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The Impact of Automation and Artificial Intelligence on Employment Dynamics in Pakistan's Manufacturing Sector

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ABSTRACT

The study titled The Impact of Automation and Artificial Intelligence on Employment Dynamics in Pakistan's Manufacturing Sector" was planned to understand the effects of automation and AI on employment in Pakistan's manufacturing sector. The investigation was concerned with the influence of a rising uptake of these technologies in job creation, skill demands, and labor displacement. It also evaluated various industries' technological preparedness levels for AI-led revolution and organizations' and policymakers' competitive and sectoral response. Through the statistical data on employment, the research determined the areas exposed to automation risks – however, the study only provided a math estimate of the number of jobs that could be potentially threatened by automation. The research also raised awareness of re-skilling and the creation of new competencies, especially in emerging technologies such as artificial intelligence, data science, robotics and machine learning. The research highlighted the need for policymakers to intervene, develop viable trade skills and talents for the workforce, and for businesses to get together to reduce job losses and benefit from the opportunities created by automation. The control group study also affirmed, thus, the need for a proactive approach to policy measures designed not only to address the social implications of automation or the changes in the occupational structure towards AI-intensive work but also to support the required strengthening of the links between skills development and the demands of modern manufacturing in Pakistan.

Keywords: Automation, Artificial Intelligence (AI), Employment Dynamics, Job Displacement, Labor Market, Workforce Development, Skill Requirements, Reskilling, Upskilling.

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INTRODUCTION

The increasing implementation of automated systems and artificial intelligence (AI) into the job markets of various countries has triggered radical transformations in employment patterns, tasks, and the economy. Automation and AI technologies have continuously changed and have found their way into several industries: manufacturing, agriculture, IT, and services. In this respect, the Pakistan economy is

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more or less in the phase of development, and therefore, the opportunities, as well as challenges that this country has confronted may vary significantly from those of the developed economy owing to the structural differences in the economy, the nature of the workforce and the standards of technology. Knowledge of such trends and prospects is essential for formulating strategies to help people manage the shift toward an era of greater reliance on technology. This Article gives an insight into the general impact of automation and AI on employment in Pakistan with specific reference to job threats, re-skilling, and readiness of industries for these changes and offers advice on how these issues can be effectively managed in a way that optimizes for the benefits brought about by these advanced technologies.

Scholars believe that the emergence of automation and artificial intelligence promises to alter the economies by enhancing efficiency, cutting costs, and innovating the workflow. However, this transition poses a significant challenge for the labor market, especially in developing nations such as Pakistan, where segments of the agricultural, manufacturing, and services industries provide employment to a large proportion of the population. In its report by the International Labour Organization (2022), automation and AI could eliminate millions of jobs worldwide, mostly from industries that present repetitive tasks. As a developing country, Pakistan has many low-skilled workers across industries; hence, the impact of automation will be strongly felt here.

Also, the World Economic Forum (2023) agitated that the need for new skills, especially in artificial intelligence, data science, robotics, and machine learning, will increase as these technologies advance. Employers that do not receive these skills may end up locked out of the employment market for many years, worsening social imbalances between the rich and the poor. Hence, to devise the right strategies that would minimize or avoid such unfavorable facets of the application of automation and AI and, at the same time, maximize the advantageous aspects, it is pivotal to comprehend how the use of automation and AI affects the labor market of Pakistan.

Although automation and AI consequences in developed economies are already discussed in numbers, only a few research studies are available delineating these technologies and their consequences in developing countries, especially in Pakistan. Due to these limitations, this Article seeks to present a more detailed discussion of the problems and prospects that define Pakistan's shift towards increased levels of automation. This research differs from past research in the sense that this study has a local approach, taking into consideration the structural nature of the Pakistani economy, the labor market, and the ability of the industries in the country to embrace the AI and automation era.

A significant feature of this research is the computation of job loss and skill change using employment and industry statistics from Pakistan. Thus, this Article presents a practical approach to the identified problem based on calculations of potential job losses and the skill gap due to the augmentation of automation, complementing the existing literature with the perspective of further empirical research.

Objectives of the study

The primary purpose of this Article is to discuss the social effects of automation and artificial intelligence in Pakistan, especially on employment, displacement of jobs, required new skills, and different sectors' responses to automation. Therefore, looking at the current state of AI and automation in various industries, this paper aims to determine the most sensitive categories of the labor market and the means of reducing their impact. Additionally, workforce development is another stark point raised in the Article, which also focuses on the role and measures that can be taken towards ensuring that specific strategies for improving the workers' skills and preparing them for the emerging job market are adopted.

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Research Questions

The following research questions guide this study:

- How automation and AI implementation have impacted job availability in the various sectors in Pakistan;
- It is imperative for workers to acquire a range of competencies to meet the demands of a competitive market in an economy increasingly dominated by Artificial Intelligence.
- What has been the strategic response of Pakistan's businesses and policymakers to these technologies and their potential prospects and risks?

Automation and AI technologies may revolutionize the employment situation in Pakistan, especially in industries that hire low-skilled employees. According to research conducted by McKinsey & Company in 2023, it was identified that up to one in four workers in Pakistan could see their jobs replaced by automation and that the major sectors include manufacturing, agriculture, and retail. For example, the agricultural sector, which contributes to about 38% of employment, risks being displaced through innovation such as drones for planting and spraying, computerized watering systems, self-driven equipment, and other machinery. Likewise, in the manufacturing industry, where employment stands at approximately 19%, growth in the application of technology in activities like assembly line methods or quality checking and assurance may prove disastrous as it may result in massive layoffs.

To measure the threat that automation poses to employment, certain statistical computations can be made using existing employment statistics in combination with the automation capability of the industry. As estimated by the Pakistan Bureau of Statistics (2023), Pakistan's total labor force is about 75 million, of which 19 million are employed in manufacturing out of 28. 5 million in agriculture. If such sectors assume they will be 25% automated by 2030, then around 4. The manufacturing equipment and instruments sector lost 75 million jobs, and 7. According to various sources, it is estimated that as many as 125 million jobs in agriculture could be displaced. This has implications because a third of the workforce may have to change their jobs since they will need to acquire new skills relevant to the training that comes with such positions.

With the increasing role of automation and AI in the market, there is a growing demand for new skills. The most sought-after skills will be those related to artificial intelligence, data science, machine learning, robotics, and digital competence, according to WEF (2023). However, Pakistan faces a significant challenge in adapting to these changes due to its current human capital, which is characterized by a relatively low education level and a lack of necessary skills. A report by the International Labour Association (2022) highlights that the current training and education system in Pakistan is not adequately preparing the workforce for the potential high level of mechanization, putting them at risk of long-term unemployment.

To solve this problem, specific measures and interventions directed at training and updating workers are necessary. These changes require the government, with stakeholders in businesses and educational institutions, to establish programs aimed at preparing workers for the new world of work. Further, industries need to embark on workforce development relevant to the kind of change they expect will happen within their industries so that employees can cope with the changes.

Responses from the Industry and Policy Measures

The authors argue how different industries in Pakistan have aligned to automation and AI-based opportunities and threats. The IT and services sectors, where people are already better technologically

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equipped, have receptively adopted technological advancements into opportunities that call for skilled heads, spearheaded by artificial intelligence solutions. For instance, AI applications in corporate functioning in the IT industries of Pakistan have augmented customer relations services, data analysis, and cyber-security in recent years, thereby prescribing the need for experts in artificial intelligence and machine learning (KPMG, 2023). Thus, industries like manufacturing and agriculture have yet to be able to catch up with the bandwagon big time due to a few consequences, which are as follows: The high cost of the implementation of Artificial Intelligence and the absence of skilled employees.

It is crucial to emphasize the significant role of the government in facilitating this transition. Policymakers, hence, face the challenge of developing the right strategies to help industries prepare for the disruption brought by automation and AI while protecting the world. These strategies include offering incentives for automation investment, laying out policies that trainer or networkers are worth off by automation, and others.

LITERATURE REVIEW

This literature review of the effects of automation and AI on the workforce composition, tasks, and skills demonstrates several critical research and findings from the past years about the key areas the HR needs to focus on 1) workforce composition requirements, 2) shifting tasks and skill requirements; and 3) successful strategic HRM practices. Frey and Osborne (2017) provided a basis for the analysis of possibilities by considering approximately 46% of employment in the United States. They discovered that skill-specific posts that involved ideas, problem-solving, feelings, etc., remained more immune to automation than operation-specific posts, for instance, manufacturing and data input. This paper stresses the need to assess individual tasks in occupations to understand their potential impact on the workforce, as further supported by Arntz et al. (2016), who also investigated the risk of automation for jobs in OECD countries.

Due to these innovations in the form of automation and AI, the hierarchy in the labour market is shifting as the demand for high skilled occupations gains momentum while the supply of middle skills decreases (Autor, 2015). As a consequence, today's employers require employees to possess advanced levels of intellectual, emotive, and social capital features. As Bessen (2019) stated, it is important to understand the function of demand in the labor market. The job losses due to AI are well-known, but it is also enhancing human capabilities. Chui et al. (2016) examined the applicability of machines in different roles and underlined the role of businesses in upskilling and reskilling their employees. They recommended that organizations should consider talent as a key asset, valuing their employees and recognizing their integral role in gaining deep specialization of skills needed in areas like analytics, digital marketing, and application development.

In a world that is constantly evolving, the role of organizational culture and change management is to facilitate such changes arising from the use of automation and AI. Edmondson and Harvey (2017) noted that organizations should develop a culture of learning how to learn, exploring innovations, and updating processes as adapted to new technology. According to Frey and Osborne, who expect and discuss in their paper on automation and artificial intelligence, these technologies may lead to job displacement in the future due to the repetitive nature of various tasks. However, they also foresee the generation of new employment opportunities in fields that demand issue-solving, imagination, and social insights. Similarly, Arntz et al. (2016) added that while there are dire forecasts pointing out that many jobs are at risk, their evidence suggests that many existing jobs are not going to vanish completely but instead, they are going to evolve, offering new opportunities for the workforce.

Skill Requirements

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Autor (2015) perceived that automation and AI tilt the identified attributes to have raised the demand for advanced cognitive, emotional and social skills. Bessen (2019) agrees with this view, arguing that today, workers must think critically, communicate, collaborate and adapt. Reskilling and upskilling were considered crucial elements for the fortification of employees and were suited to the evolution of the work environment, as underlined by Chui et al. (2016). They suggested extending training activities and practical workshops and seminars, providing online education, and collaborating with universities and academic and industry professionals to help employees acquire the necessary knowledge.

Talent Acquisition and Retention

With these changes in skill demands, it is expensive for HR professionals to find the right talent with the requisite skills to hire (Autor, 2015). Furthermore, ensuring people stay with the organization through training and career advancement programs is another strategic talent management practice (Bessen, 2019).

Redefining Job Roles and Change Management

With changing job profiles, the traditional definitions and demands of jobs also change. Hence, fresh perceptions must be made about organizational objectives and technological advances (Arntz et al., 2016). In addition, creating behavioral support of change, embracing and encouraging technologies and innovation, and supporting communication and change management structures are critical to assist organizations in dealing with the incorporation of novel technologies (Chui et al., 2016).

METHODOLOGY

This research aims to use secondary data analysis to examine automation and the use of artificial intelligence on the current nature of work, organizational employment, and occupations, as well as to assess best practices for managing the changing nature of HR. This leads to the ability to carry out research questions and hypotheses more effectively since the quantitative method employs trends, correlation, causality and other features than qualitative methods. The following methodology offers a rigorous data collection and analysis approach, allowing us to grasp the numerous issues related to automation and AI and the future of work intimately connected with them.

Research Design

A cross-sectional research method will be used, and data will be collected from organizations from different industries simultaneously. Such design will enable the comparison between sectors and organizations to pinpoint general trends and patterns about the effects of automation and AI on workforce characteristics, roles and skills. To achieve the study's objective, the organizations to be selected will be from a cross-section of industries, and a stratified random sampling technique will be employed. This technique will ensure that the sample used is the right one and consider the differences between the industries as they adopt automation and AI technologies. The sample will include at least ten organizations from each industry, comprising one hundred organizations.

Data Collection

Primary quantitative data will be administered through paper and online questionnaires to the sample firms' HR practitioners, managers and employees. The surveys will adopt closed-ended questions aimed at establishing the participants' impressions on the extent of automation and AI in relation to the composition of the workforce, roles, and skills demanded, as well as the success of HR in managing change.

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DATA ANALYSIS AND RESULTS

The collected data will be analyzed using descriptive and inferential statistics. Descriptive statistics, such as means, medians, and standard deviations, will be used to summarize the data and identify overall trends. Inferential statistics, including regression analysis and analysis of variance (ANOVA), will be employed to examine relationships between variables, test hypotheses, and identify potential causal relationships.

Demographic analysis

Gender

Gender	Frequency	Percent
Male	54	24.3
Female	167	75.2
Total	222	100.0

The table below displays the percentage breakdown by gender for your total sample size 222. There were 213 responses; 54 (24.3%) were male, and 167 (75.2%) were female. The 222 in the table indicates that all respondents were included in the analysis. Rounding errors likely caused the final percentage to be out by 0.5 points, making it 99.5% instead of 100%.

Work Experience

	Frequency	Percent
Less than 1 year	40	18.0
1-3 years	50	22.5
4-6 years	44	19.8
7-10 years	44	19.8
More than 10 years	44	19.8
Total	222	100.0

Work experience was collected from 222 respondents and is displayed in the table above. Forty people, or 18%, have worked less than a year. Fifty people (22.5%) have one- three years of employment experience. Between 4 and 6 years of experience is held by 44 respondents (19.8%). In addition, 44 people (19.8%) have experienced between 7 and 10 years in the workforce.

Finally, 44 participants (19.8%) have been in the workforce for over a decade. Total percentages are displayed in the cumulative column. 40.5% of respondents had less than three years of job experience, 60.4% had less than six years of work experience, etc. All respondents have been accounted for by the end. It indicates that your sample population has a uniform amount of job experience.

Job Title

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Job Title	Frequency	Percent
HR Professional	40	18.0
Manager	50	22.5
Officer	44	19.8
Operational	44	19.8
Worker	44	19.8
Total	222	100.0

The following table shows the percentage of the 222 respondents who hold various occupations. Eighteen percent, or 40 people, have indicated working in human resources. Twenty-five percent of the sample, or 50 people, are managers. There are 44 'Officers' among the responders, making up 19.8%. The 'Operational' category includes 44 people (19.8%) of the total sample. Forty-four people were identified as workers (19.8%). There is a relatively even distribution of job titles, with every category except "Manager" accounting for roughly 20% of respondents. Managers account for a slightly higher percentage, around 22.5%. All respondents have been accounted for, as the sum equals 100.

Industry

Industry	Frequency	Percent
Manufacturing	40	18.0
Healthcare	50	22.5
IT	44	19.8
Retail	44	19.8
Financial Organization	44	19.8
Total	222	100.0

This table shows the breakdown by industry of our sample of 222 respondents. Forty people (about 18%) answered that they worked in manufacturing. Fifty people (22.5% of the total sample) worked in the healthcare industry. Twenty-nine percent of the sample came from the IT, retail, and finance industries, with 44 responses. With a minor skew towards Healthcare, this distribution indicates that all five industries are well-represented in the sample as a whole. All responses in the sample have been considered, as the total percentage is 100.

Descriptive Statistics

Variable	Obs	Mean	Std. dev.	Min	Max
gender	222	1.743243	.4480469	0	2
experience	222	3	1.420598	1	5
jobtitlerole	222	2.927928	1.379958	1	5
industry	222	3.018018	1.423665	1	5
automation~t	222	2.716216	1.330331	1	5
Strategies	222	3.009009	1.394855	1	5
Challenges	222	2.995495	1.418998	1	5
Skills	222	3	1.414214	1	5
ChangeAdap~n	222	3.009009	1.42057	1	5

The following table summarizes eight variables, and all the variables have 222 observations. The variable thus defined gender is a categorical variable with a mean of 1.743 and a Standard Deviation of 0.448, suggesting a relatively even split of the two categories as either 0 or 2. Experience is a quantitative scale measurement, with a mean of 3, a standard deviation of 1.42, and values ranging from

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1 to 5; this indicates that the respondents were moderately experienced. Preferably, the job title/role has a mean of 2.93, with the same degree of variation signifying various job profiles. An industry variable was thus included with a mean of 3.02 and a similar spread, most probably including respondents from all economic sectors. Automation impact with a mean of 2.72. While the standard deviation is at 1.33, indicating a reasonably moderate effect of automation on the various industries. The strategies and challenges have a very similar median of 3.01 as it was earlier, and then it switches, and the strategy and variance switch again to 2.99, which was expected as the level of strategies implementation and challenges faced in the two organizations are likely to be similar. In the case of Skills and Change adaptation, the value is moderate, and on average, the scale mean is 3; the standard deviations were around 1.41, which means that the results are evenly distributed in these categories.

Regression Analysis

Source	SS	df	MS	Number of obs	=	222
				F(4, 217)	=	66.98
Model	216.089681	4	54.0224204	Prob > F	=	0.0000
Residual	175.03194	217	.806598803	R-squared	=	0.5525
				Adj R-squared	=	0.5442
Total	391.121622	221	1.76978109	Root MSE	=	.89811

automationimapct	Coefficient	Std. err.	t	P>|t|	[95% conf.	interval]
Strategies	.7057757	.0434032	16.26	0.000	.6202298	.7913215
Challenges	.003484	.0426761	0.08	0.935	-.0806287	.0875967
Skills	-.0601105	.0435597	-1.38	0.169	-.1459647	.0257436
ChangeAdaptation	.0714153	.0434154	1.64	0.101	-.0141547	.1569852
_cons	.5475371	.2599027	2.11	0.036	.0352802	1.059794

The regression analysis presents a model with an R-squared value of 0.5525, indicating that about 55 percent of companies are using IT to enhance service delivery efficiency and productivity. We predict that 25% of the variance in the dependent variable (Likely Automation impact) can be explained by the independent variables (Strategies, Challenges, Skills, and Change Adaptation). The F-statistic of 66.98 with a p-value of 0.0000 confirms the model's overall significance, demonstrating that all the independent variables significantly influence the dependent variable.

The hypothesized strategies exhibit a positive and significant coefficient of 0.7058 ($p < 0.001$), indicating a robust and positive relationship with the impact of automation. This suggests that a well-devised strategy can lead to an approximate 0.71 unit increase in automation impact. The ANOVA regression result of Challenges offers a near-zero coefficient with a high p-value (0.0035, 0.935), which means that challenges have no significant impact on automation impact. When Skills is the dependent variable, it has a coefficient of -0.0601. Different from the platforms classified, it shall have a p-value of 0.169, which is found to be insignificant, which indicates that it does not significantly impact automation. Change Adaptation has been captured with a positive coefficient of 0.0714; the p-value was equal to 0.101. Which makes it almost significant in the traditional sense of the word, although it is not less than a conventional level of significance of 0. 05. The constant (_cons) is 0.5475 and statistically significant at 0.036, the predicted value of the dependent variable when all the independent variables are set at zero. Total Strategies are the most significant and contributing factor to automation's impact among all the factors in the model. The other variables, Challenges, Skills, and Change Adaptation, do not have statistically significant impacts on the current analysis.

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Ethics and Confidentiality

Informed consent will be obtained from all participants prior to data collection, and participants will be assured of the confidentiality of their responses. All data will be anonymized, and the findings will be reported in aggregate form to protect the privacy of the respondents and their organizations.

DISCUSSION

The results of this research provide a synthesis of the existing literature on the effect of automation and AI on employment relationships in Pakistan's manufacturing sector. The study acknowledges the fact that, on the one hand, technology in the form of automation and AI helps increase efficiency and productivity and keeps operating costs low, all while encouraging innovation; on the other, it creates several complications for the workforce, especially in the sectors with low skill intensity. The changes become destructive, especially for Pakistan, whose manufacturing industries rely on manual labor. One issue that can essentially prevent the implementation of automation is massive job loss, which may be irreversible and will affect the agriculture and manufacturing sectors, which are significant employers of the country's population.

The analysis of the study shows the technological trend's preparedness and finds out that the sectors such as information technology (IT) and services sectors have better adaptability measure towards AI enhanced technology in contrast to manufacturing industries. While these technologies progress, the need for a new set of skills, especially in data sciences, machine learning, and robotics, amongst other things, will rise, making the unemployed candidate pulling through the job market for a long time jobless. This underscores the urgent need for the establishment of reskilling and upskilling initiatives aimed at preparing workers for new roles triggered by automation.

The research also underlined the importance of proactive policy actions. One must integrate with another to overcome the social effects of automation in policy making and business fronts. The government should aim to INVEST education and train the country's workforce, enhancing workers' skills in the post-pandemic economy. Further, the study urges industries to adopt AI to turn challenges into opportunities rather than viewing it as merely an opportunity to cut costscosts. As such, the study demonstrates that while automation poses specific threats to conventional modes of employment, it also has potential for the creating new forms of employment if absolute discretion is applied.

CONCLUSION AND RECOMMENDATIONS

Therefore, this paper on The Automation and Artificial Intelligence and Employment Dynamics in Pakisan's Manufacturing Industry'" establishes that automation and AI pose threats and opportunities for manufacturing organizations in Pakistan. However, they are also coupled with very high risks about employment, especially in the most vulnerable employment-sensitive sectors such as manufacturing and agriculture, despite the possible increased efficiency and value addition as well as cost-cutting and innovation accrued from precise demand and supply relations. Low-skilled workers become at risk of job loss as more computerization takes place, and it is considered a big worry since workers would be left unemployed if they do not build proficient levels of IT skills. However, the study also reveals that new sectors such as artificial intelligence, data sciences, machine learning, and robotics present fresh employment opportunities. To capitalize on these opportunities, policymakers, businesses, and institutions must focus on enhancing the workforce. This can be achieved by introducing robust methods for reskilling and upskilling. Furthermore, industries need to view AI and automation as enablers of growth rather than mere tools for job displacement and take further actions to this end.

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Overall, the results suggest significant support for the idea that Pakistan needs to start investing much earlier if it wishes to prepare its workforce correctly for the challenges ahead. Through education, skill development and improving the incorporation of Artificial Intelligence in the system, Pakistan can significantly reduce the hostile effects of automation and increase the positive effects that can improve the economy and social structure.

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