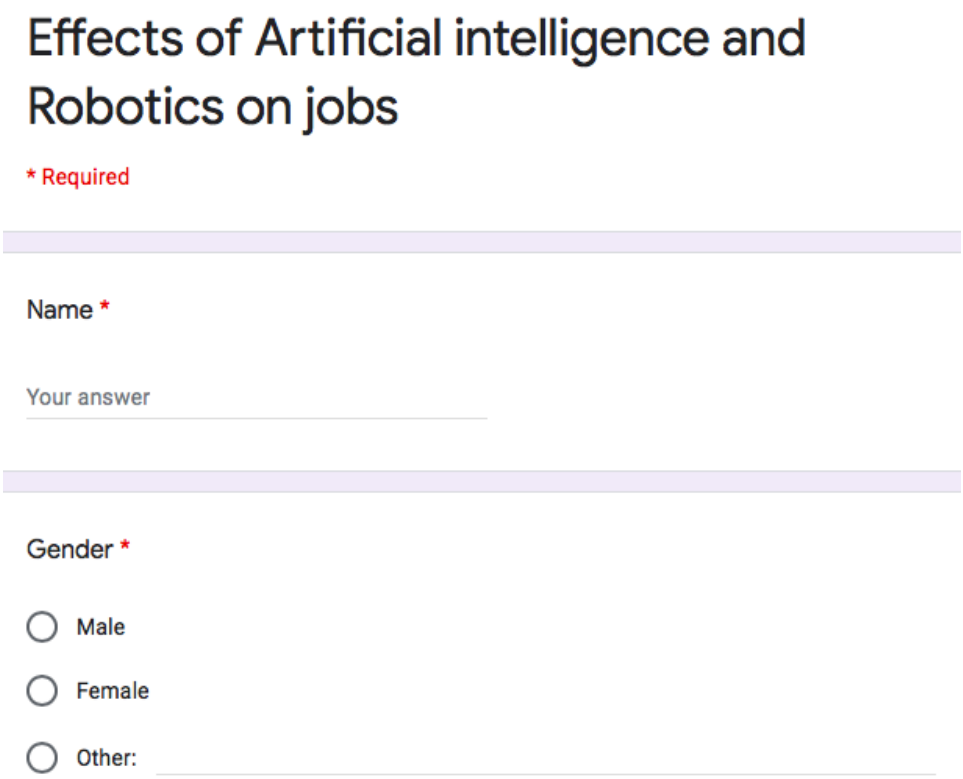
5.9 Data Collection Instruments

The study used only primary sources of data. The data was collected using questionnaires that contained both structured and unstructured questions that were both open and closed ended. This ensured uniformity and consistency of the answers given by various respondents. The researcher distributed the questionnaires through LinkedIn, Facebook,and Whatsapp because of lockdown as it was not possible to meet the respondents in person. The respondents were given three (3) weeks to complete the questionnaire.

5.10 Limitations:

1. Project duration is limited to 60 days only.
2. Some of the respondents could not spared much time to answer the questionnaire because of lack of their valuable time.
3. Complete information has not revealed by the companies for administrative reasons.

5.11 Questionnaire-



Age *

- Below 18
- 18-22
- 23-27
- 28-32
- Above 32

Do you think machines can totally take over all the work? *

- Yes
- No
- Maybe
- Cant say

Artificial intelligence and robotics changed our workplace? *

	1	2	3	4	5	
Strongly Disagree	○	○	○	○	○	Strongly Agree

What will be the role of future managers? *

- Developing AI Solutions
- Managing operations
- Handling workforce
- Handling machine data

How accurate you feel automation is? *

	1	2	3	4	5	
Least	○	○	○	○	○	Most

Which is the biggest limitation of artificial intelligence? *

- Inaccuracy
- Illogical
- Innovation
- Cost

Can robots handle more complicated jobs? *

- ◯ Yes
- ◯ No
- ◯ May be
- ◯ Cant say

Can humans beat automated machinery in future? *

- ◯ Yes
- ◯ No
- ◯ Maybe
- ◯ Cant say

How dependable and secure you feel artificial intelligence and chat bots are? *

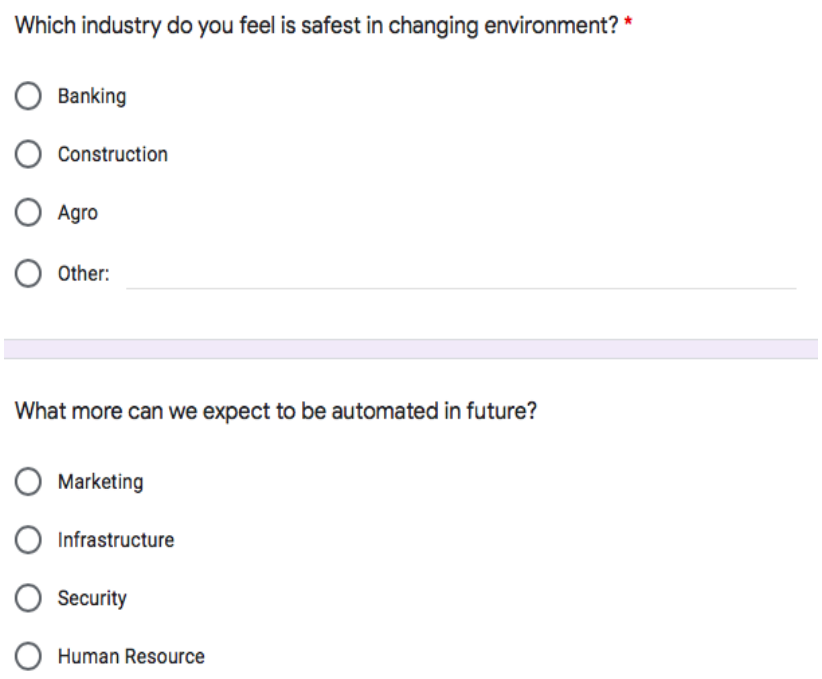
	1	2	3	4	5	
Least	◯	◯	◯	◯	◯	Most

What can be the possible ways to secure your job in future? *

- ◯ Grow your skill set
- ◯ Expertise
- ◯ Communication
- ◯ Commitments

Artificial intelligence reduce the cost of work. *

- ◯ Strongly disagree
- ◯ Disagree
- ◯ Neutral
- ◯ Agree
- ◯ Strongly agree



5.12 Data Collection Procedure

This is gathering of information from the nominated elements of study. The researcher distributed the questionnaires through LinkedIn, Facebook,and Whatsapp because of lockdown as it was not possible to meet the respondents in person. The researcher kept a register of all the questionnaires issued which provided an account of the questionnaires issued and those that were received back.

5.13 Data Analysis and Presentation

Data analysis is the process of bringing order, structuring and interpreting the mass of data collected. Before processing the responses, the collected data was prepared for statistical analysis. After the collection of data, it was recorded and analyzed using Statistical Package for Social Sciences (SPSS) and Microsoft Excel spreadsheets. For quantitative data, descriptive and inferential statistics were used to analyze where descriptive statistics was comprised of percentages, frequencies, means and standard deviations. The five hypotheses in the study were subjected to a test of 95% confidence level which formed a statistical basis for drawing conclusions. Each research variable was combined using SPSS to generate composite scores.

Analysis of Variance (ANOVA) was used to examine if the overall models were statistically significant by indicating whether or not R sq. could have occurred by chance alone. The analysis generated a P value of the F-ratio which should be less than 0.05 for the equation to be statistically significant.

6. RESEARCH FINDINGS AND DISCUSSION

6.1 Introduction

This chapter presents an analysis and findings of the study where a discussion on them is built.

6.2 Descriptive Statistics

This section presents descriptive results on the variables of the study. The study analyzed the data based on number of respondents (N), minimum (Min) score and maximum (Max) score given, the mean (Mean) and the standard deviation (Std. Deviation) in each variable. The section required the respondents to give their answers based on a scale of 1-5 for questions on various parameters shown in questionnaire.

6.3 Hypotheses Testing

The results of the hypotheses testing were analysed and presented as shown below –

6.3.1 Test of Hypothesis One

Impact of automation on employees demand.

In an industry or sector, automation increases worker productivity, which means that the same amount of output could be produced with fewer workers. However, more productive workers also earn higher wages, and lower production costs mean lower prices and more output demanded, which tends to raise employment.

Automation has the potential to transform future jobs and the structure of the labor force. As we discussed in the March edition of the *QEB*, automation in manufacturing has steadily decreased costs for decades, making US manufactures more competitive while also reducing the amount of labor required to produce them. Looking forward, technical advances in computing power, artificial intelligence, and robotics have created the potential for automation to penetrate deeply into occupations beyond manufacturing.

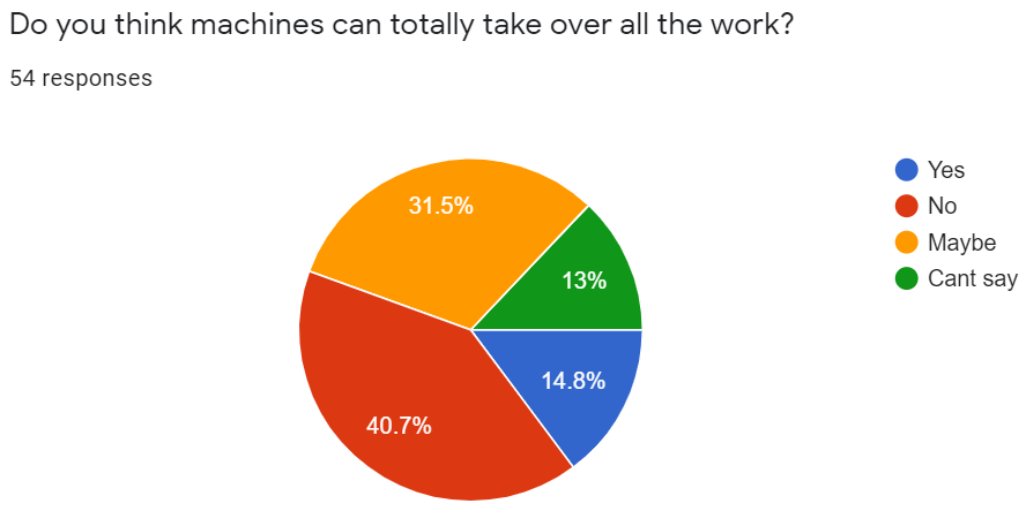


Figure 5- How many people believe machines can take over all the work

More than 40% people feel that no machinery cannot take all the work means there will be jobs in the market and we can also include people which opted maybe option means we strongly feel that machines and artificial intelligence is taking upon majority of the tasks and reducing human efforts but we will always require employees to perform their tasks.

We will present our analysis in two parts. This edition of the *QEB* provides historical context for automation and explains why automation in the future has the potential to change labor markets more dramatically than in the past. We review several recent studies that quantify the potential for automation expansion across occupations and economic sectors, and address the question of which jobs are most susceptible to automation.

Next we need to think upon what will be the roles of future managers for that we can look at our survey.

According to survey managers will be majorly involved in tasks related to managing operations as most of the work will be taken by automation and then handling the work force means more people will be managing automation then workforce.

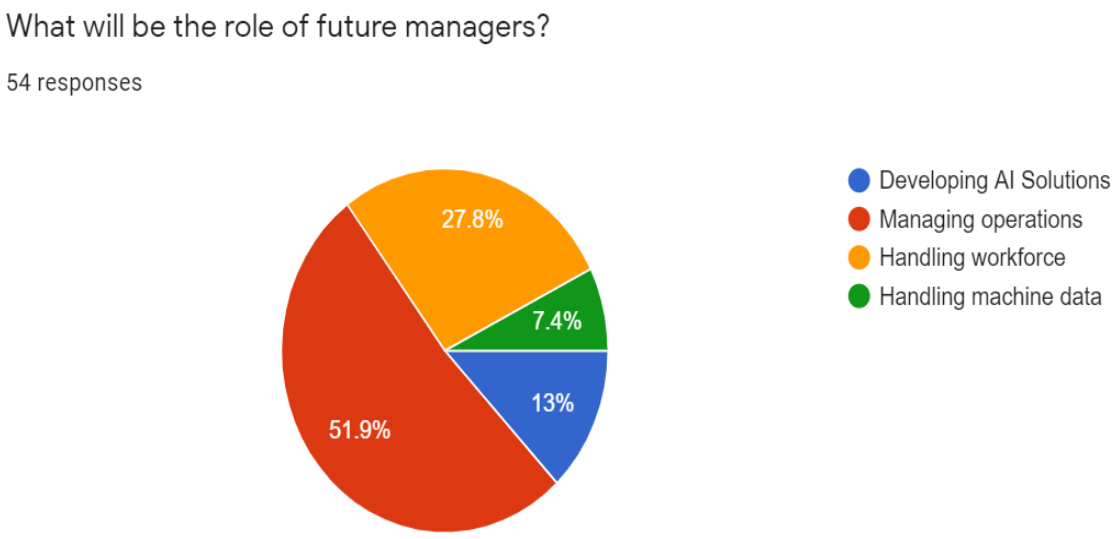


Figure 6- Role of future managers

Today, advances in artificial intelligence and machine learning enable software to detect patterns in data, allowing some nonroutine tasks and judgmental decisions to be automated. Combined with advances in mobile robotics, machine learning can even permit nonroutine manual tasks to be automated—tasks that could only be performed by humans in the past.

Therefore we accept the alternate hypothesis "Automation has adverse effect on employee demand" that because of automation where 100s of employees were indulged in one production activity now one machinery can do do 10times faster production accurately without getting tired so soon thus jobs are reduced with automation coming in process.

6.3.2 Test of Hypothesis Two

How dependable is artificial intelligence.

Hypothesis

H0 = We can not totally depend on artificial intelligence.

H1 = We can trust artificial intelligence totally.

The **t test** is one type of inferential statistics. It is used to determine whether there is a significant difference between the means of two groups. With all inferential statistics, we assume the dependent variable fits a normal distribution.

One-Sample Statistics

	N	Mean	Std. Deviation	Std. Error Mean
How accurate you feel automation is?	54	3.519	.9264	.1261
How dependable and secure you feel artificial intelligence and chat bots are?	54	3.889	.7931	.1079

One-Sample Test

	Test Value = 0					
					95% Confidence Interval of the Difference	
	t	df	Sig. (2-tailed)	Mean Difference	Lower	Upper
How accurate you feel automation is?	27.911	53	.000	3.5185	3.266	3.771
How dependable and secure you feel artificial intelligence and chat bots are?	36.035	53	.000	3.8889	3.672	4.105

As per the table the probability distribution plot indicates that each of the two shaded regions has a probability of 0.9264—for a total of 0.7931. This graph shows that t-values fall within these areas almost 6% of the time when the null hypothesis is true.

Therefore we accept the null hypothesis we cannot totally depend on artificial intelligence as there are limitations with it and we need proper supervision over artificial intelligence.

6.3.3 Test of Hypothesis Three

Impact on business and employment.

H0 = Automation has not changed the way we work

H1 = There are significant changes in way we work because of automation

Automation is not a new occurrence, and has contributed to significant shifts in employment throughout the 20th century. With the widespread adoption of the gas-powered tractor in the early 20th century, farmers experienced many benefits including the more efficient use of labor and increased production. This contributed to a decline in agricultural employment from close to 40% of total employment in 1900 to less than 2% since 2000.

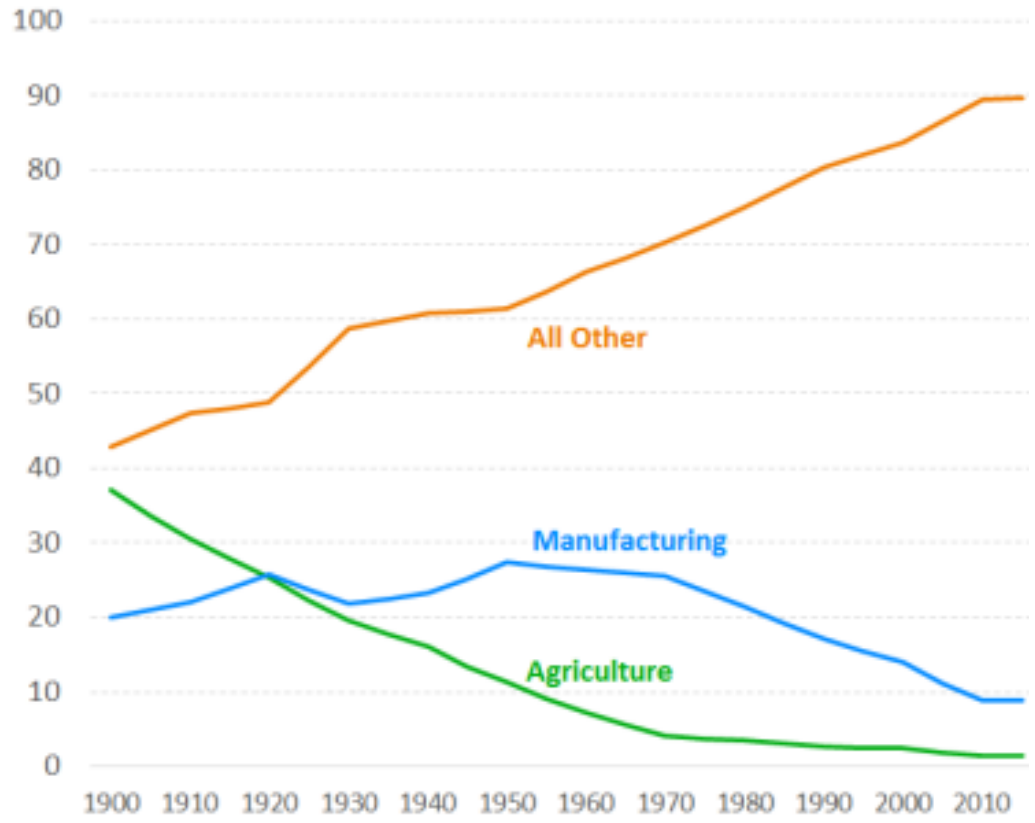


Figure7- Distribution of labour force by sector

Likewise, manufacturing's share of employment has also declined from a peak of over 25% in the 1950s to less than 10% currently. Much of this decline is due to automation. A Ball State University study found that 87% of the job losses in manufacturing from 2000 to 2010 were due to automation, while 13% were due to globalization and trade.

Automation has also contributed to an increase in output, as seen in Figure 2. Since 1990, manufacturing output *grew* 71.8% while manufacturing employment *fell* 30.7%. This means that in 2016 the United States produced almost 72% more goods than in 1990, but with only about 70% of the workers. Over the same period, US manufacturing labor productivity grew 140.1%[III]. Automation in manufacturing has decreased production costs, making US manufactures less expensive and more competitive by reducing the amount of labor required to produce them.

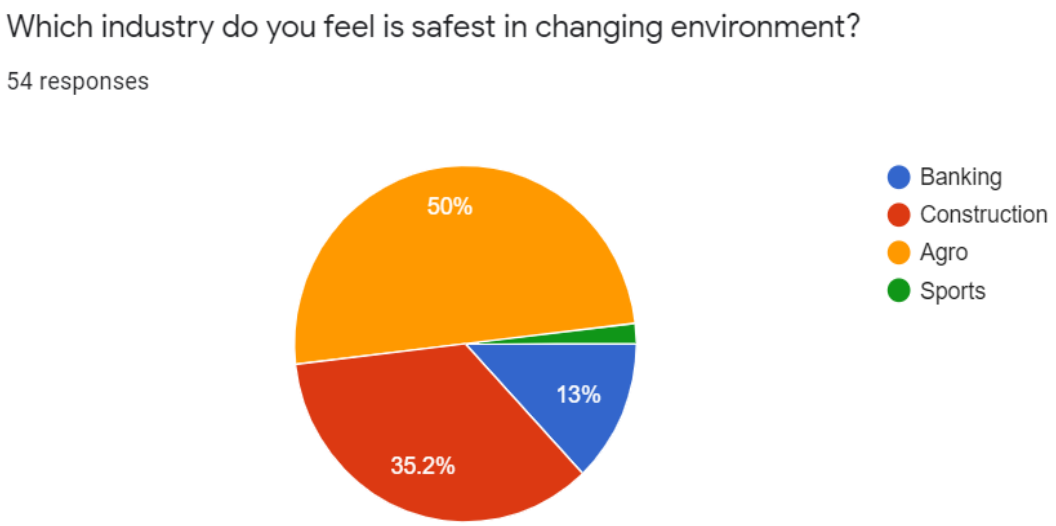


Figure 8- Industries safe from automation.

Until recently, automation displaced routine tasks that were predictable and could be easily programmed. This included assembly line robots in factories and computers to replace certain occupations such as switchboard operators. Today, advances in artificial intelligence and machine learning enable software to detect patterns in data, allowing some nonroutine tasks and judgmental decisions to be automated. Combined with advances in mobile robotics, machine learning can even permit nonroutine manual tasks to be automated—tasks that could only be performed by humans in the past.

After looking at the above graphs we can conclude that we accept the alternate hypothesis that automation has totally changed the way we work agriculture is been affected allot and employment in manufacturing is also reduced but in others it has increased more automation work is now part of the work.

6.3.4 Test of hypothesis four

Transformation in skills required

H0 = Traditional skill sets are enough to work in current time.

H1 = We need to develop our skills to meet the upcoming job requirements.

Descriptive Statistics

	Mean	Std. Deviation	N
What more can we expect to be automated in future?	2.333	1.0816	54
What can be the possible ways to secure your job in future?	2.019	1.0901	54

Correlation

Correlation or dependence is any statistical relationship, whether causal or not, between two random variables or bivariate data. In the broadest sense correlation is any statistical association, though it commonly refers to the degree to which a pair of variables are linearly related.

Correlations

		What more can we expect to be automated in future?	What can be the possible ways to secure your job in future?
Pearson Correlation	What more can we expect to be automated in future?	1.000	-.197
	What can be the possible ways to secure your job in future?	-.197	1.000
Sig. (1-tailed)	What more can we expect to be automated in future?	.	.076
	What can be the possible ways to secure your job in future?	.076	.
N	What more can we expect to be automated in future?	54	54
	What can be the possible ways to secure your job in future?	54	54

There is a negative correlation of -0.197 means more the automation will develop less secure our jobs will be value of P = 0.76.

Regression analysis is a powerful statistical method that allows you to examine the relationship between two or more variables of interest. While there are many types of regression analysis, at

their core they all examine the influence of one or more independent variables on a dependent variable.

Model Summary[b]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics					Durbin-Watson
					R Square Change	F Change	df1	df2	Sig. F Change	
1	.197[a]	.039	.020	1.0704	.039	2.108	1	52	.153	1.541

a. Predictors: (Constant), What can be the possible ways to secure your job in future?

b. Dependent Variable: What more can we expect to be automated in future.

Regression also gives you an R squared value, which for this graph is 0.39. This number tells you how good your model is. The values range from 0 to 1, with 0 being a terrible model and 1 being a perfect model. As you can probably see, 0.39 is a fairly decent model so you can be fairly confident in our prediction therefore we accept the null hypothesis that we continuously need to develop our skills in order to move equally with the progressive environment.

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	2.415	1	2.415	2.108	.153[b]
	Residual	59.585	52	1.146		
	Total	62.000	53			

a. Dependent Variable: What more can we expect to be automated in future?

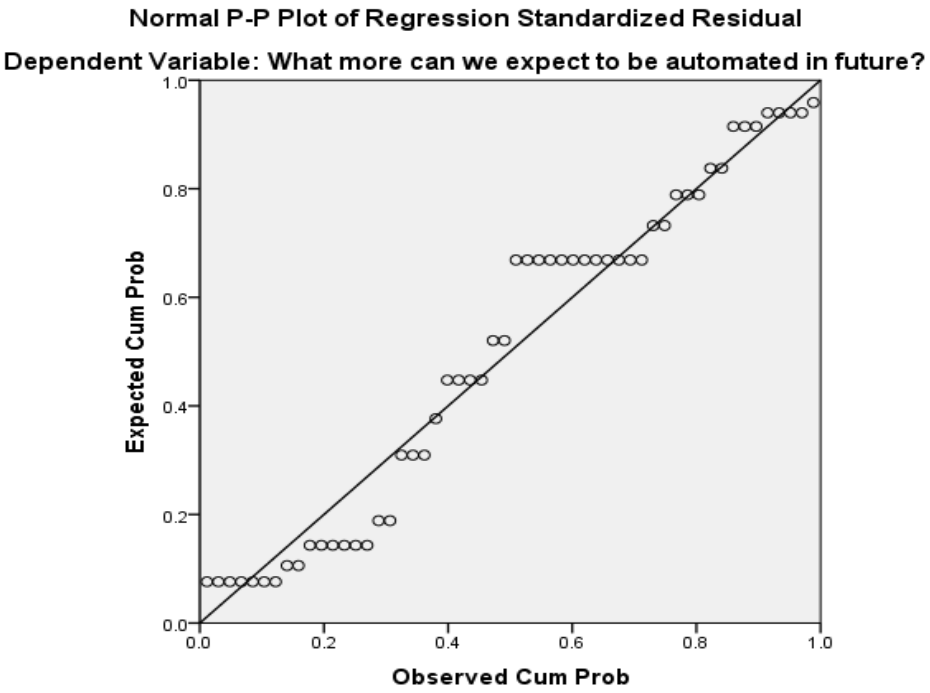
b. Predictors: (Constant), What can be the possible ways to secure your job in future?

Coefficients[a]

Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.	95.0% Confidence Interval for B		Correlations			Collinearity Statistics	
	B	Std. Error	Beta			Lower Bound	Upper Bound	Zero-order	Partial	Part	Tolerance	VIF
1 (Constant)	2.729	.309		8.837	.000	2.109	3.348					

What can be the possible ways to secure your job in future?	-.196	.135	-.197	-1.452	.153	-.466	.075	-.197	-.197	-.197	1.000	1.000

a. Dependent Variable: What more can we expect to be automated in future?



After looking at the graphs we can see that they are closely correlated and we have accepted the null hypothesis and need to develop our skills continuously.

6.3.5 Test of Hypothesis five

Cost of robots and AI vs regular workforce

H0 = There is no significant change in cost because of artificial intelligence and robotics

H1 = There is a significant change in cost because of artificial intelligence and robotics

Descriptive Statistics

	Mean	Std. Deviation	N

Artificial intelligence and robotics changed our workplace?	3.944	.8336	54
How accurate you feel automation is?	3.519	.9264	54

Correlation

Correlation or dependence is any statistical relationship, whether causal or not, between two random variables or bivariate data. In the broadest sense correlation is any statistical association, though it commonly refers to the degree to which a pair of variables are linearly related.

Correlations

		Artificial intelligence and robotics changed our workplace?	How accurate you feel automation is?
Pearson Correlation	Artificial intelligence and robotics changed our workplace?	1.000	-.084
	How accurate you feel automation is?	-.084	1.000
Sig. (1-tailed)	Artificial intelligence and robotics changed our workplace?	.	.273
	How accurate you feel automation is?	.273	.
N	Artificial intelligence and robotics changed our workplace?	54	54
	How accurate you feel automation is?	54	54

There is a negative correlation of -0.084 means artificial intelligence and have changed our workplace but also it is not that accurate value of P = 0.273.

Regression analysis is a powerful statistical method that allows you to examine the relationship between two or more variables of interest. While there are many types of regression analysis, at

their core they all examine the influence of one or more independent variables on a dependent variable.

Model Summary[b]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics					Durbin-Watson
					R Square Change	F Change	df1	df2	Sig. F Change	
1	.084[a]	.007	-.012	.8386	.007	.371	1	52	.545	1.853

a. Predictors: (Constant), How accurate you feel automation is?

b. Dependent Variable: Artificial intelligence and robotics changed our workplace?

Regression also gives you an R squared value, which for this graph is 0.70. This number tells you how good your model is. The values range from 0 to 1, with 0 being a terrible model and 1 being a perfect model. As you can probably see, 0.7 is a fairly decent model so you can be fairly confident in your weather prediction

Therefore we accept the alternate hypothesis means automation has actually helped in reduction of operating cost as machinery and developing artificial intelligence costs a lot one time but in a long operational time the cost of production will be less.

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	.261	1	.261	.371	.545[b]
	Residual	36.572	52	.703		
	Total	36.833	53			

a. Dependent Variable: Artificial intelligence and robotics changed our workplace?

b. Predictors: (Constant), How accurate you feel automation is?

Coefficients[a]

Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.	95.0% Confidence Interval for B		Correlations			Collinearity Statistics	
	B	Std. Error	Beta			Lower Bound	Upper Bound	Zero-order	Partial	Part	Tolerance	VIF
1 (Constant)	4.211	.452		9.312	.000	3.304	5.118					

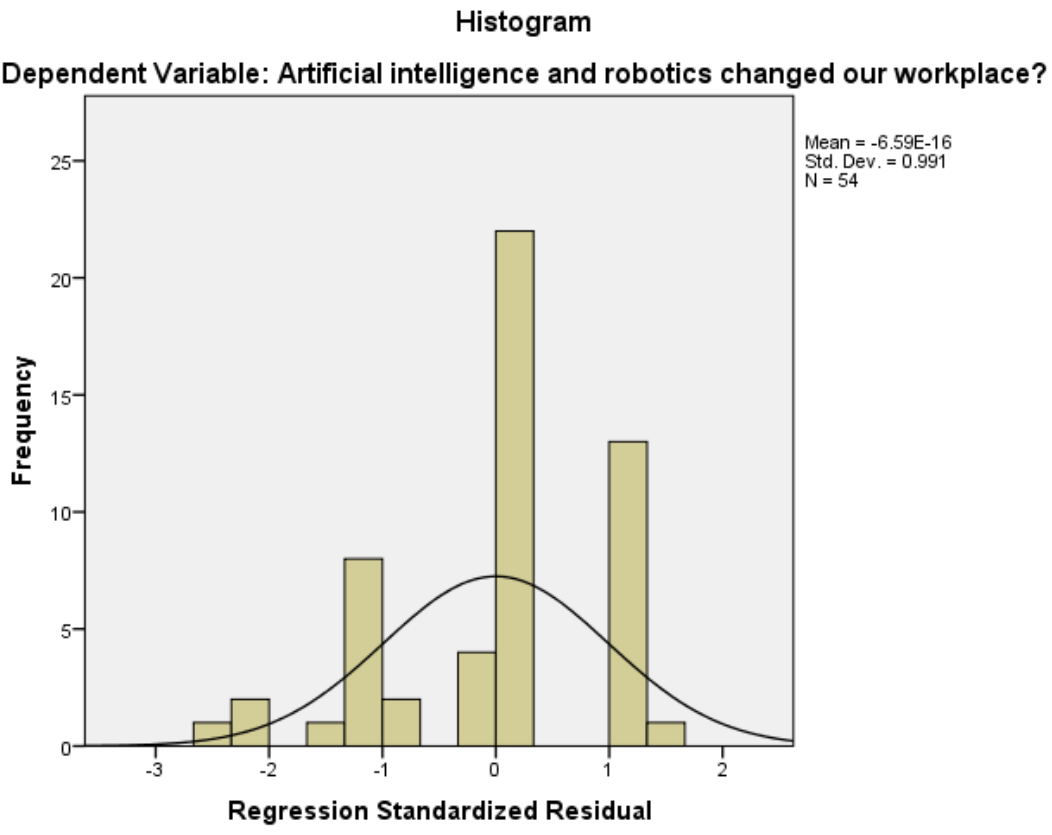
How accurate you feel automation is?	-.076	.124	-.084	-.609	.545	-.325	.174	-.084	-.084	-.084	1.000	1.000

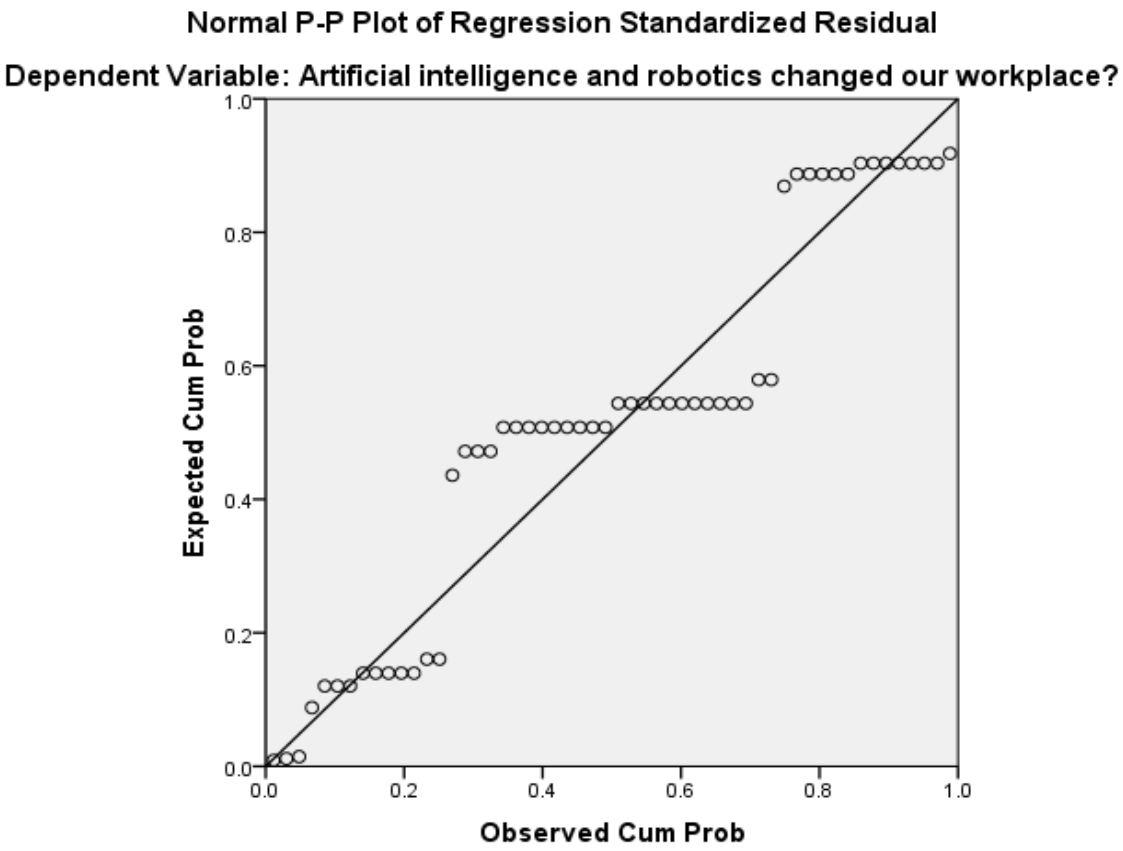
a. Dependent Variable: Artificial intelligence and robotics changed our workplace?

Collinearity Diagnostics[a]

Model	Dimension	Eigenvalue	Condition Index	Variance Proportions	
				(Constant)	How accurate you feel automation is?
1	1	1.968	1.000	.02	.02
	2	.032	7.796	.98	.98

a. Dependent Variable: Artificial intelligence and robotics changed our workplace?





The graph is pretty much spread and we can accept the alternate hypothesis according to which cost of production is reduced in a long run of operations.

7. Summary, Conclusion and Recommendations

7.1 Introduction

The chapter presents the summary of findings, conclusions, contributions and recommendations of the study.

This study was undertaken for the purpose of finding out effects of Artificial Intelligence and robotics on Jobs and employment of workers.

7.2 Summary

7.2.1 Summary of findings on Objective One

Impact of automation on employee demand

"Automation has adverse effect on employee demand" that because of automation where 100s of employees were indulged in one production activity now one machinery can do do 10times faster production accurately without getting tired so soon thus jobs are reduced with automation coming in process.

7.2.2 Summary of findings on Objective Two

How dependable is artificial Intelligence

We cannot totally depend on artificial intelligence as there are limitations with it and we need proper supervision over artificial intelligence.

Some economists expect appreciable changes within the next five years, while others emphasize that the phenomenon Industry 4.0 will be widespread only in 20 to 30 years. However, the technical change is already visible today. An example of this phenomenon is robots that are able to handle customers' complaints by talking to them on the telephone.

In the low and medium qualification sectors primarily, several million jobs worldwide are under threat, and it is not at all certain that they can be regrouped to other areas.

Thus, we cannot totally depend on artificial intelligence.

7.2.3 Summary of findings on Objective Three

Impact on business and employment

Automation has totally changed the way we work agriculture is been affected allot and employment in manufacturing is also reduced but in others it has increased more automation work is now part of the work.

7.2.4 Summary of findings on Objective Four

Transformation in skills required

Traditional skill sets are not enough and we need to develop our skills to meet the upcoming job requirements. To cope up with the ongoing changes and upcoming technologies and IOTs, continuous development of skills is of utmost importance.

7.2.5 Summary of findings on Objective Five

Cost of robots and AI vs regular workforce

Automation has actually helped in reduction of operating cost as machinery and developing artificial intelligence costs a lot one time but in a long operational time the cost of production will be less.

7.3 Conclusion

Automation has adverse effect on employee demand that is because of automation where 100s of employees were indulged in one production activity now one machinery can do 10times faster production accurately without getting tired so soon thus jobs are reduced with automation coming in process.

We cannot totally depend on artificial intelligence as there are limitations with it and we need proper supervision over artificial intelligence.

Automation has totally changed the way we work agriculture is been affected allot and employment in manufacturing is also reduced but in others it has increased more automation work is now part of the work.

We continuously need to develop our skills in order to move equally with the progressive environment.

Automation has actually helped in reduction of operating cost as machinery and developing artificial intelligence costs a lot one time but in a long operational time the cost of production will be less.

This review has drawn on literature from a range of disciplines to inform on-going discussions about the potential impact of AI on work.

Evidence from economics, history, sociology and other disciplines shows that the impact of AI is likely to be influenced not only by technology but also by cultural, economic, social factors. Indeed, the way in which work is organized can change significantly across borders even where the same technology is used in production.

There is evidence that digital technology and automation have already significantly affected work over and above the role of trade liberalization. This evidence shows that the use of digital technology in work is linked with increasing polarization of work between jobs mainly performed by workers with low levels of formal education ('low-educated') and jobs performed by high-educated workers.

Employment overall has not declined, but there have been shifts from manufacturing to services, across geographical areas, and income losses for displaced low-educated workers. Individual losses from displacement related to automation have not yet been estimated but a broader literature suggests that these losses can be significant and persistent.

There is significant uncertainty around the technical potential for AI to automate tasks currently performed in the workplace. Several studies suggest that AI could affect at least a significant minority of existing jobs, and that occupations performed by low-educated workers more likely to be affected compared to those performed by high-educated workers.

If AI is widely adopted and this leads to automation, economic modeling suggests that potential job losses in the short term will be compensated to an extent by countervailing mechanisms through which increasing productivity leads to greater demand for labor. This may nevertheless lead to significant increases in inequality, particularly if employers have significant market power.

We have identified the following gaps in evidence base:

- There is limited evidence on how AI is being used now and on how workers' tasks have changed where this has happened.
- There has been relatively little discussion of how existing institutions, policies, social responses are shaping and are likely to shape the evolution of AI and its adoption.
- We have identified little consideration of how international trade, mobility of capital and of AI researchers are shaping the development of AI and therefore its potential impact on work.

7.4 Recommendations

1) **<u>The past isn't an accurate predictor of the future.</u>**

In the past, technological disruption of one industry didn't necessarily mean the disruption of another. Let's take car manufacturing as an example; a robot in automobile manufacturing can drive big gains in productivity and efficiency, but that same robot would be useless trying to manufacture anything other than a car. The underlying technology of the robot might be adapted, but at best that still only addresses manufacturing.

In the past, yes, more jobs were created than were destroyed by technology. Workers were able to reskill and move laterally into other industries instead. **But the past isn't always an accurate predictor of the future.** We can't complacently sit back and think that everything is going to be ok.

2) **<u>The transition will be extremely painful</u>**

Blue-collar and white-collar jobs will be eliminated—basically, anything that requires middle-skills (meaning that it requires some training, but not much). This leaves low-skill jobs, as described above, and high-skill jobs that require high levels of training and education.

There will assuredly be an increasing number of jobs related to programming, robotics, engineering, etc.. After all, these skills will be needed to improve and maintain the AI and automation being used around us.

But will the people who lost their middle-skilled jobs be able to move into these high-skill roles instead? Certainly not without significant training and education. What about moving into low-skill jobs? Well, the number of these jobs is unlikely to increase, particularly because the middle-class loses jobs and stops spending money on food service, gardening, home health, etc.

In addition to transforming our whole education system, we should also accept that learning doesn't end with formal schooling. The exponential acceleration of digital transformation means that learning must be a lifelong pursuit, constantly re-skilling to meet an ever-changing world.

3) **<u>There are some jobs that only humans can do.</u>**

We already know that machines are better than humans at physical tasks, they can move faster, more precisely, and lift greater loads. When these machines are also as intelligent as us, there will be almost nothing they can't do—or can't learn to do quickly. Therefore, 99% of jobs will eventually be eliminated.

But that doesn't mean we'll be redundant. We'll still need leaders (unless we give ourselves over to robot overlords) and our arts, music, etc., may remain solely human pursuits too. As for just about everything else? Machines will do it—and do it better.

"But who's going to maintain the machines?" The machines.
"But who's going to improve the machines?" The machines.

Assuming they could eventually learn 99% of what we do, surely they'll be capable of maintaining and improving themselves more precisely and efficiently than we ever could.

So while AI and automation may eliminate the need for humans to do any of the *doing*, we will still need humans to determine *what to do*. And because everything that we do and everything that we build sparks new desires and shows us new possibilities, this "job" will never be eliminated.

If you had predicted in the early 19th century that almost all jobs would be eliminated, and you defined jobs as agricultural work, you would have been right. In the same way, I believe that what we think of as jobs today will almost certainly be eliminated too. But this does not mean that there will be no jobs at all, the "job" will instead shift to determining, what do we want to do? And then working with our AI and machines to make our desires a reality.

Is this overly optimistic? I don't think so. Either way, there's no question that the impact of artificial intelligence will be great and it's critical that we invest in the education and infrastructure needed to support people as many current jobs are eliminated and we transition to this new future.

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