# How the Blue-Collar Workers are motivated in Digitalization Period. Link Job Satisfaction with Organizational Performance

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## ABSTRACT

*The rapid advancement of digital technologies and the emergence of Industry 4.0 have transformed engineering and manufacturing operations through the adoption of automation, artificial intelligence (AI), robotics, and information and communication technologies (ICTs). While these technological advancements enhance organizational efficiency and competitiveness, they also reshape the nature of work for blue-collar employees, making job satisfaction a critical factor influencing organizational effectiveness. This study investigates the impact of artificial intelligence and automation, information and communication technology, and job satisfaction among blue-collar workers on organizational effectiveness in Pakistan's manufacturing sector. A quantitative, cross-sectional research design was employed, with data collected from 221 blue-collar workers employed in manufacturing organizations in Karachi, Pakistan. The data were analyzed using IBM SPSS and Microsoft Excel through descriptive statistics, reliability analysis, correlation analysis, and multiple regression analysis. The findings reveal that artificial intelligence and automation, information and communication technology, and job satisfaction each have a significant positive effect on organizational effectiveness. In addition, the findings indicate that job satisfaction is a significant predictor of organizational effectiveness, suggesting that employees who are satisfied with their jobs and maintain a positive attitude toward technological changes contribute substantially to organizational success. Overall, the study demonstrates that technology alone is insufficient to ensure organizational success in the Industry 4.0 era. Organizations must also prioritize employee well-being and job satisfaction to maximize the benefits of technological advancements and achieve sustainable organizational effectiveness.*

***Keywords:*** *Artificial intelligence, information and communication technology, blue collar worker, job satisfaction.*

## INTRODUCTION

The fast evolution of digital technologies along with the emergence of Industry 4.0 has brought about drastic changes in engineering and manufacturing systems. Industry 4.0 uses various advanced technologies including artificial intelligence (AI), automation, robotics, Internet of Things (IoT), big data analytics, cloud computing, and ICTs to form intelligent and efficient manufacturing systems (Kagermann et al., 2013; Da Xu et al., 2018; Frank et al., 2019). This technological revolution has helped organizations to increase efficiency, enhance flexibility and quality of products, and achieve cost competitiveness (Culot et al., 2020; Sony & Naik, 2020).

Throughout the world, there have been massive investments in industry 4.0 over the past ten years with manufacturing firms speeding up the integration of advanced technologies such as AI-powered

production facilities, industrial robots, predictive maintenance, and digital communication technologies (World Economic Forum, 2023; Deloitte, 2024). These innovations have enabled higher productivity, cost savings, and manufacturing flexibility (Frank et al., 2019). Digital transformation of the workplace, however, has come with challenges for workers, who have needed to learn digital skills (Jaiswal et al., 2022).

Digital transformation is being adopted by Pakistan's manufacturing industry as a measure to increase efficiency and maintain competitiveness in regional and global industries (State Bank of Pakistan, 2024). However, technological development has created a sense of insecurity among blue-collar workers because of issues of job security and changes in skills needed (Acemoglu & Restrepo, 2020). This insecurity could affect the motivation of workers and job satisfaction and eventually organizational effectiveness (Parker & Grote, 2022).

The manufacturing industry in Pakistan is slowly incorporating digital technologies to ensure efficiency and stay competitive both regionally and internationally (State Bank of Pakistan, 2024). Nonetheless, technological change has brought about some level of uncertainty among blue-collar workers in terms of job security, skills requirements, and career sustainability (Acemoglu & Restrepo, 2020). These issues could affect employee motivation and organizational effectiveness. Though there is a consistent advance in technology, the most valuable resource that an organization possesses continues to be its human resource (Sabuncuoğlu, 2013). Though technological advances like automation and artificial intelligence increase efficiency, these can never substitute for the practical experience, creative abilities, adaptability, and decision-making capabilities of humans (Brynjolfsson & McAfee, 2014). The blue-collar workforce continues to be indispensable in production operations.

Automation and intelligent technology use is rapidly revolutionizing the landscape of blue-collar occupations. While automation eliminates mundane activities, employees must be adept at controlling advanced computer-based machinery and working alongside intelligent machines (Roto et al., 2019). Even though automation decreases the amount of routine work and enhances efficiency, there is a concern that automation may lead to displacement of jobs, obsolescence of skills, and increased stress on workers (Acemoglu & Restrepo, 2020). Workers who view technological developments in a positive manner tend to exhibit higher levels of motivation, organizational commitment, and adaptability than those who see automation as a threat.

Job satisfaction is well known to be one of the strongest indicators of employee performance and organizational success (Judge et al., 2001; Bakotić, 2016). OB-satisfied employees show increased productivity, higher commitment to the organization, less absence, and increased readiness to accept changes within the organization (Inuwa, 2016). In Industry 4.0 settings, OB satisfaction plays an even more significant role since employees are constantly required to develop new competencies and adjust to new technologies (Parker & Grote, 2022).

Organizational effectiveness is the measure of an organization’s capability of attaining strategic goals using efficient use of resources, innovation, employee performance, and sustainability (Richard et al., 2009). While technological innovation improves organizational effectiveness, findings indicate that technology is not the sole factor behind organizational success but rather the integration of technology and HR policies (Vial, 2019).

However, even in light of an increasing number of studies about the topic of Industry 4.0, most of the earlier investigations have been focused on the adoption of technology, efficiency, and optimization of production (Frank et al., 2019; Culot et al., 2020). There has not been much focus on the impact of these factors together, i.e., AI, automation, ICT, and job satisfaction, on organizational effectiveness, especially when it comes to looking at blue-collar employees in emerging economies like Pakistan (Jaiswal et al., 2022).

This paper contributes to existing literature by building and empirically validating a framework which studies the impact of artificial intelligence and automation, information and communication technology, and job satisfaction on the effectiveness of organizations through the lens of blue-collar workers in the manufacturing industry in Pakistan. Through combining technological and human resource perspectives in the examination of Industry 4.0, this paper builds upon the existing literature on the subject matter in terms of both perspective and region of study.

## LITERATURE REVIEW

Bank In the framework of Industry 4.0, the adoption of digital technologies drastically alters production techniques and, consequently, blue-collar workers' occupations. Blue-collar workers typically have a harder time adjusting to digital employment because of their lesser skill endowment. However, little research has been done on the digitalization of blue-collar jobs or how blue-collar people adjust to this change. The character and structure of human labor in manufacturing are being shaped by the ongoing spread of digitalization, but there is no actual data to back up the increasing number of forecasts about how workers would be impacted by this change (Kadir, Broberg, & Conceição, 2019).

Since it requires businesses to reconsider their organizational strategy, which includes, among other things, value proposition communication, customer relationship management, work structure and environment, etc., digital transformation (DT) is regarded as one of the most difficult tasks that organizations encounter (Gong, Parisot, & Reis, 2024). Blue-collar workers typically have a harder time adjusting to digital employment because of their lesser skill endowment. However, little research has been done on the digitalization of blue-collar jobs or how blue-collar people adjust to this change.

The theoretical framework of this study includes three interconnected theories in order to fill this gap. The TAM theory helps us understand the adoption of new digital technologies by employees based on its usefulness and ease of use, which implies that acceptance of ICT is one of the main factors that determine employees' behavioral response to digitalization in the workplace (Davis, 1989). Moreover, according to the SDT theory, using digital tools allows fulfilling psychological needs of workers regarding autonomy, competence, and relatedness and, therefore, can enhance intrinsic motivation among employees and lead to positive work attitudes (Deci & Ryan, 1985). Finally, JCT theory emphasizes the important role of job characteristics like autonomy, task significance, feedback, and skill variety as motivators and contributors to job satisfaction; digital technologies, in turn, can improve these characteristics through better communication, information flow, and feedback (Hackman & Oldham, 1976).

### The Effects of Digital Technologies on Labor

A significant portion of the literature, on the one hand, outlines a broad enrichment prospect for blue-collar workers. Assuming that blue-collar workers' jobs are generally degrading, a quite different scenario is outlined. The bulk of employees' responsibilities are reduced to simply keeping an eye on the automated system, with a small number of sophisticated positions that involve aspects of innovation or the system's design, implementation, and training remaining (Waschull et al., 2020).

In addition to increasing operational effectiveness, digitization promotes a change in workplace culture toward one that is more relational, encouraging cooperation and communication among employees. By reducing worries about job security and surveillance, this relational approach can help blue-collar workers feel that their jobs have intrinsic meaning and purpose, which is in line with their basic human needs (García-Ruiz et al., 2021).

## Information and Communication Technology (ICT)

The complex connection between blue-collar workers and information and communication technologies (ICTs) is still being studied in recent years, with both potential and concerns being highlighted. The research on how ICTs affect blue-collar workers shows a complex and changing environment. ICTs present challenges in the form of automation-induced job displacement, the need for ongoing upskilling, and the possibility of detrimental effects on job satisfaction and well-being if not implemented carefully, even though they also present significant opportunities for increased productivity, efficiency, and possibly better working conditions. ICTs have a great deal of promise to improve blue-collar work's efficiency and productivity. Examples include wearable technology for real-time monitoring and guidance, digital platforms for optimizing workflows and logistics, and sensors and data analytics for predictive maintenance.

"Information technologies include all forms of technology that are used to create, store, and share information in various forms (business data, speech, sound, images, multimedia, etc.)" is one of the many definitions of IT that are pertinent (Mitic, 2019). “Technologies that include laptops and desktop computers, software, accessories, and Internet connectivity devices designed for information processing and communication" is how some authors define the field of information and communication technologies in order to highlight the wider aspect of information technology through the use of communications, particularly electronic ones (Mitic, 2019).

A wide range of technologies that make information accessible and communication easier are included in the field of information and communication technology, or ICT. Mobile phones, computers, software programs, wireless networks, the internet, and other digital instruments are all included in this. ICT has developed into a game-changing force in a number of fields over the last few decades, including business, education, healthcare, and governance. This review of the literature looks at the function, effects, and difficulties of ICT in several important areas. ICT places a strong emphasis on the population's general adoption of ICT and the indirect consequences of the components identified (Katz et al. 2014).

There are a number of ways in which the connection between Information and Communication Technology (ICT) and job satisfaction can be established. The first explanation is based on the Technology Acceptance Model (TAM), according to which workers’ job satisfaction and effectiveness are determined by their perception of ICT as useful and easy-to-use technology (Davis, 1989; Venkatesh et al., 2003). The second perspective on this issue can be derived from Self-Determination Theory (SDT), according to which ICT may contribute to workers' job satisfaction because it helps meet their psychological needs of autonomy, competence, and relatedness due to increased opportunities of information access and communication (Deci & Ryan, 2000). Moreover, job satisfaction according to the Job Characteristics Theory of Hackman and Oldham (1976) depends on such job characteristics as autonomy, task significance, feedback, etc., all of which can be increased via ICT support.

Current literature continues to support the claim that there is a strong positive relationship between the use of Information and Communication Technology (ICT) and employee job satisfaction. The improvement of communication, improved access to work-related information, and improved operational effectiveness as a result of ICT use all contribute to a positive employee experience. Recent empirical evidence (Applied Economics Letters, 2022) provides support for the claim that ICT use is positively related to job satisfaction by improving work processes and the perceived quality of jobs. The evidence also supports the notion that digitalization in the workplace provides an increase in autonomy and resources for employees, thereby leading to higher levels of satisfaction, when digital technology is used to design jobs

(International Review of Economics, 2022). Recent research conducted by organizations in both IT enabled and industrial work environments provides additional evidence that ICT systems enable coordination among employees (reducing the time necessary to complete their work) and clear up the employees' understanding of their responsibilities for completing their own tasks positively influencing employee satisfaction and engagement (Frontiers in Psychology, 2023, and Frontiers in Public Health, 2023). Overall, current literature demonstrates that the use of ICT results in employee job satisfaction, particularly where ICT improves efficiency and reduces constraints on employees to perform their jobs.

H1: ICT motivates the Blue-Collar Worker Job Satisfaction.

## Automation

While studies conducted in 2023–2024 highlight the growing need for digital literacy and new skills to operate and maintain advanced technology, they also highlight the ongoing trend of automation that may result in employment displacement in regular jobs (ETUI, 2024; MDPI, 2024). Automation through the use of computers marked the beginning of digitalization in industry decades ago. The acceptance of digital technologies was further aided by the development of the internet (Waschull et al., 2022). Industrial settings offer a chance to comprehend worker viewpoints because of the history of automation in production, as new types of technology are being incorporated into the shop floor in creative ways (Sheehan, & Dantec, 2023). It is anticipated that the digital revolution within Industry 4.0 will automate information processing tasks at ever-expanding industrial production scopes (Waschull et al., 2020). Opportunity was freed to perform new duties as a result of the routine and repetitive jobs being automated and simplified as outlined.

There are still a number of enduring issues, such as restricted access to work environments, performance-based organizational requirements that hinder long-term studies in context, and little employee involvement in the design process. As digitalization equips workers with new types of automation, it is more important than ever to offer contextualized and engaging worker experiences. Even while automation may have advantages including higher productivity, enhanced security, and lower expenses, its effect on blue-collar workers' motivation is an important factor that needs to be carefully considered (FasterCapital, n.d.; BrightCollar, 2024).

Given the changing nature of work and the significance of proactive tactics to assure a motivated and engaged workforce in an increasingly automated environment, research on the long-term consequences of automation on blue-collar worker motivation should continue.

H2: Automation motivates the Blue Collar Worker Job Satisfaction

## Artificial intelligence

The modern workplace has undergone a revolution because of information and communication technology (ICT), which has changed how services are provided, activities are completed, and communication is maintained. Understanding how ICT affects employee motivation is becoming more and more important as businesses use digital tools to increase productivity. Performance is mostly driven by motivation, and depending on how it is applied and incorporated into the corporate culture, ICT can have both positive and bad effects on it.

AI's dual effects on blue-collar work have been repeatedly highlighted in recent literature. While automation brought about by AI threatens jobs that require repetitive tasks, integrating AI also requires new skills and opens up opportunities for managing and maintaining AI systems, which will transform rather

than completely replace the workforce (People Matters Global, 2024; Staffing Industry Analysts, 2023). This change necessitates concentrating on upskilling and reskilling programs to give blue-collar workers the technical know-how and digital literacy required for new "AI-collar" jobs, as well as the ability to work productively with AI-powered tools that improve efficiency and safety in a variety of industries (TheSecretariat.in, 2024; Dayjob.com.au, n.d.; FINE magazine, 2024).

By automating risky tasks, anticipating mishaps, and monitoring dangers, artificial intelligence (AI) can help create safer workplaces. Additionally, wearable technology and AI-powered tools can boost skilled trades' productivity and offer real-time coaching (Dayjob.com.au, n.d.).

H3: Artificial Intelligence motivates the Blue Collar Worker Job Satisfaction

## Job Satisfaction & Organizational Performance

According to Locke (1976), "A person's emotional state of enjoyment and excitement that stems from their work is known as job satisfaction. "Reducing attrition and raising motivation are two benefits of job satisfaction. The most crucial component of the company is thought to be job happiness. An organization needs to maintain employee satisfaction in order to flourish (Wubuli, 2009).

As per Edwin A. Locke's (1976) definition of Job Satisfaction, it is defined as a positively emotional reaction that one experiences toward their job in response to how well they think they have done at their jobs. Job Satisfaction has been identified as one of the most important factors that influence employee motivation, decrease employee turnover intentions and contribute to overall organizational effectiveness. Job Satisfaction also plays an important role in creating an organization that is successful. Wubuli (2009) has stated that Job Satisfaction will be a primary contributor to the success of an organization because employees who are satisfied have greater commitment, productivity and alignment to the organization's objectives, resulting in better performance and increased revenue for the organization.

Research studies show that blue-collar workers have a lower level of job satisfaction as compared to white-collar professionals concerning salary, job significance, and recognition (Çiçek, 2013). On the other hand, the unprecedented growth in the scope of digital transformation changes the nature of work in an organization. Digital technologies have the potential to improve job satisfaction because of automation of routine work, increased productivity, and improved communication among others. Nevertheless, digital transformation creates various obstacles including job uncertainty, technostress, and mismatch between skills and technology, which may affect worker attitude towards job positively or negatively depending on how those problems are managed (McKinsey & Company, 2023; Deloitte, 2023). Accordingly, contemporary scientific works note that human-centered digital transformation is vital for developing psychological consequences of workers and organizational performance because it combines technological advantages with employee health and engagement (Nazir et al., 2026). Consequently, effective use of digital technologies and training of blue-collar workers become the main factors that can increase their job satisfaction.

Compared to their white-collar colleagues, blue-collar workers frequently report lower levels of job satisfaction, especially when it comes to factors like compensation and the significance of their work (Çiçek, 2013). By eliminating monotonous chores, digitalization can increase job satisfaction; yet, it also brings with it job insecurity and skill mismatches, which, if left unchecked, can demotivate employees (McKinsey & Company, 2023). Digital upskilling, recognition, and participation in technological advancements are increasingly more important motivators for blue-collar workers than pay and job stability (Deloitte, 2023).

H4: Blue Collar Worker Job satisfaction enhances organizational performance.

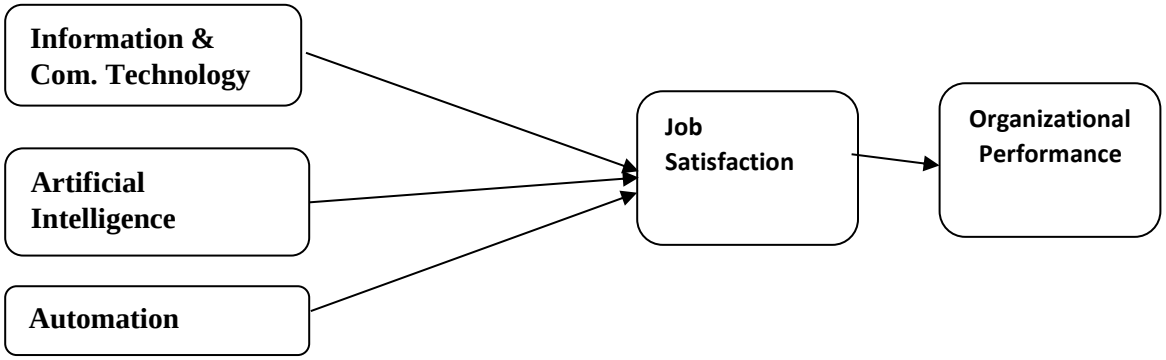


**Figure 1:** Model of the study

## METHODOLOGY

This section has provided an overview of the research technique. The process used in this study gives us methods for gathering and processing data and related information. In addition to the particular techniques and instruments employed in data collecting and analysis, this chapter offers a summary of the general research methods and processes used in this study.

### Samples and Procedures

The methodology of this study included the use of quantitative, cross-sectional survey research design in order to investigate the associations between ICT, Artificial Intelligence (AI), Automation, Job Satisfaction, and Organizational Performance. The sample population consisted of blue-collar workers in manufacturing and industrial firms operating in Karachi, Pakistan. A structured questionnaire was used in order to collect the primary data.

The data were collected from blue collar workers who were employed at manufacturing and industrial organizations in Karachi, Pakistan by employing a quantitative research methodology of survey research. The structured survey was distributed among the employees and these employees voluntarily participated in the study after being made aware of the objective of the study and that it was not compulsory for them to participate in the study. Respondents took part in this research voluntarily. Before filling out the questionnaire, the respondents were briefed on the aim of the research and assured that the data collected will be used only for academic purposes. They were also informed that the information supplied by them will be kept confidential and anonymous.

A total of 274 surveys were collected back. Through data screening process 53 surveys were found incomplete and thus discarded leaving the researcher with 221 surveys for final data analysis. The screening process through demographic and employment related questions helped in making sure that those people who met the inclusion criterion of the study which includes having experience of manufacturing industry were only selected for the final analysis. It is made clear to respondents that their data will be used for academic purposes only, keeping their identity confidential and will not be shared with anyone without authorization.

Data analysis was done through the use of the software called IBM SPSS Statistics. The data analysis was conducted following a well-structured process. Firstly, the dataset was examined in order to remove all missing data and the analyses were done based on valid datasets only. Secondly, descriptive statistics were calculated in order to provide an overview of the demographic profile of the participants.

Finally, the relationship between ICT, AI, AUT, JS, and OP was assessed through the Pearson correlation analysis. Correlation coefficient values gave an indication of the nature of the relationships between the study variables.

The analysis involved a step-by-step process. Firstly, the data set was checked for any missing data, incomplete data, and data coding errors. Secondly, descriptive statistics were calculated to provide information on the demographics of the respondents.

Thirdly, the reliability of the measurement scales was evaluated using Cronbach's alpha, where values of 0.70 and above were regarded as satisfactory for internal reliability. To test the content validity of the questionnaire items, they were based on existing scales found in literature. The suggested hypotheses were then tested using multiple regression analysis. The explanatory power of the regression models was evaluated using the coefficient of determination ($R^2$).

### Measure

All of the scales used in this analysis are well-known and have ample validity and reliability. Furthermore, the research tool was created using the KISS (keep it easy, simple) method.

## ANALYSIS AND RESULTS

### Descriptive Statistics

The full investigation was carried out using the data collected from the samples via a disseminated questionnaire. Several programs, such as Microsoft Excel and SPSS, were used to analyze the data.

### Descriptive Statistics

The descriptive statistics for employee engagement tactics and how they impact the perception of corporate performance are as follows:

**Table 1: Descriptive Statistics**

| | | ICT | JS | OP | AUT | AI |
|---|---|---|---|---|---|---|
| N | Valid | 221 | 221 | 221 | 221 | 221 |
| | Missing | 0 | 0 | 0 | 0 | 0 |
| Mean | | 20.76 | 20.98 | 20.19 | 16.71 | 16.80 |
| Std. Deviation | | 2.42 | 2.242 | 1.71 | 2.02 | 1.912 |
| Skewness | | -.048 | -.492 | 1.43 | -.296 | -.282 |
| Kurtosis | | -.342 | .707 | 2.41 | .063 | -.344 |

ICT: Information & Communication Technology; JS: Job Satisfaction; OP: Organizational Performance; AUT: Automation; AI: Artificial Intelligence

Table #3 displays the data interpretation of descriptive statistics. All 221 respondents' means and standard deviations have been calculated. The overhead analysis also shows the normalcy of the data.

The data is regularly distributed, as indicated by the kurtosis and skewness values, which are both around 3.5.

### Demographic Statistics

The following are the demographics of Worker Job Satisfaction practices and their effect on organizational performance:

**Table 3: Demographics Statistics – Gender**

| | Frequency | Percent | Valid Percent | Cumulative Percent |
|---|---|---|---|---|
| Male | 131 | 59.3 | 59.3 | 59.3 |
| Female | 90 | 40.7 | 40.7 | 100.0 |
| Total | 221 | 100.0 | 100.0 | |

The second variable in this analysis is gender. As indicated in Tables (one hundred and thirty-one only) men and 90 (ninety only) women took part in this study.

**Table 4: Demographics Statistics – Education**

| | Frequency | Percent | Valid Percent | Cumulative Percent |
|---|---|---|---|---|
| Matric | 95 | 43% | 43% | 43% |
| Intermediate | 110 | 50% | 50% | 93% |
| Graduation | 15 | 7% | 7% | 7% |
| Masters | 1 | 0.45% | 0.45% | 0.45% |
| MS/Phd | 0 | 0 | 0 | 100.0 |
| Total | 221 | 100.0 | 100.0 | |

According to Table, the educational backgrounds of the respondents, the majority had an intermediate level education (49.8%, n = 110), followed by matriculation (43.0%, n = 95). Just one respondent (0.5%) reported having a master's degree, and a comparatively small percentage of respondents (6.8%, n = 15) have a graduation degree. None of the interviewees have an MS or PhD. These results imply that those with secondary and higher secondary educational backgrounds make up the majority of the sample, with relatively little representation from higher education levels.

**Table 5: Demographics Statistics – Age**

| | Frequency | Percent | Valid Percent | Cumulative Percent |
|---|---|---|---|---|
| 20-27 | 35 | 15.8 | 15.8 | 15.8 |
| 28-35 | 132 | 59.7 | 59.7 | 75.6 |
| 36-43 | 51 | 23.1 | 23.1 | 98.6 |
| 44-51 | 3 | 1.4 | 1.4 | 100.0 |
| Total | 221 | 100.0 | 100.0 | |

Table 5 contains the fourth element, Era. A total of 221 employees responded, of whom 35 were between the ages of 20 and 27, 132 were between the ages of 28 and 35, 51 were between the ages of 36 and 43, and three were between the ages of 44 and 51.

**Table 6: Bivariate Correlation**

| | ICT | JS | OP | AUT | AI |
|---|---|---|---|---|---|
| ICT | 1 | ** | | | |
| JS | .677** | 1 | | | |
| OP | .029 | .095 | 1 | | |
| AUT | .404** | .229** | .064 | 1 | |
| AI | .601** | .589** | .017 | .478** | 1 |

ICT: Information & Communication Technology; JS: Job Satisfaction; OP: Organizational Performance; AUT: Automation; AI: Artificial Intelligence

Based on the correlation results, it can be noted that ICT, automation, and AI show high positive associations with each other, which is expected since Industry 4.0 technologies are usually implemented jointly. Also, job satisfaction shows positive association with ICT (r = .677), AI (r = .589) and automation (r = .229). At the same time, there are no significant bivariate correlations between organizational performance and ICT (r = .029), automation (r = .064), AI (r = .017), and job satisfaction (r = .095). Thus, it can be stated that, although technological adoption and employee satisfaction are positively correlated, there is no correlation between these factors and organizational performance.

It is likely that these variables have significant impact on organizational performance when analyzed together through multiple regression and SEM analysis in order to assess the unique contribution of each predictor with controlling other independent variables' impact. Finally, the highest r-value (.677) is significantly lower than the threshold of 0.80, which means that there is no indication of serious multicollinearity between the independent variables (Hair et al., 2022). Thus, the variables can be used in further regression analyses.

## Reliability Analysis

Reliability analysis was used to test the internal accuracy of the questionnaire. The overall Cronbach's Alpha value of 0.89 indicates the reliability of the questionnaire. The results are described in Table 7.

**Table 7: Reliability Analysis**

| Cronbach's Alpha | N of Items |
|---|---|
| .89 | 221 |

The great reliability of the questionnaire is demonstrated by the Cronbach's alpha rating. The reliability of the questionnaire for each component is displayed in Table 8.

**Table 8: Construct Reliability Analysis**

| | Cronbach's Alpha |
|---|---|
| Information Technology | 0.82 |
| Org Performance | 0.71 |
| Artificial Intelligence | 0.75 |
| Job Satisfaction | 0.8 |
| Automation | 0.76 |

The above table displays the reliability analysis for each variable. The reliability of the entire construct is demonstrated by the fact that every variable has a value larger than 0.7. Organizational performance has the lowest reliability value (0.71), while information technology has the greatest (0.82)

## Model Testing

Since there are multiple independent variables in the model, Multiple Regression Analysis was used to determine the combined impact of the independent variables (Information and Communication

Technology, Artificial Intelligence, Automation,) on blue collar worker motivation activities using IBM SPSS

**Table 9: Endogenous Constructs ($R^2$)**

| | R Square | R Square Adjusted |
|---|---|---|
| Job Satisfaction | 0.61 | 0.60 |
| Organizational Performance | 0.48 | 0.48 |

Table 9 displays the R-value, which shows the correlation between the dependent variable's expected and observed values. The accuracy of the model is indicated by the R-Square coefficient of determination (Guar, 2006). Job satisfaction is a dependent variable for which the model will predict 60.0 percent of the variance; the adjusted R-Square value of 0.60 indicates that independent factors including automation, artificial intelligence, and information and communication technologies are all present. The greatest results were obtained from the model's R square. Furthermore, 48% of organizational performance may be predicted by staff engagement, according to the adjusted R-Square of Job Satisfaction on Organizational Performance, which is 0.48.

## Path Analysis

The structural model was examined via the PLS-SEM approach to evaluate the hypothesized relationships between ICT, Automation, Artificial Intelligence, Job Satisfaction, and Organizational Performance in Figure 2. The model reveals acceptable explanatory capabilities since Job Satisfaction accounts for 61.0% of the variance ($R^2 = 0.610$), while Organizational Performance explains 48.0% of the variance ($R^2 = 0.480$).

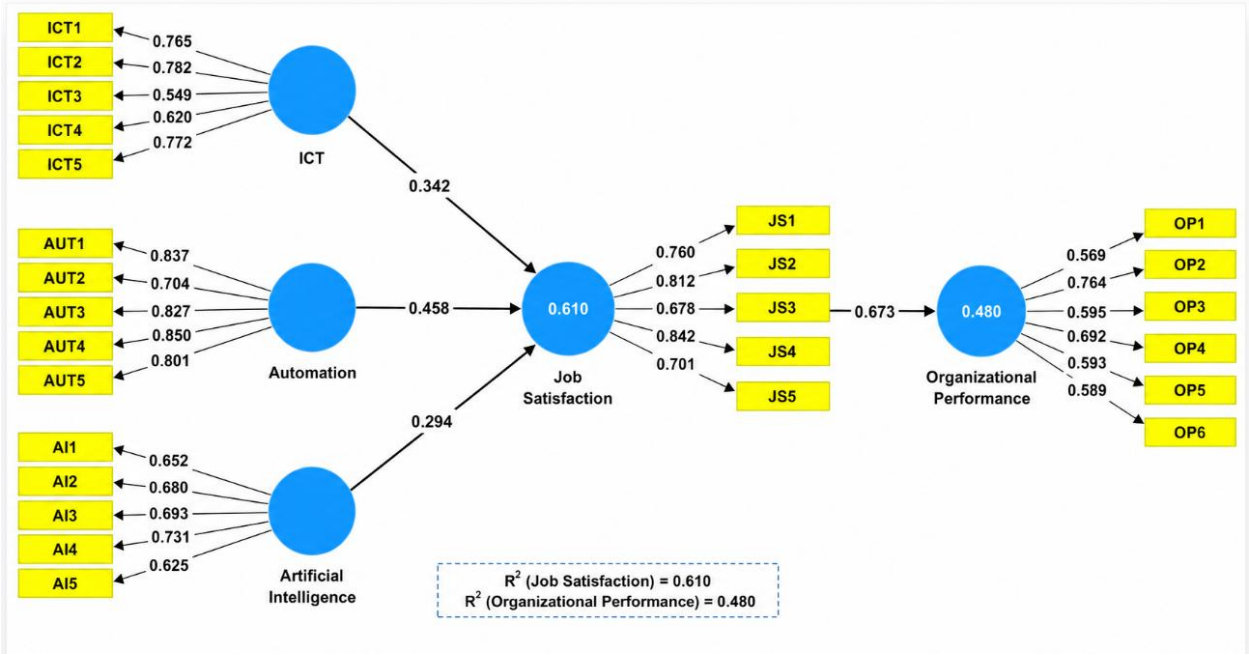


**Figure 2:** Structural Equation Modeling

In summary, the structural model confirms all relationships hypothesized above, as ICT, Automation, and Artificial Intelligence increase the level of Job Satisfaction, resulting in better Organizational Performance.

## Path Coefficient

The overall results of linear regression are displayed in Table # 10. Every theory has been discussed and explained in light of the findings.

**Table 10: Path Coefficient**

| | T Statistics (\|O/STDEV\|) | P Values |
|---|---|---|
| ICT -> Worker Satisfaction | 5.41 | 0.00 |
| Automation -> Worker Satisfaction | 8.47 | 0.00 |
| Worker Satisfaction-> Org Performance | 22.67 | 0.00 |
| Artificial Intelligence -> Worker Satisfaction | 6.03 | 0.00 |

**Table 11: Summery of Hypotheses**

| Description | Results |
|---|---|
| H1: ICT motivates the Blue Collar Worker Job Satisfaction. | Accepted |
| H2: Automation motivates the Blue Collar Worker Job Satisfaction | Accepted |
| H3: Artificial Intelligence motivates the Blue Collar Worker Job Satisfaction | Accepted |
| H4: Blue Collar Worker Job satisfaction enhances organizational performance. | Accepted |

Based on the hypothesis testing results, it becomes evident that all relationships postulated in the study are statistically significant. To be more precise, ICT significantly and positively affects worker satisfaction ($t = 5.41$, $p < 0.001$). Thus, H1 is confirmed, and the adoption of ICT helps to make workers more satisfied due to better communication, availability of information, and increased efficiency of the work process.

At the same time, automation has a statistically significant positive impact on worker satisfaction ($t = 8.47$, $p < 0.001$). It confirms H2, and means that automation technology helps to increase the level of satisfaction among workers because it makes their work more interesting, efficient and safe. Also, it has been found that artificial intelligence (AI) has a significant impact on worker satisfaction ($t = 6.03$, $p < 0.001$). It means that H3 is supported because AI systems positively influence workers helping them to solve some problems and increasing their productivity.

Finally, the level of worker satisfaction is a key factor in predicting the performance of organizations ($t = 22.67$, $p < 0.001$). Thus, H4 is confirmed, and the path between worker satisfaction and organization performance is the most significant one.

## Discussion

The results of this research reveal that Industry 4.0 technologies have a positive effect on workers' job satisfaction, which, in turn, positively influences the performance of an organization. Job satisfaction was found to be the most significant variable that influences organizational performance, showing that organizations should not only invest in technology but also focus on improving their employees' well-being.

Coefficient of determination ($R^2 = 0.60$) shows that this model can explain 60% of organizational performance, and adjusted $R^2$ (0.48) proves that job satisfaction has a significant impact on organizational performance.

The positive impact of automation on employee satisfaction corroborates with the findings of Hirsch-Kreinsen (2016), according to which the increase in automation takes place with respect to the automation of routine processes and makes it possible for the employee to concentrate on non-routine processes. At the same time, Frey and Osborne (2017) believed that the implementation of automation makes it possible for employees to spend more time on analysis and creativity at work, which increases job satisfaction.

Similarly, the relationship that exists between ICT and worker satisfaction aligns with Brynjolfsson and McAfee (2014), who contended that the use of digital technology helps improve workers' skills through improved communication and information gathering as well as decision-making. Moreover, according to Zaniboni et al. (2021), there is evidence linking increased learning and skill improvement opportunities in technology-driven work environments to job satisfaction. Lastly, the positive effect of AI is also indicative that AI can boost the working experience of employees when used as a support system rather than a substitute for their jobs (Jaiswal et al., 2022; Parker & Grote, 2022).

In general, the results suggest that technology alone is not enough for improving performance. Organizations should strive to make sure that digital transformation is accompanied by development of employees, constant training, and activities that increase their satisfaction. In this way, this research adds value to the Industry 4.0 field by proving that worker satisfaction acts as an important channel for improving performance through information technologies, automation, and artificial intelligence.

## Managerial Implications

For managers looking to maintain strong organizational performance, knowing and improving blue-collar worker motivation in the digital age offers strategic benefits. First and foremost, managers need to understand that digital transformation changes the psychological contract between employers and employees in addition to reshaping operations. Managers should fund digital upskilling initiatives that are specific to frontline positions in order to keep employees motivated and make them feel capable and prepared for the future. Clear communication regarding technology advancements can foster a culture of trust and allay concerns about losing one's job. Additionally, blue-collar workers' sense of ownership and participation can be raised by incorporating them in decisions about technology adoption, such as tool selection or workflow design.

It's also crucial to implement hybrid reward schemes that honor both conventional work output and technological flexibility. Morale can be raised by non-monetary rewards including praise for mastering new systems, adhering to safety regulations, or taking part in innovative projects. In order to promote a learning-oriented atmosphere where errors are viewed as a necessary component of development, managers should also modify their leadership philosophies to be more encouraging and inclusive. Managers can also monitor employee performance and happiness by utilizing real-time digital feedback technologies, which enables prompt interventions.

In summary, CEOs are more likely to fully utilize their blue-collar workers if they approach digital transformation as a human-centered change process rather than a merely technical improvement. In turn,

this improves organizational agility, lowers attrition, and boosts productivity in a company environment that is becoming more automated.

## Theoretical implications

The traditional workplace has been drastically altered by the quick development of digital technologies, which has had a special effect on blue-collar workers. In order to maximize organizational performance in the digital age, it is necessary to reevaluate well-established theories of motivation and how they are applied. Blue-collar worker motivation's theoretical ramifications for organizational performance in this changing environment are complex, encompassing traditional motivational theories, new digital difficulties, and the possibility of developing new theoretical frameworks.

Rapid technological innovations in the digital world have changed the traditional work environment dramatically, especially the working lives of blue-collar employees who are being influenced more and more by technologies such as automation and AI and ICTs. This new dynamic calls for a reevaluation of theories of motivation that need to be reinterpreted in order to help us understand and explain the behavior of employees and its effects on organizational performance.

The findings provide compelling evidence for the incorporation of job design theories (Hackman & Oldham, 1976) and technology acceptance models (TAM; Davis, 1989) into contemporary motivation frameworks such as Self-Determination Theory (Deci & Ryan, 1985) in digitally altered workplaces. ICT, automation, and artificial intelligence (AI) all have a notable positive effect on worker satisfaction, suggesting that technology tools that increase autonomy, efficiency, and perceived competence are increasingly influencing blue-collar motivation.

The results provide support for the view that a combination of Job Characteristics Theory (Hackman & Oldham, 1976), the Technology Acceptance Model (Davis, 1989), and Self-Determination Theory (Deci & Ryan, 1985) can be used to explain what motivates people working in corporate environments that have been transformed through digital technology. According to Job Characteristics Theory, digital tools have improved core job characteristics such as autonomy, feedback about how well an employee is doing their work, and task significance; therefore, employees' motivation to perform their work is increased, as well as the level of satisfaction they experience in performing their work. In a similar manner, the Technology Acceptance Model contends that employees who believe that using an information and communication technology (ICT) will result in improved performance will be more apt to use it, and consequently will perform better at work. Self-Determination Theory helps to further illustrate this relationship between intrinsic motivation and digital technologies by discussing how digital technologies can fulfil psychological needs of autonomy, competence, and relatedness, thereby increasing intrinsic motivation for individuals who use these technologies. Collectively, these theoretical frameworks suggest that through improving the efficiency of workers, the perceived competence of workers, and providing workers with greater control over their jobs through using ICT, automation, and artificial intelligence, blue collar workers will experience a higher level of job satisfaction.

According to Davenport and Kirby (2015), a motivated blue-collar workforce with digital skills is more likely to recognize opportunities for digital innovation, help improve processes and swiftly adjust to changing needs and technology. Through automation, real-time data, and enhanced communication, digital tools can increase efficiency and productivity. Blue-collar employees who are driven are more likely to

adopt and use these tools efficiently, which increases productivity, lowers error rates, and streamlines procedures.

Additionally, recent academic research suggests that using artificial intelligence (AI) and other methods of digitally supported leadership to motivate employees will become even more effective by supporting the development of both technologically efficient organizational processes and emotionally intelligent transformational leadership practices, thus helping to create more flexible, adaptive, and human-oriented workplaces (Tanveer, 2025). One method of achieving greater productivity through digital technologies is providing employees with access to real time data, using automated processes, and providing means for improved communication among employees (e.g., email, instant messaging, etc.), allowing users to complete their work with increased efficiency and fewer mistakes. Companies that support the development of employees' capabilities in using digital technologies; have meaningful job designs; and treat employees fairly, are more likely to retain a skilled workforce and attract talent in competitive labor markets (Bersin, 2018). In turn, these factors will help to lower the turnover rate within organizations and help companies to maintain institutional knowledge.

Businesses are more likely to retain seasoned talent and draw in new hires looking for digitally advanced workplaces if they successfully inspire their blue-collar employees in the digital age by offering chances for skill development, meaningful work, and equitable treatment (Bersin, 2018). This preserves institutional knowledge and lowers turnover costs.

In summary, the digital age forces a change in perspective from considering blue-collar job to be solely manual labor to acknowledging the growing demands of digital and cognitive skills. In order to take into consideration the ways that digital tools impact traditional motivators and hygiene factors, create new types of motivation (such digital competence), and affect organizational performance through increased productivity, innovation, quality, and retention, theoretical frameworks must change. Future studies should focus more on the psychological foundations of blue-collar workers' motivation and digital adaptability in order to create more sophisticated and practical methods for maximizing their performance in a technologically advanced society.

## CONCLUSION

This study examined the effects of information and communication technology (ICT), automation, and artificial intelligence (AI) on worker satisfaction and organizational performance among blue-collar workers in Pakistan's manufacturing industry. The findings indicate that ICT, automation, and AI each have a significant positive effect on worker satisfaction, while worker satisfaction, in turn, has a significant positive effect on organizational performance. These results further demonstrate that the successful implementation of Industry 4.0 depends not only on technological innovation but also on employees' ability to effectively adopt and utilize these technologies (Da Xu et al., 2018; Parker & Grote, 2022).

From a theoretical perspective, this study supports the Job Demands–Resources (JD-R) Theory (Bakker & Demerouti, 2007) and Socio-Technical Systems (STS) Theory (Trist & Bamforth, 1951), suggesting that technological resources enhance organizational performance by improving worker satisfaction. From a practical perspective, the findings emphasize that organizations should complement investments in advanced technologies with employee-centered initiatives, such as continuous training and reskilling, effective communication, and structured change management programs. These initiatives can reduce employees' uncertainty regarding technological change, facilitate the successful adoption of Industry 4.0 technologies, and ultimately enhance organizational performance (Jaiswal et al., 2022; Vial, 2019).

### Limitations and Future Research

However, there are some disadvantages to this study that must be addressed. Firstly, the use of a cross-sectional research design restricts the possibility of causal relationships identification between the studied variables. In the future, researchers need to apply longitudinal studies to investigate how perceptions of employees and organizational outcomes change in different phases of the implementation of Industry 4.0. Secondly, self-reporting was used in this study, which is why it is prone to the issue of common method bias. Multiple sources of data, for example, supervisor's ratings or indicators of organizational performance, could be used in the future to enhance the robustness of research.

Thirdly, the sample of the current study included only blue-collar employees from manufacturing organizations in Karachi, Pakistan, which implies that the results are not applicable to other industries or regions. Thus, future research needs to generalize the current model in different settings. Lastly, the current framework can be extended through the introduction of some other variables, like digital leadership, technological readiness, organizational culture, resilience, or psychological safety (Frank et al., 2019; Parker & Grote, 2022).

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