British Journal of Interdisciplinary Research August 2026, Volume 3, Number 13, pp. 56-75
ISSN 3049-8899

THE IMPACT OF ADVANCED ROBOTICS ON EMPLOYEES' PERFORMANCE IN LARGE-SCALE OPERATIONS: EVIDENCE FROM THE NATIONAL CENTRE FOR ARTIFICIAL INTELLIGENCE AND ROBOTICS (NCAIR), ABUJA, NIGERIA

Queen Ladi PATRICK,

Department of Business Administration, Faculty of Management Sciences, University of Abuja, Abuja, Nigeria. patrickqueen270@gmail.com

&

I. T. NDULUE,

Asso Prof., HOD-Department of Business Administration, Faculty of Management Sciences, University of Abuja, Abuja, Nigeria, nduluetheresa@yahoo.com

Abstract

The increasing use of advanced robotics in today's organizations has greatly changed how work is done, changing the way employees perform their jobs, what is expected of them, and how operations are carried out. This research looks into how advanced robotics affect the performance of employees in big operations at the National Centre for Artificial Intelligence and Robotics (NCAIR) in Abuja, Nigeria. Based on the Technology-Organization-Environment (TOE) Framework, the study aimed to achieve four goals: first, to look at how robotic process automation (RPA) affects employee productivity; second, to evaluate how working with robots influences job satisfaction; third, to find out how much robotic deployment impacts skill development; and fourth, to check how integrating robotics affects overall operational efficiency. A quantitative, causal-descriptive research design was adopted. The study focused on 210 employees from NCAIR Abuja. Using Slovin's formula with a 5% error margin, 138 participants were selected. To account for those who didn't respond, 173 questionnaires were given out, resulting in 157 valid responses, which is a 91% response rate. The data were examined using simple linear regression, analysis of variance (ANOVA), and Pearson correlation through SPSS Version 27. The findings show that robotic process automation has a strong and positive impact on employee productivity ($\beta = .741, p < .001$); working together with robots also greatly affects job satisfaction ($\beta = .683, p < .001$); using robots helps improve skills development ($\beta = .659, p < .001$); and integrating robotics into operations leads to better efficiency ($\beta = .712, p < .001$). All four null hypotheses were rejected. The study finds that advanced robotics plays a major role in improving employee performance at NCAIR Abuja and suggests implementing ongoing training programs, a clear plan for working together with robots, active management of change, and a tool to track performance in real time.

Keywords: *Advanced Robotics, Employee Performance,Robotic Process Automation, Human-Robot Collaboration, Skills Development, Operational Efficiency.*

DOI: 10.31039/bjir.v3i13.150

1. INTRODUCTION

The rise of advanced robotics has become a major change in how organizations manage their operations, shifting traditional views on work, employee value, and performance in the twenty-first century. As countries speed up their use of artificial intelligence and automation, the way robots and human workers interact has become a major topic of discussion in management studies and how organizations behave. Advanced robotics, which includes robotic process automation (RPA), collaborative robots (cobots), autonomous guided vehicles, and AI-based decision-making systems, is no longer limited to manufacturing. It is now widely used in service industries, government organizations, research facilities, and technology-focused agencies, becoming more common over time (Brynjolfsson & McAfee, 2014).

In Nigeria, the federal government has pledged to build a digital-first economy by supporting innovation hubs, AI centers, and technology-driven public institutions, as outlined in its National Digital Economy Policy and Strategy for 2020–2030. A key part of this plan is the National Centre for Artificial Intelligence and Robotics (NCAIR) in Abuja, which was created as the main institution for conducting AI research, developing new technologies, shaping policies, and applying advanced technologies in major national projects. NCAIR Abuja works where technology rules, AI is used, and managing workers meets, making it a great place to look at how advanced robots affect how employees perform (Oyelaran & Fakolujo, 2019).

Global research shows mixed results about how advanced robotics affect how well employees perform their jobs. Research in countries with heavy manufacturing sectors like Germany, South Korea, and Japan shows that companies using collaborative robots can see productivity improvements of as much as 30% (International Federation of Robotics, 2022). Research in growing economies shows that the advantages of using robots depend on how well people are trained, how prepared the companies are, and the level of support from institutions (Ogbeibu, Emelifeonwu, Sarpong, & Gaskin, 2020). This difference shows how important it is to study things in the right context, considering the particular environment and culture they are in. This study is driven by the lack of real-world research on how advanced robotics impacts the workforce at NCAIR Abuja, focusing on four key areas: productivity, job satisfaction, skills development, and operational efficiency.

1.1 Statement of the Problem

Even though advanced robotic systems are widely used at NCAIR Abuja, it's still not clear how this integration specifically impacts the employees who have to work alongside, adjust to, and cooperate with these systems every day. Three issues highlight the importance of this investigation. Quickly deploying robots has happened faster than organizations can train their workers, leading to a lack of needed skills and lower confidence in jobs. Second, unclear boundaries between human and machine roles lead to role conflict and performance anxiety. Third, even though robotics is expected to boost productivity and operational efficiency, there isn't much real-world evidence to support this in the specific case of NCAIR Abuja. Earlier research has mainly looked at manufacturing sectors and situations in more developed countries (Acemoglu & Restrepo, 2018; IFR, 2022), but there's not much information about AI-related government research organizations in Nigeria. This leaves an important area of study uncovered.

1.2 Research Questions

i. How much does robotic process automation impact the productivity of employees at NCAIR Abuja?

ii. How does working with robots impact the happiness and satisfaction of employees at NCAIR Abuja?

iii. How much does the use of robots influence the growth of employees' skills at NCAIR Abuja?

iv. How does the use of robotics affect the efficiency of workers at NCAIR Abuja?

1.3 Objectives of the Study

The main goal of this study is to examine how advanced robotics affect the performance of employees in big operations at NCAIR Abuja. The main goals are to: (i) look into how robotic process automation impacts the productivity of employees at NCAIR Abuja; (ii) check how working with robots affects job satisfaction among employees at NCAIR Abuja; (iii) find out how much the use of robots influences the skill growth of employees at NCAIR Abuja; and (iv) review the effect of integrating robotics on the overall efficiency of employees at NCAIR Abuja.

1.4 Statement of Hypotheses

H_{01}: Robotic process automation has no significant effect on the productivity of employees at NCAIR Abuja.

H_{02}: Human-robot collaboration has no significant influence on the job satisfaction of employees at NCAIR Abuja.

H_{03}: Robotic deployment has no significant effect on the skills development of employees at NCAIR Abuja.

H_{04}: Robotics integration has no significant impact on the operational efficiency of employees at NCAIR Abuja.

1.5 Scope of the Study

This study is confined to NCAIR Abuja and focuses on large-scale operations covering both management and non-management staff engaged in research, administration, AI development, data processing, and operational management. The independent variable is advanced robotics, proxied by RPA, human-robot collaboration, robotic deployment, and robotics integration. The dependent variable is employee performance, measured through productivity, job satisfaction, skills development, and operational efficiency. The study period covers 2020–2025.

2. LITERATURE REVIEW AND THEORETICAL FRAMEWORK

CONCEPTUAL REVIEW

Advanced Robotics

Advanced robotics involves the latest type of robotic systems that have improved ability to work on their own, adjust to different situations, sense their surroundings, and communicate effectively with people and changing environments. Traditional industrial robots are stiff, do the same thing over and over, and can only do specific jobs. But advanced robots use AI, machine learning, computer vision, and smart sensors. These tools let the robots handle tricky and changing tasks in a smart and flexible way (Acemoglu & Restrepo, 2018). This range covers RPA, cobots, autonomous mobile robots (AMRs), and systems that use exoskeletons.

Robotic Process Automation (RPA)

RPA uses software robots or 'bots' to do tasks that follow certain rules and are repeated, which used to be done by people. These tasks include logging into apps, getting and working with data, filling out forms, and making reports. These bots can do these things faster and more accurately than humans can (van der Aalst, Bichler, & Heinzl, 2018). At NCAIR Abuja, RPA is used in various tasks like managing data, creating research reports, keeping track of AI models, and handling administrative work. Studies show that using RPA makes work more efficient by taking over simple tasks, which allows people to focus on more important thinking and decisions (Willcocks, Lacity, & Craig, 2015).

Human-Robot Collaboration (HRC)

HRC involves setups where human workers and robotic systems operate together in the same workspace and collaborate to achieve shared objectives of the organization. Effective human-robot collaboration is marked by the presence of both humans and robots in the same physical space, their tasks working together in a complementary way, constant communication happening in real time, and both sides adjusting to each other as they perform tasks (Villani, Pini, Bonfè, & Secchi, 2018). Employees who view robotic colleagues as helpful, dependable, and focused on their tasks tend to be more satisfied with their jobs compared to those who see robots as disruptive or unsettling, according to Bauer and Wollherr (2008).

Robotic Deployment and Skills Development

The use of advanced robotics leads to major shifts in the skills required by the workforce. As robots take on more routine tasks, workers are increasingly needed to show skills in monitoring robotic systems, understanding data, checking algorithms, and making decisions using technology (Autor, Levy, & Murnane, 2003). Scholars have identified two different paths: upskilling, where workers gain more advanced skills, and deskilling, where automation reduces the need for certain skills (Bessen, 2019). At NCAIR Abuja, the main direction is probably focused on improving skills, which aligns with its research-based mission, but this depends on the organization's commitment to investing in organized training programs.

Robotics Integration and Operational Efficiency

Operational efficiency is the capacity of an organization to achieve desired outputs with minimum resource input while maintaining output quality (Handoyo, Suharman, Ghani, & Soedarsono, 2023). Robotics integration — the systematic incorporation of robotic technologies into core organizational processes — is widely regarded as one of the most powerful levers for improving operational efficiency. By automating high-volume processes, reducing error rates, and enabling 24/7 continuity, advanced robotics dramatically compresses cycle times and improves throughput quality (IFR, 2022).

Employee Performance

Employee performance involves several aspects, including the quality, amount, punctuality, and originality of their work contributions. In technology-heavy organizations like NCAIR Abuja, performance is not just about completing tasks but also involves efficiently managing technological settings and consistently adjusting to new requirements (Duan, Deng, & Wibowo, 2023). This study looks at four key areas: productivity, job satisfaction, skills development, and operational efficiency.

THEORETICAL FRAMEWORK

Technology-Organization-Environment (TOE) Framework

This study uses the Technology-Organization-Environment (TOE) Framework, which was first introduced by Tornatzky and Fleischer in 1990, as its main theoretical basis. The TOE Framework is favored over earlier models like the Technology Acceptance Model (Davis, 1989) because it goes beyond understanding individual perceptions of technology to offer a thorough, multi-level examination of the contextual factors that influence how technology adoption leads to organizational performance. This broader scope makes it much more suitable for addressing the complex institutional environment of NCAIR Abuja. The TOE Framework suggests that the way technology is adopted and how it performs depends on three connected factors: (1) the technological context, which includes both the internal and external technologies relevant to an organization, such as current robotic systems like RPA, cobots, and autonomous systems, as well as new automation technologies; (2) the organizational context, which looks at specific features of the company, such as its size, management structure, available human resources, and how ready employees are to adopt robotics, all of which can either help or hinder effective implementation; and (3) the environmental context, which refers to external pressures from the industry, regulations, and competition, including policies like Nigeria's National Digital Economy Policy and broader AI governance rules in Africa, which influence how quickly and widely technology is integrated (Tornatzky & Fleischer, 1990; Oliveira & Martins, 2011).

At NCAIR Abuja, the TOE Framework illustrates how the impact of advanced robotics—including RPA, HRC, robotic deployment, and robotics integration—on employee outcomes such as productivity, job satisfaction, skills development, and operational efficiency is influenced by the interaction between technological infrastructure, organizational capacity, and the wider Nigerian AI policy environment. The TOE Framework has been effectively used in recent research related to automation and how institutions perform in developing countries (Baker, 2012; Oliveira, Thomas, & Espadanal, 2014). It offers a strong theoretical approach for understanding how the use of robotics relates to performance within a public-sector organization that uses artificial intelligence.

Research Model

The research model illustrates the hypothesized directional relationships between advanced robotics (the independent variable) and employee performance (the dependent variable). Advanced robotics is operationalized through four dimensions: robotic process automation (RPA), human–robot collaboration (HRC), robotic deployment, and robotics integration. Employee performance is measured using four corresponding indicators: employee productivity, job satisfaction, skills development, and operational efficiency. The model is underpinned by the Technology–Organization–Environment (TOE) Framework, which provides the contextual basis for explaining how technological, organizational, and environmental factors influence the adoption and effective utilization of advanced robotics. Specifically, the model proposes that robotic process automation positively influences employee productivity (H_1), human–robot collaboration positively influences job satisfaction (H_2), robotic deployment positively influences skills development (H_3), and robotics integration positively influences operational efficiency (H_4).

Review of Empirical Studies

Acemoglu and Restrepo (2018) conducted a seminal study examining industrial robot effects on employment across United States labor markets (1990–2007). Using instrumental variable regression, they found displacement effects but also noted that firms with complementary retraining investments converted robotic adoption into measurable performance gains.

Willcocks, Lacity, and Craig (2015) investigated RPA’s impact on service delivery in three multinational corporations in the United Kingdom and Australia. RPA reduced processing time by 70% and error rates by 85%, with employees reporting higher job satisfaction and greater upskilling opportunities after routine tasks were automated.

Ogbeibu et al. (2020) examined the moderating role of organizational culture in technology adoption and employee performance in Nigerian financial institutions, finding that a supportive culture significantly strengthened the positive relationship between automation adoption and productivity.

Manyika et al. (2017) demonstrated that approximately 60% of occupations have at least 30% technically automatable activities, with the most significant performance gains occurring where human and machine capabilities are strategically integrated rather than substituted.

Bessen (2019) found that automation initially displaced routine skills but over time contributed to higher-order skills development among adaptable employees, resulting in wage premiums supporting the argument that managed robotic deployment catalysis skills development.

Gap in the Literature

Despite the growing literature on advanced robotics and employee performance, significant gaps remain. Most existing studies are concentrated in manufacturing industries or Western contexts; few studies simultaneously investigate all four performance dimensions within a single institutional setting; and there is a dearth of empirical research on Nigerian government technology institutions. This study addresses all three gaps through a comprehensive, contextualized investigation at NCAIR Abuja.

3. METHODOLOGY

Research Design

This study employed a causal and descriptive research design. The causal (explanatory) design ascertains cause-and-effect relationships between advanced robotics and the four dimensions of employee performance, while the descriptive design characterizes the nature and extent of robotic deployment at NCAIR Abuja. A quantitative research approach was adopted, consistent with the study's objective of generating statistically testable, generalizable findings (Ogbeibu et al., 2020; Willcocks et al., 2015).

Population of the Study

The target population comprised all staff of NCAIR Abuja, including management and non-management cadre employees engaged in research, AI development, data analytics, administration, and operational management. Based on the Human Resource Department of NCAIR Abuja, the total staff strength at the time of the study was 210 employees, distributed as shown in Table 1.

Table 1. Population Frame of NCAIR Abuja, 2026

S/N	Category of Staff	Number
1	Management Staff	62
2	Senior Non-Management Staff	88
3	Junior Non-Management Staff	60
	Total	210

Source: Human Resource Department, NCAIR Abuja.

Sampling Technique and Sample Size

The study adopted simple random sampling to ensure every staff member had an equal and independent chance of selection, minimizing selection bias. Sample size was determined using Slovin's formula (Slovin, 1960): $n = N / (1 + N(e)^2)$

Where n = required sample size; N = total population = 210; e = margin of error = 0.05. Therefore, $n = 210 / (1 + 210 \times 0.0025) = 210 / 1.525 \approx 138$. Adjusting for an anticipated 20% non-response rate: 138 /173 questionnaires were administered.

Method of Data Collection

Primary data were collected through a structured, closed-ended questionnaire designed on a five-point Likert scale (1 = Strongly Disagree to 5 = Strongly Agree). Secondary data were sourced from peer-reviewed journal articles, institutional reports, and policy documents.

Validity and Reliability

Content validity was established by systematically deriving questionnaire items from the study's objectives and hypotheses, validated by two senior academic researchers at the University of Abuja. Cronbach's alpha reliability coefficients for each construct are reported in Table 2; all values exceeded the recommended 0.70 threshold (Nunnally, 1978).

Table 2. Reliability Statistics

Construct	No. of Items	Cronbach's Alpha	Decision
Robotic Process Automation	6	0.83	Reliable
Human-Robot Collaboration	6	0.81	Reliable
Robotic Deployment	6	0.79	Reliable
Robotics Integration	6	0.84	Reliable
Employee Performance (Composite)	8	0.86	Reliable

Source: Field survey, 2026.

Method of Data Analysis

Data from the 157 valid questionnaires were analysed using descriptive statistics (frequencies, percentages, means, and standard deviations) and inferential statistics comprising simple linear regression analysis, ANOVA, and Pearson correlation via SPSS Version 27. The estimation equations are specified as follows:

EP = f(AR) ....(i)

PROD = $a_0 + a_1$RPA + e............. (ii)

JS = $a_0 + a_1$HRC + e .... (iii)

SD = $a_0 + a_1$RD + e............. (iv)

EOE = $a_0 + a_1$RI + e............. (v)

Where PROD = Productivity; JS = Job Satisfaction; SD = Skills Development; EOE = Employees' Operational Efficiency; RPA = Robotic Process Automation; HRC = Human-

Robot Collaboration; RD = Robotic Deployment; RI = Robotics Integration; a_0 = intercept; a_1 = specification estimate; e = error term.

4. DATA PRESENTATION AND ANALYSIS

4.1 Response Rate

Table 3. Response Rate

Variable	Frequency	Percentage (%)
Questionnaires Administered	173	100
Questionnaires Retrieved and Valid	157	91
Questionnaires Not Retrieved / Invalid	16	9

Source: Field survey, 2026.

Table 3 shows that of the 173 questionnaires administered to staff of NCAIR Abuja, 157 were successfully retrieved and valid for analysis, representing a 91% response rate. The remaining 16 (9%) were either unreturned or invalid due to incomplete responses. All subsequent analyses are based on the 157 valid responses.

4.2 Descriptive Statistics

Table 4. Descriptive Statistics

Variable	N	Min	Max	Mean	SD
Robotic Process Automation	157	1	5	3.84	0.712
Human-Robot Collaboration	157	1	5	3.71	0.748
Robotic Deployment	157	1	5	3.65	0.693
Robotics Integration	157	1	5	3.79	0.721
Employee Productivity	157	1	5	3.90	0.683
Job Satisfaction	157	1	5	3.77	0.715
Skills Development	157	1	5	3.68	0.702
Operational Efficiency	157	1	5	3.83	0.694

Source: Field survey, 2026.

The descriptive statistics (Table 4) indicate that all study variables recorded means above the midpoint of 3.0 on the five-point Likert scale, suggesting that respondents perceived advanced robotics favourably and reported moderate-to-high levels of performance outcomes. RPA recorded the highest mean (3.84), while robotic deployment recorded the lowest (3.65), reflecting the uneven depth of robotic integration across NCAIR Abuja's operational units.

4.3 Correlation Analysis

Table 5. Pearson Correlation Matrix

Variable	1	2	3	4	5	6	7	8
1. RPA	1.00							
2. HRC	.614**	1.00						
3. Robotic Deployment	.589**	.603**	1.00					
4. Robotics Integration	.641**	.618**	.597**	1.00				
5. Productivity	.741**	.512**	.498**	.583**	1.00			
6. Job Satisfaction	.503**	.683**	.491**	.527**	.614**	1.00		
7. Skills Development	.488**	.501**	.659**	.512**	.573**	.598**	1.00	
8. Operational Efficiency	.526**	.497**	.508**	.712**	.601**	.579**	.621**	1.00

Table 5 reveals statistically significant positive correlations among all study variables ($p < .01$). The strongest correlation exists between RPA and productivity ($r = .741$), and between robotics integration and operational efficiency ($r = .712$), providing preliminary support for the study's hypotheses. No correlation coefficient exceeded .80, confirming the absence of multicollinearity.

4.4 Hypothesis Testing

Test of Hypothesis 1: Effect of RPA on Employee Productivity

Table 6a. Model Summary – H1

Model	R	R Square	Adjusted R Square	Std. Error
1	.741	.549	.546	.461

Table 6b. ANOVA – H1

	Sum of Squares	df	Mean Square	F	Sig.
Regression	40.871	1	40.871	192.341	.000
Residual	32.846	155	.212		
Total	73.717	156			

Table 6c. Coefficients – H1

Model	B	Std. Error	Beta	t	Sig.
(Constant)	.814	.183		4.448	.000
RPA	.693	.050	.741	13.869	.000

Decision: The regression model was statistically significant ($F(1,155) = 192.341$, $p < .001$), with RPA explaining 54.9% of the variance in employee productivity ($R^2 = .549$). The standardised coefficient ($\beta = .741$, $t = 13.869$, $p < .001$) indicates a strong, positive, and significant effect of RPA on productivity. H_{01} is rejected.

4.4.1 Test of Hypothesis 2: Influence of HRC on Job Satisfaction

Table 7a. Model Summary – H2

Model	R	R Square	Adjusted R Square	Std. Error
1	.683	.467	.463	.523

Table 7b. ANOVA – H2

	Sum of Squares	df	Mean Square	F	Sig.
Regression	37.621	1	37.621	137.517	.000
Residual	42.397	155	.273		
Total	80.018	156			

Table 7c. Coefficients – H2

Model	B	Std. Error	Beta	t	Sig.
(Constant)	.932	.201		4.637	.000
HRC	.657	.056	.683	11.727	.000

Decision: The regression model was statistically significant ($F(1,155) = 137.517$, $p < .001$), with HRC explaining 46.7% of the variance in job satisfaction ($R^2 = .467$). The standardised coefficient ($\beta = .683$, $t = 11.727$, $p < .001$) indicates a strong, positive, and significant influence of HRC on job satisfaction. H_{02} is rejected.

4.4.2 Test of Hypothesis 3: Effect of Robotic Deployment on Skills Development

Table 8a. Model Summary – H3

Model	R	R Square	Adjusted R Square	Std. Error
1	.659	.434	.431	.527

Table 8b. ANOVA – H3

	Sum of Squares	df	Mean Square	F	Sig.
Regression	33.149	1	33.149	119.314	.000
Residual	43.074	155	.278		
Total	76.223	156			

Table 8c. Coefficients – H3

Model	B	Std. Error	Beta	t	Sig.
(Constant)	.871	.197		4.421	.000
Robotic Deployment	.638	.058	.659	11.014	.000

Decision: The regression model was statistically significant ($F(1,155) = 119.314$, $p < .001$), with robotic deployment explaining 43.4% of the variance in skills development ($R^2 = .434$). The standardized coefficient ($\beta = .659$, $t = 11.014$, $p < .001$) indicates a strong, positive, and significant effect. H_{03} is rejected.

4.4.3 Test of Hypothesis 4: Impact of Robotics Integration on Operational Efficiency

Table 9a. Model Summary – H4

Model	R	R Square	Adjusted R Square	Std. Error
1	.712	.507	.503	.489

Table 9b. ANOVA – H4

	Sum of Squares	df	Mean Square	F	Sig.
Regression	38.512	1	38.512	160.927	.000
Residual	37.092	155	.239		

Total	75.604	156			

Table 9c. Coefficients – H4

Model	B	Std. Error	Beta	t	Sig.
(Constant)	.789	.189		4.175	.000
Robotics Integration	.683	.054	.712	12.686	.000

Decision: The regression model was statistically significant ($F(1,155) = 160.927$, $p < .001$), with robotics integration explaining 50.7% of the variance in operational efficiency ($R^2 = .507$). The standardized coefficient ($\beta = .712$, $t = 12.686$, $p < .001$) confirms a strong, positive, and significant impact. H_{04} is rejected.

4.4.4 Summary of Hypothesis Testing Results

Table 10. Summary of Regression Results

Hypothesis	Beta	F-Statistic	p-value	R^2	Decision
H1: RPA - Productivity	.741	192.341	.000	.549	Rejected
H2: HRC - Job Satisfaction	.683	137.517	.000	.467	Rejected
H3: Robotic Deployment - Skills Development	.659	119.314	.000	.434	Rejected
H4: Robotics Integration - Operational Efficiency	.712	160.927	.000	.507	Rejected

Source: Field survey, 2026 (SPSS Version 27 output).

4.5 Discussion of Findings

Finding 1 – RPA and Employee Productivity (H1): The rejection of H_{01} ($\beta = .741$, p < 2.001, R = .549)

confirms that robotic process automation exerts a strong, positive, and statistically significant effect on

employee productivity at NCAIR Abuja. This finding corroborates Willcocks et al. (2015), who reported a 70% reduction in processing time following RPA deployment, and aligns with Acemoglu and Restrepo (2018), who noted productivity gains in firms with complementary human-RPA integration strategies. By automating data management, report generation, and administrative processing, RPA liberates employees' cognitive resources for higher-order analytical and strategic functions, directly elevating individual productivity levels.

Finding 2 – HRC and Job Satisfaction (H2): The rejection of H_{02} (β = .683, p < 2.001, R = .467)

establishes that human-robot collaboration significantly and positively influences employee job

satisfaction. This result matches what Bauer and Wollherr (2008) found, showing that employees who see robotic coworkers as helpful and reliable feel more satisfied. In the TOE Framework, this result shows how important the organization's environment is — especially how managers try to set up human resources in a way that works well with, rather than against, people's roles — in affecting how satisfied people are with using new technology.

Finding 3 – Robotic Deployment and Skills Development (H3): The rejection of H_{03} (β = .659, p <.001, R^2 = .434) demonstrates that robotic deployment significantly drives skills development at NCAIR

Abuja. This finding is consonant with Bessen (2019), who found that automation catalyses higher-order skills development among technologically adaptable employees. The result further corroborates Autor, Levy, and Murnane's (2003) task-biased technological change hypothesis, which posits that as robots absorb routine tasks, demand for cognitive and interpersonal competencies among human employees intensifies, stimulating continuous learning.

Finding 4 – Robotics Integration and Operational Efficiency (H4): The rejection of H_{04} (β = .712, p <.001, R^2 = .507) confirms that robotics integration exerts the strongest explanatory power on operational efficiency among the four hypotheses, accounting for 50.7% of variance. This is consistent with the International Federation of Robotics (2022) report, which documented dramatic reductions in cycle times and error rates in institutions with systematic robotics integration. Within the TOE Framework, this result underscores the importance of environmental factors including Nigeria's AI policy imperatives in incentivizing coherent robotics integration strategies that yield measurable efficiency gains.

5. CONCLUSION AND RECOMMENDATIONS

Conclusion

This study aimed to look at how advanced robotics affect employees' work performance in big operations at the National Centre for Artificial Intelligence and Robotics (NCAIR) in Abuja, using the Technology-Organization-Environment (TOE) Framework as a foundation. Based on looking at 157 real responses, these are the results we found. At NCAIR Abuja, robotic process automation has a big positive impact on employee productivity. RPA helps free up human workers from doing repetitive tasks, allowing them to focus on more important work like analyzing data and making strategic decisions. Second, working together with robots can greatly improve how satisfied people feel at their jobs; when robots help humans instead of taking their place, and when workers see robots as helpful and reliable, their overall satisfaction tends to increase. Third, using robots in work settings helps employees develop their skills a lot. Advanced robot systems require new types of technical and thinking abilities, which encourages people to keep learning and improving. Fourth, using robotics helps a lot in making operations more efficient. By carefully adding robot technology into the main work processes of the organization, it helps cut down on the time needed for tasks, reduces mistakes, and makes the overall workflow better. This strengthens NCAIR Abuja's ability to handle its big operational goals. In short, advanced robotics plays a big role in improving how employees perform at NCAIR Abuja, and this effect is seen in all four areas: productivity, job satisfaction, skill growth, and how efficiently operations run. All four null hypotheses were rejected with a p-value less than 0.001.

Recommendations

Based on the findings, the following recommendations are made:

i. The management of NCAIR Abuja should institutionalize structured reskilling and upskilling programmes directly aligned with deployed robotic systems. These programmes should be continuous, responsive to technological changes, and accessible to employees at all cadre levels.

ii. The Human Resource Department should develop and implement a comprehensive human-robot collaboration framework that clearly defines roles, boundaries, and interaction protocols for employees working alongside robotic systems, with regular feedback mechanisms to monitor and enhance satisfaction in HRC environments.

iii. A robust change management strategy should accompany all future robotic deployment and integration initiatives, including pre-deployment employee engagement sessions, transparent communication of objectives, and post-deployment support systems.

iv. NCAIR Abuja should establish a real-time performance monitoring dashboard tracking the four key dimensions examined productivity, job satisfaction, skills development, and operational efficiency to enable evidence-based adjustments to robotics integration strategies.

REFERENCES

Acemoglu, D., & Restrepo, P. (2018). Robots and jobs: Evidence from US labor markets. *Journal of Political Economy*, 128(6), 2188–2244. https://doi.org/10.1086/705716

Autor, D. H., Levy, F., & Murnane, R. J. (2003). The skill content of recent technological change: An empirical exploration. *Quarterly Journal of Economics*, 118(4), 1279–1333. https://doi.org/10.1162/003355303322552801

Baker, J. (2012). The technology–organisation–environment framework. In Y. K. Dwivedi, M. R. Wade, & S. L. Schneberger (Eds.), *Information Systems Theory* (pp. 231–245). Springer.

Barney, J. (1991). Firm resources and sustained competitive advantage. *Journal of Management*, 17(1), 99–120. https://doi.org/10.1177/014920639101700108

Bauer, A., & Wollherr, D. (2008). Human-robot collaboration: A survey. *International Journal of Humanoid Robotics*, 5(1), 47–66.

Bessen, J. E. (2019). Automation and jobs: When technology boosts employment. *Economic Policy*, 34(100), 589–626. https://doi.org/10.1093/epolic/eiz014

Brynjolfsson, E., & McAfee, A. (2014). *The second machine age: Work, progress, and prosperity in a time of brilliant technologies*. W. W. Norton & Company.

Davis, F. D. (1989). Perceived usefulness, perceived ease of use, and user acceptance of information technology. *MIS Quarterly*, 13(3), 319–340.

De Stefano, V. (2019). *Negotiating the algorithm: Automation, artificial intelligence and labour protection*. International Labour Organization.

Duan, S. X., Deng, H., & Wibowo, S. (2023). Exploring the impact of digital work on work–life balance and job performance. *Information Technology & People*. https://doi.org/10.1108/ITP-04-2021-0262

Handoyo, S., Suharman, H., Ghani, E. K., & Soedarsono, S. (2023). A business strategy, operational efficiency, ownership structure, and manufacturing performance. *Journal of Open Innovation: Technology, Market, and Complexity*, 9(1), 100039.

Hartika, A., Fitridiani, M., & Asbari, M. (2023). The effect of job satisfaction and job loyalty on employee performance. *Journal of Information Systems and Management*, 2(3), 9–15.

International Federation of Robotics. (2022). *World robotics 2022: Industrial robots*. IFR Press. https://ifr.org/worldrobotics/

Manyika, J., Chui, M., Miremadi, M., Bughin, J., George, K., Willmott, P., & Dewhurst, M. (2017). *A future that works: Automation, employment, and productivity*. McKinsey Global Institute.

Nunnally, J. C. (1978). *Psychometric theory* (2nd ed.). McGraw-Hill.

Ogbeibu, S., Emelifeonwu, J., Sarpong, D., & Gaskin, J. (2020). Technological turbulence and greening of team creativity, product innovation, and human resource management. *Journal of Cleaner Production*, 244, 118703.

Oliveira, T., & Martins, M. F. (2011). Literature review of information technology adoption models at firm level. *The Electronic Journal Information Systems Evaluation*, 14(1), 110–121.

Oliveira, T., Thomas, M., & Espadanal, M. (2014). Assessing the determinants of cloud computing adoption: An analysis of the manufacturing and services sectors. *Information & Management*, 51(5), 497–510.

Oyelaran, O., & Fakolujo, O. A. (2019). Innovation systems and industrial development in Africa. *African Journal of Science, Technology, Innovation and Development*, 11(5), 601–610.

Slovin, E. (1960). Slovin's formula for sampling technique. https://doi.org/10.2307/1359190 Tornatzky, L. G., & Fleischer, M. (1990). *The processes of technological innovation*. Lexington Books.

Van der Aalst, W. M. P., Bichler, M., & Heinzl, A. (2018). Robotic process automation. *Business & Information Systems Engineering*, 60(4), 269–272. **Error! Hyperlink reference not valid.**

Villani, V., Pini, F., Bonfè, M., & Secchi, C. (2018). Survey on human-robot collaboration in industrial settings.

Mechatronics, 55, 248–266.

Willcocks, L., Lacity, M., & Craig, A. (2015). The IT function and robotic process automation. *The Outsourcing Unit Working Research Paper Series*, 15(05).