

Internet of Things Optimizing Workforce Management in Healthcare

Pinki Paul^{1*} and Balgopal Singh²

¹Research Scholar, Faculty of Management Studies, Banasthali Vidyapith, Banasthali, Rajasthan, India. Email: pinkipaul83@gmail.com

²Associate Professor, Faculty of Management Studies, Banasthali Vidyapith, Banasthali, Rajasthan, India. Email: balgopalsingh@banasthali.in

*Corresponding Author

Abstract: *Introduction:* Human Resource Management (HRM) emphasizes the efficient administration of personnel inside firms, delivering value at strategic, managerial, and operational tiers. Hospital Management Systems (HMS) are engineered to assist healthcare organizations in handling essential information and improving the efficiency of healthcare professionals. Nonetheless, despite their advantages, existing HMS implementations frequently fail to completely engage staff, facing ongoing issues in communication and collaboration that may impede optimal performance. Rectifying these deficiencies via enhanced HRM integration and IoT-centric system design is crucial for augmenting employee engagement and healthcare services.

Aim: This study investigates the potential of IoT to enhance human resource skills, alleviate work-related stress, and satisfy the hierarchical demands of healthcare professionals and organizations within HR facilities in the healthcare sector in Northeast and Eastern India.

Methodology: A descriptive research design was employed to explore the nature of employee engagement in the context of the Internet of Things (IoT) within HR facilities in the healthcare sector. The study began with systematic data collection, followed by detailed analysis. A quantitative approach, guided by inductive reasoning, was used to investigate and derive insights related to the study. This methodology enabled a comprehensive understanding of how IoT influences employee engagement in complex healthcare environments.

Results: The study findings indicate that a majority of employees 58.9% in Northeast and Eastern India are female, while 41.1% are male. Most respondents reported holding an associate degree, with 27.8% indicating that they did not possess one. Regarding work experience, 38.9% of participants stated they had been employed in

HR roles within the healthcare sector for 5 to 10 years. Furthermore, a significant proportion of respondents agreed that the implementation of the Internet of Things (IoT) has facilitated enhanced information sharing among teams (46.3%) and improved collaboration between employees (44.1%).

Conclusion: The implementation of IoT technology in healthcare human resources in Northeast and Eastern India has enhanced collaboration and employee engagement. It improves collaboration and optimizes HR procedures through ongoing communication and instantaneous data exchange, cultivating a more productive and engaged workforce.

Keywords: Communication, Employee engagement, Hospital management system, HR management, IoT, Teamwork.

I. INTRODUCTION

Human resource management (HRM) is concerned with managing people and collecting individuals at work. HRM delivers value to organizations at three stages; strategic, managerial, and operational [1]. The strategic stage entails planning and creating a human resource (HR) strategy to underpin the delivery of a company's strategy and mission [2]. Activities are overseen and managed by an HR management function [3]. Lastly, at the operational stage, HRM backs the efficient running of an organization by allowing the actualization of standard HR policies and practices daily. Aforesaid, hospital management systems face different contextual challenges in running their daily HR functions. HR facilities denote the departments, systems, or support structures within an organization responsible for managing Human Resource (HR) functions in the healthcare sector operate in complex economic, structural, and political surroundings, where people management practices and decisions are restricted

and affected by a broad range of stakeholders. In most nations, decision-making regarding human resource policies, such as employee engagement, compensation, working conditions, and employment terms, is centralized through national forums [1]. Also, professional representative entities impact the training requirements for doctors, nurses, and other clinical staff and subsequent selection and hiring criteria for positions. The co-existence of different staff cohorts creates extra complexity for hospital HR management systems. Employee teams (for instance, managerial workers, caregivers, doctors, and allied health professionals (AHPs)) differ in terms of their value and uniqueness to the organization [1] [4]. Therefore, workers within these teams have different union representation, collective agreements, and employment relations [1]. Thus, the healthcare sector is a classic domain entailing multiple players and divergent objectives. Hospital management systems (HMS) aid hospitals manage information linked to healthcare and aid in the job accomplishment of healthcare providers effectively. The systems management information is related to all healthcare departments, such as nursing, radiology, operation theatre, financial, and clinical [5]. HMS was introduced to resolve the sophistication coming from managing all the paperwork. However, with the current HMS, employees are not fully engaged, and there are still communication and teamwork problems associated with the systems. This study examines how IoT can boost human resource capabilities, remove work stress, and fulfill the hierarchy needs of healthcare workers and organizations.

II. LITERATURE REVIEW

A. IoT and Workplace Stress

Having a job improves a person's health and overall attitude towards life in many ways. However, most individuals endure stress in the workplace that overshadows any possible gains and poses a threat to their well-being. The American Institute for Occupational Safety and Health defines workplace stress as the harmful emotional and physical reactions that happen when the prerequisites of a job do not match the needs, resources, and capabilities of the employee, in turn, resulting in poor health and injury [16]. Most employees record enduring work-related stress at their workplaces, and this compromises their health and performance. A survey by Northwestern National Life revealed that around forty percent of workers reported that their jobs were extremely stressful [17]. In another study by Yale University, twenty-nine percent of employees recorded feeling extreme stress due to their jobs [17].

Research shows that embracing technological innovations, such as IoT, machine learning, and artificial intelligence (AI) puts workers in control of how they spend their time at work and greatly lowers the risks of burnout and stress [18]. For instance, through wearable IoT devices, such as fitness trackers, organizations can keep track of workers' fitness. It helps

organizations design wellness programs for their workers to improve their productivity and health levels [19] [20]. An IoT system for stress management has an element that allows one to measure vital parameters for pinpointing stress and another for stress control. A study by Rodic-Trmcic *et al.* (2018) evaluated an IoT system for stress among university students, confirming that time spent utilizing mobile health apps with relaxing content can lower stress in learners [21].

IoT technology makes workers feel more satisfied and helps to avert workplace stress by allowing them to better coordinate and organize schedules. Attempting to get time when a group can meet to deliberate on something crucial can take longer than the meeting [22]. Suppose it is a last-minute meeting trying to get everybody together may cause workers a huge amount of stress. However, with calendar connectivity in IoT systems, this process may be automated, avoiding double bookings and any stress the process might cause [22]. Instead of long back-and-forth phone calls and email chains, the individual organizing the meeting can tell the system whom they require in the meeting. The IoT system can then propose a list of times when everybody at the workplace is free to meet.

B. Machine Learning and Employee Engagement

Worker engagement is becoming a crucial element of a company's success. For most organizations, increases in engagement imply an increase in productivity. While companies have long utilized conventional questionnaires to gauge engagement, these leave room for interpretation, and attempting to get clarity makes them longer, which reduces participation [23]. However, research shows that it is possible to utilize modern technologies, such as machine learning and AI, to boost employee engagement. In their study, Golestani *et al.* (2018) apply a machine learning approach to predict worker engagement [24]. They aimed to carry out a robust and straightforward test of the effectiveness of their machine-learning model for pinpointing phrases and words for worker engagement prediction. The researchers' general concept was to utilize machine learning to capture the level of worker engagement through social activity as a mirror of a worker's views and thoughts [24]. The authors developed a classifier by training a Naïve Bayes multinomial model under ten-fold authentication. An assessment of the accuracy of their classifier, the study results show that the training accuracy was seventy-four percent. Based on the research findings, the authors note that a particular set of words utilized by people might be a strong indication for a specific type of engagement behavior, implying that disengaged and engaged workers can be pinpointed via the way individuals express themselves on social media [24]. Due to the role of social media in individuals' daily lives and consequently rapid advancement of social media data, the machine learning model allows HR managers to have not only a temperature check of their workers' engagement but also have access to

the type of occurrences and reasons fueling the engagement in their company. Getting such a relationship offers an ideal opportunity for HR managers to launch new programs or abolish programs that are not beneficial, according to worker feedback.

Chug and Vibhuti (2017) delve into the direct link between various elements of organizational communication and culture, such as supervisory media quality, co-worker communication, communication climate, organization integration, corporate information, individual feedback, improvement orientation, HR orientation, inter-departmental collaboration, and autonomy with worker engagement measured in terms of commitment, vigor, and absorption [25]. The authors used the group method of data handling (GMDH) machine learning approach to measure, authenticate, build, and test the non-linear complex and full structural relationships among hospitality personnel working in NCR and Delhi. The study results offered insight into the weightage of every independent variable in upholding optimal organizational communication and culture to boost the overall level of worker engagement. The results showed that workers, who got personal feedback, particularly from supervisors, had higher levels of worker engagement [25]. Other critical elements of organizational orientation, HR orientation, and media quality comparatively carried more weight [25]. The suggested mathematical model might be applied as a general framework to augment organizational communication and culture to attain optimized worker engagement.

C. AI and Worker Engagement

Non-maleficence, justice, explainability, beneficence, and autonomy are the key five signals of artificial intelligence responsibility for healthcare workers [26]. These five indicators considerably raise healthcare workers' engagement, resulting in more favorable attitudes, higher utilization intentions, and greater contentment with AI technology [26]. More importantly, "techno-overload" as a major technostressor moderates the mediating impact of engagement on the connection between attitudinal and behavioral outcomes and AI justice. The moment healthcare workers perceive AI as adding more workload, such techno-overload will dent the significance of the justice indication and subsequently impact their contentment, usage intentions, and attitudes toward AI technology. In a different study, Sari *et al.* (2020) sought to see whether AI-based software, tools, and technology may assist HR in detecting intangible things like worker engagement and offer clues as to what elements impact it and how organizations might improve it [27]. The study results show that the utilization of AI-based software can significantly assist HR managers in pinpointing each worker's level of engagement and anticipating their behaviors and attitudes via predictive indicators [27]. Therefore, an organization may proactively retain key workers.

III. RESEARCH OBJECTIVES

The study seeks to:

- To identify the human resource problems associated with hospital management systems, especially those related to employee engagement.
- To determine the significance of IoT for employee engagement in healthcare (teamwork, communication, and autonomy).
- To measure the effectiveness of employee performance on the use of IoT.

A. Hypotheses

The study seeks to test whether:

H_1 : The adoption of IoT significantly influences human resource management practices in healthcare leading to improved employee engagement.

H_0 : IoT does not affect human resource management practices adopted by HR facilities in the healthcare sector for employee engagement.

B. HR Problems in Hospital Management Systems

The current hospital management systems cannot account for changing and complex schedules. The sheer figure of staff members and provider teams at any HR facility in the healthcare sector makes for very sophisticated scheduling [6]. Healthcare workers find it hard to keep track of who at any given moment—the confusion results in missed and delayed communications between workers. Time spent finding out who is on-call or scheduled wastes valuable time. Low user adoption and technical malfunctions are common criticisms about hospital communication systems. Rather than boost healthcare operations, this disjointed system creates frustration and confusion among employees, which results in oversights and mistakes. Moreover, the current hospital management systems are not unified to manage all sectors of HR. Therefore, employee engagement scores have remained low without integrated talent management systems and processes [7]. It increases the administrative burden for HR managers to keep all the healthcare professionals in their facilities engaged. Research reveals that HR facilities with siloed HR processes have a reduced capacity to pinpoint performance, and high-potential talent, plan for the future, and establish ongoing engagement [8]. Hospitals with paper-anchored processes are at an even more profound disadvantage; as healthcare facilities expand, paper tracking and review not only limit the big-picture perspective of talent crucial to making succession decisions but may negatively impact compliance [9]. Autonomy gives hospitals greater control over key management functions and

resources [28]. However, the current hospital management system cannot allow HR managers to integrate all these functions for easy oversight and control. As a result, there are technical inefficiencies in running management functions, such as hiring, engagement, and payment of healthcare workers. The hospital management systems do not give healthcare organizations reliable accountability mechanisms [29]. Healthcare organizations have a challenge managing many employees directly under their watch under the hospital autonomy policy. The solution to these unsettling issues that directly impact worker engagement in the healthcare sector is the Internet of Things (IoT). The Internet of Things (IoT) is an innovative technology that seamlessly and pervasively connects devices to the Internet. The Internet of Things (IoT) is made up of various smart devices, such as RFID tags, sensors, and smartphones [10]. Smartphones enable contact with the environment and collaborate with other entities to deliver various services such as health analysis, fitness tracking, and identification of physical activity [11]. The IoT is the network of physical devices that can connect and exchange data, creating opportunities to input more information into computer-based systems to highlight efficiency improvements and other economic or human benefits [3].

Technology overrides everything in the sectors of an organization's functions, including in the healthcare industry [12]. Technology through a one-on-one, instant link from anywhere has a huge effect in establishing a better experience in the least time with the assistance of IoT gadgets. The future of IoT enables the labor force might enhance operational efficiency, maximize productivity, and optimize human-machine cooperation [13]. As employee demands and time constraints increase, engagement within the organizational environment becomes essential. Organizations continually seek methods to enhance productivity, save costs, reduce employee turnover, and foster innovation.

The greatest and most modern IoT advancement will allow HR operations in the healthcare sector to get more in a short period. Workers will be able to accomplish large-scale tasks faster while making fewer errors in their work. What is more, the advanced linkage IoT provides lets organizations easily connect with their customers, averting potential issues and establishing new avenues anchored on automatically gathered feedback [14]. On the other hand, IoT potentially improves interactions between workers. According to a survey by Harvard Business, organizations are already experiencing important gains from IoT-anchored solutions, and fifty-eight percent of the respondents stated that they had seen enhanced collaboration with the organization [15]. Lastly, communication is a crucial part of worker engagement. The IoT platform makes it possible for healthcare organizations to link in several ways. For instance, the facilities might instantly communicate with any team of healthcare providers and exchange ideas. This way, the Internet of Things optimizes the effectiveness of workers' workday and provides a better workforce. It makes it easy to keep an eye on the mobile labor force and track their activities without stress.

C. Management Theories and Implementation of Technology-Based Employee Engagement

The scientific management theory and systems management theories suggest that a good organization incorporates technology to boost employee engagement. Frederick Taylor conceptualized the scientific management theory [35]. His doctrines indicated that the scientific approach should be utilized to carry out tasks in the workplace instead of the leader depending on their intuition or individual discretion. Taylor's doctrine reiterated that forcing individuals to work hard would lead to the most productive workplace [35]. Instead, he proposed simplifying tasks to enhance productivity. IoT is a technology that assists HR leaders in simplifying tasks by constantly engaging with workers on the various job and well-being aspects. The massive employee data collected through IoT can allow HR managers to allocate workers' responsibilities based on their abilities.

The systems management theory asserts that organizations entail elements that should work in synchronization for the more extensive system to operate optimally. The organization's success, thus, relies on synergy, interdependence, and inter-links between subsystems [36]. According to systems management theory, workers are essential elements of an organization [36]. Implementing IoT will help employees focus more on their tasks, improving work quality. Investing in IoT can boost engagement, enhance productivity, retain talent, and elevate work quality.

IV. METHODOLOGY

A descriptive research design was employed to examine employee engagement with the Internet of Things (IoT) in human resource management (HRM) within the healthcare industry. The study employed a sequential methodology, commencing with the acquisition of quantitative data, which was subsequently processed to answer the research objectives. An inductive methodology was utilized to identify patterns and derive conclusions from the data. Quantitative methodologies yielded critical numerical insights, facilitating a greater comprehension of staff engagement dynamics concerning IoT integration [28]. The study was carried out using a survey. The utilization of this strategy allowed for a deep understanding of the conditions within the context of a specific organization.

The study targeted HR professionals in the healthcare sector in the Northeast and Eastern parts of India. Purposive sampling was used to select 351 respondents who were issued with a survey questionnaire. A survey questionnaire was used to collect data from the employees of the medical industry. It involved using structured questions based on teamwork, communications, and autonomy policy and how they influence employee engagement in the Internet of Things era. The questionnaire contained 5-point Likert questions, which will use the scale: 1-strongly disagree, 2-disagree, 3-neither agree nor disagree, 4-agree, 5-strongly agree. The questionnaires were self-administered,

with three research assistants employed in the administration of the questionnaires. As one of the tools of qualitative research, an in-depth interview was chosen. In the case of this research, three representatives of three healthcare organizations were chosen to conduct interviews. There was a pool of topics to discuss created in advance; however, those were unstructured in-depth interviews.

Statistical analysis was done for the quantitative data from the employees. It was done through descriptive statistics and

ANOVA. The ANOVA statistics were based on F-statistics and mean plots to show the relationship between IoT and employee engagement. The statistics were developed using SPSS v25. The data was presented in the form of tables, charts, and histograms. Figs. 6, 7, and 8 were plotted after performing the ANOVA statistics, and the data was exported to MS Excel 2019. MS Excel 2019 was used to generate the plots for the three histograms in the study.

V. RESULTS AND DISCUSSIONS

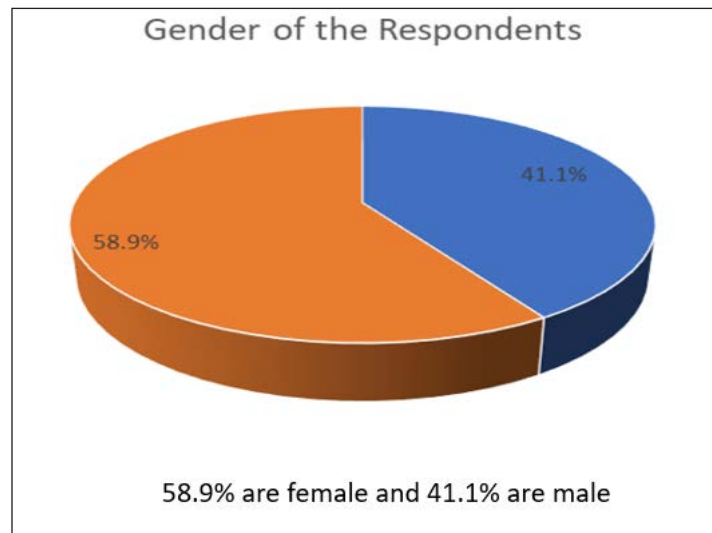


Fig. 1: Gender of the Respondents

From Fig. 1, the majority of the employees 58.9% were female. On the other hand, 41.1% were male. It indicates that the majority of the health workers in the HR department in

the healthcare sector within Northeast and Eastern India are women. This is due to the notion that the industry is for females hence the domination [29].

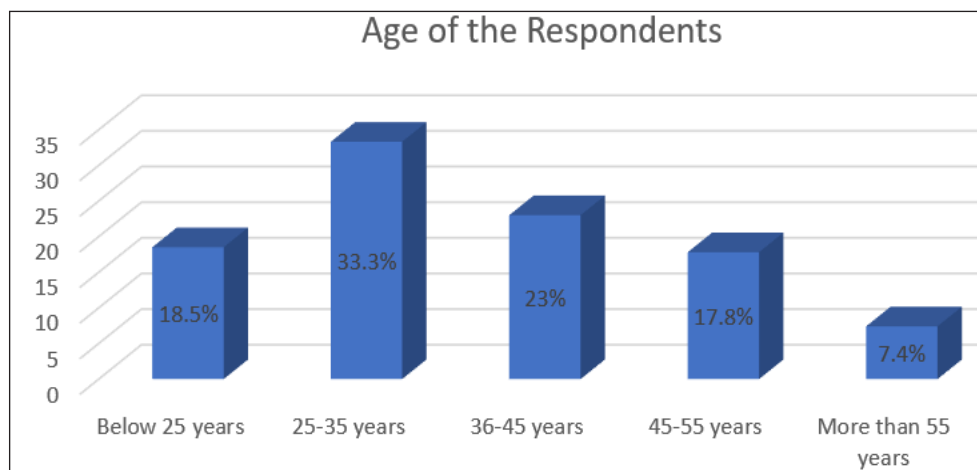


Fig. 2: Age of the Respondents

The findings on age are presented in Fig. 2. The table shows that the majority [51.8%] were below 35 years while 48.2% were above 35. It shows that the majority of the health workers

in HR facilities in the healthcare sector within Northeast and Eastern India are youthful, which shows they understand the Internet and its usage in healthcare.

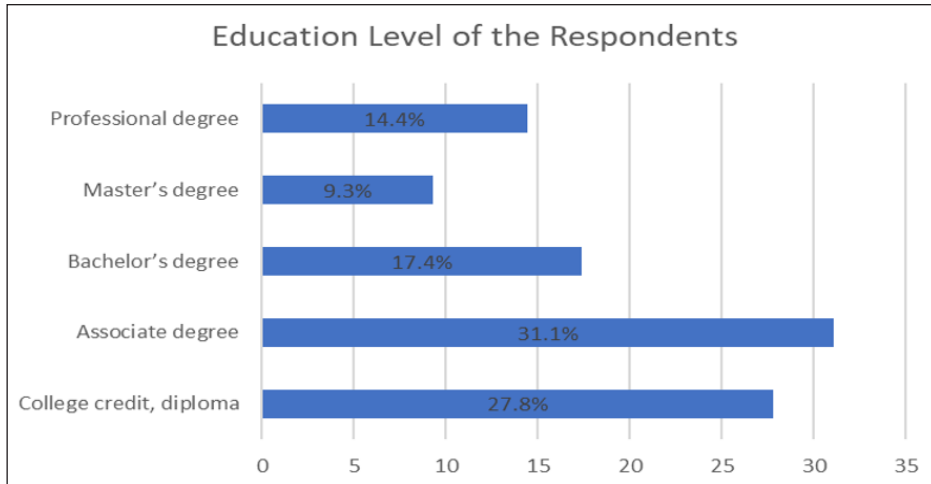


Fig. 3: Education Level of the Respondents

The research sought to establish the education level of the respondents, with results shown in Fig. 3. The majority of the respondents had an associate degree, with only 27.8% not having an associate degree. It indicates that the respondents have enough education to understand the Internet of Things and employee engagement in their facilities.

On the experience, as shown in Fig. 4, most of the respondents (38.9%) indicated that they had worked in the healthcare sector in Northeast and Eastern India for 5-10 years. The majority of the employees had worked for more than 10 years. The experience of the health worker and other employees in the health sector supports the implementation and use of IoT and have more than 10 years of experience.

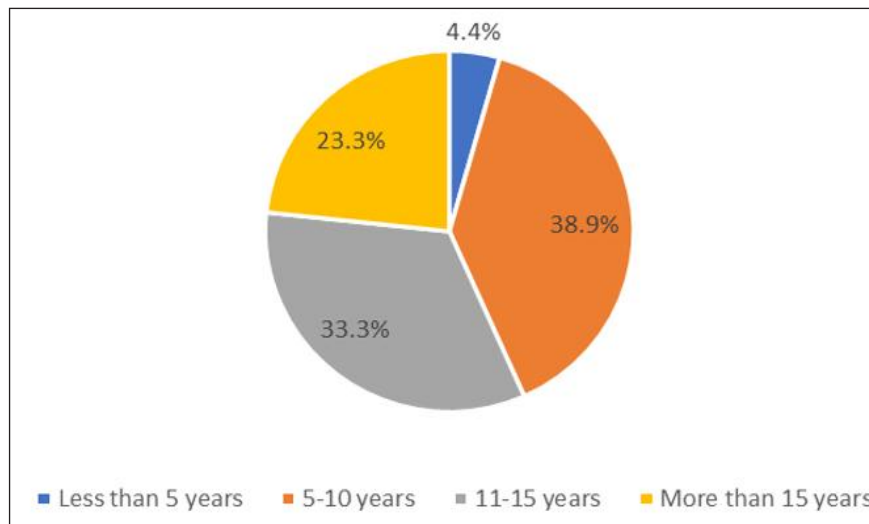


Fig. 4: Period Worked in Northeast and Eastern India

Fig. 5 presents findings on the number of years the facilities involved in the study had been in operation. The findings showed that the majority of the respondents (80.7%) indicated that they had operated for more than 10 years. A minority (19.3%) indicated the period of operations for their HR

facilities as less than 10 years. The findings show that the majority of employees have worked for more than 10 years, which has enabled them to better understand the changes in employee engagement brought about by the implementation of IoT.

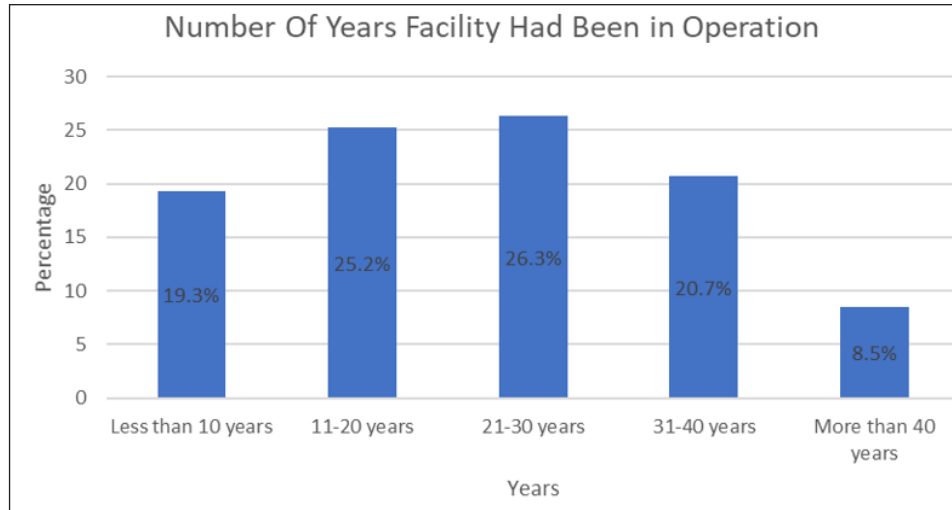


Fig. 5: Number of Years Facility has been in Operation

The research sought to establish the level of agreement on statements relating to employee engagement and IoT among HR facilities in the healthcare sector in Northeast and Eastern India. The findings are shown in Table I. The results showed that a majority of respondents strongly agreed that teams of

health professionals within a healthcare facility can work together effectively through IoT (42.6%). Additionally, 31.9% of respondents agreed that their facilities invest time and effort in training leaders to serve as role models for employee engagement.

TABLE I: AGREEMENT ON STATEMENTS RELATING TO IOT AND EMPLOYEE ENGAGEMENT

	Strongly Disagree	Disagree	Neither Agree Nor Disagree	Agree	Strongly Agree
<i>Team Work</i>					
IoT enhances team sharing knowledge about the patients.	3.3	10.4	3.7	46.3	36.3
Through IoT, cooperation among employees is improved.	5.6	11.5	3.3	44.1	35.6
IoT has brought trusting interpersonal relationships among teams in my facility.	1.5	8.1	5.6	52.6	32.2
Teams of health professionals in a health facility can effectively work together through IoT.	4.1	10.4	6.3	36.7	42.6
My facility invests in the time and effort to train the leaders to serve as examples of engagement.	8.1	24.4	6.3	29.3	31.9
<i>Communication</i>					
IoT enhances communication among employees.	7.0	10.4	12.2	54.4	15.9
Social networking has enhanced communication in my health facility.	16.7	54.1	5.9	15.2	8.1
IoT increases the levels of employee engagement.	4.1	5.2	3.3	61.9	25.6
IoT increases information management.	5.6	8.9	15.2	57.0	13.3
<i>Policy</i>					
My facility has a policy for IoT.	8.5	13.0	13.7	36.7	28.1
The policy on IoT in my firm is autonomous.	15.6	59.3	4.1	11.9	9.3
The IoT policy calls for employee engagement.	1.1	2.6	8.1	64.8	23.3
My facility has a security policy related to the Internet of Things.	8.9	10.0	18.9	36.3	25.9

The majority agreed that IoT policy calls for employee engagement (64.8%) and that IoT increased the levels of

employee engagement (61.9%). They also agreed that IoT increased information management (57.0%), IoT enhanced

communication among employees (54.4%), and built trusting interpersonal relationships among teams in their facilities (52.6%).

Most of the respondents agreed that IoT enhanced team sharing knowledge about the patients (46.3%) and that through IoT, cooperation among employees was improved (44.1%). Most

of them also agreed that their facilities had policies for IoT (36.7%) and that their facilities had security policies related to the Internet of Things (36.3%). However, the respondents disagreed that social networking has enhanced communication in their health facility (54.1%), and the policy on IoT in their facilities was autonomous (59.3%).

TABLE II: ANOVA

ANOVA						
		Sum of Squares	df	Mean Square	F	Sig.
AI	Between Groups	1579812.073	151	10462.332	3.752E33	.000
	Within Groups	.000	117	.000		
	Total	1579812.073	268			
IoT	Between Groups	9353093.451	151	61941.016	5.487E34	.000
	Within Groups	.000	117	.000		
	Total	9353093.451	268			
Machine Learning	Between Groups	6.725E7	151	445370.707	4.339E35	.000
	Within Groups	.000	117	.000		
	Total	6.725E7	268			

From the ANOVA table, the p-value (0.026) is less than the significance level (usually 0.05); Therefore, we reject the null hypothesis that the Internet of Things does not influence human resource management strategies employed by HRM in the healthcare sector for employee engagement. Hence, it can be concluded that human resource management practices like teamwork, communication, and autonomous policy influence employee engagement through IoT adopted by HR professionals in the healthcare sector in Northeast and Eastern India.

Figs. 6, 7, and 8 serve as exploratory tools for revealing three critical properties of the study sample data concerning IoT and its effects on employee engagement, Machine learning,

and employee engagement, and AI and employee engagement. The pictorial representations show that the plots for Machine learning, AI, and IoT fluctuate above zero, indicating a positive correlation with employee engagement. IoT technology is embedded with AI and machine learning devices that mimic behavior and support decision-making with little or no human interference. Having a view of the impact of AI and machine learning is vital since the technologies are embedded in most IoT devices. There are various technologies to help one plot these plots, such as Infogram, which is a tool that enables one to create over thirty chart types, Lucidchart is also another excellent technology tool for creating these charts, and Hohli Online Chart Builder an online tool to create a variety of charts.

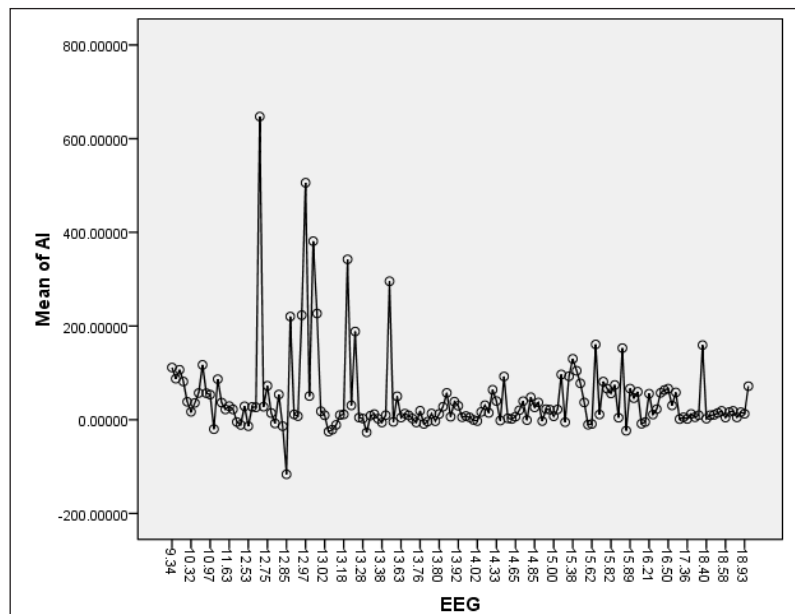


Fig. 6: The Mean Plots of AI

The plots show that AI influences employee engagement in the healthcare sector. However, the effect is high and fluctuates

mostly above zero. It shows that Artificial intelligence greatly affects employee engagement among the HR facilities.

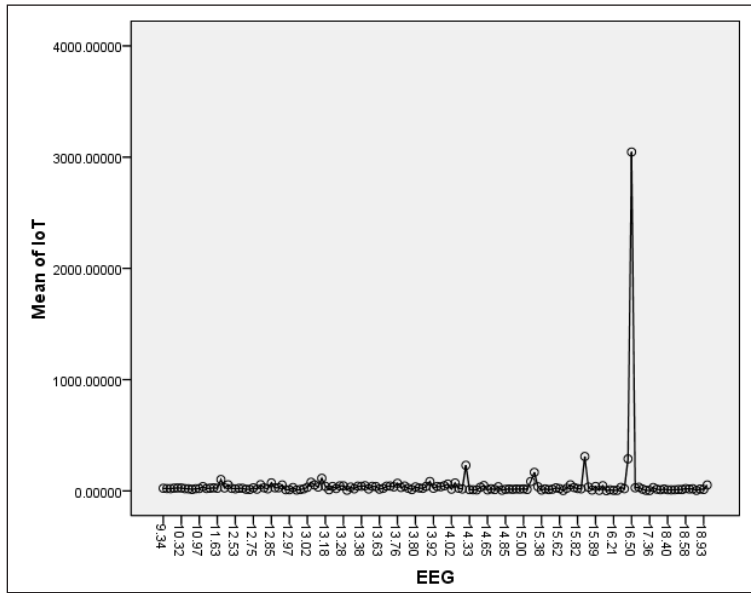


Fig. 7: Mean Plots of IoT

The plotted data suggest that IoT impacts employee engagement in the healthcare sector; nevertheless, the effect seems negligible, since the mean values of IoT hover around zero. It is significant to note that employee engagement is maximized when the average IoT value is around 3000, which

aligns with an average employee engagement score of 16.5. This indicates a possible threshold where IoT starts to enhance engagement levels, despite the overall effect being relatively constrained.

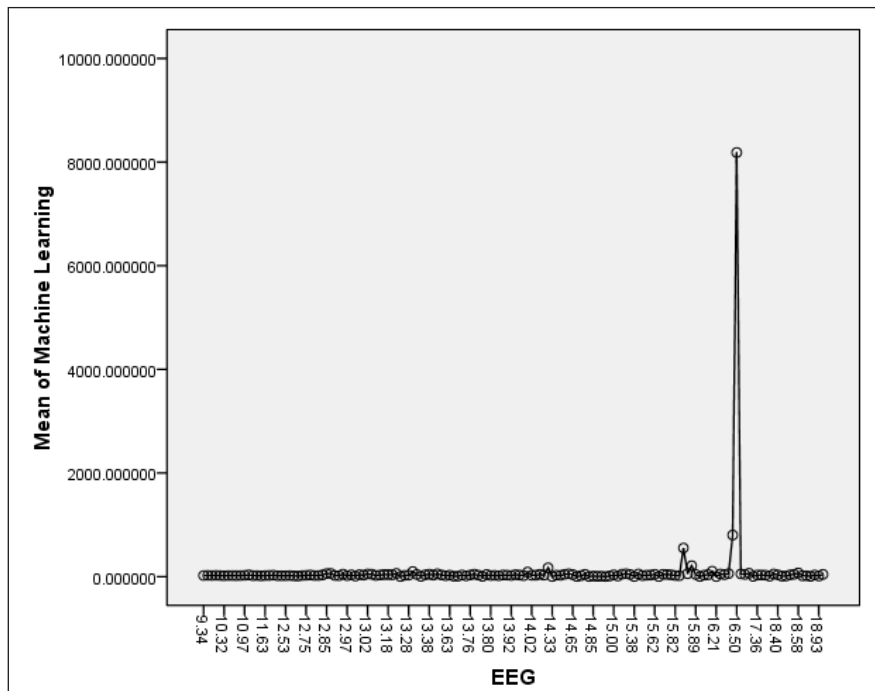


Fig. 8: Mean Plots of Machine Learning

The plotted findings demonstrate the efficacy of machine learning in impacting employee engagement within HR facilities in the healthcare industry. The observed effect is negligible, with engagement levels varying between 15.87 and 16.5. These findings indicate that, although machine learning is integrated into HR procedures, its influence on employee engagement in this setting is constrained.

From Fig. 1, the data reveal that the majority of employees 58.9% were female, while 41.1% were male, indicating a predominance of women among health workers in the Eastern and Northeastern regions of India. Female higher representation in the healthcare profession may be a result of prevalent societal attitudes and vocational trends that more firmly link female participation to the sector [28].

According to the age distribution shown in Fig. 2, 48.2% of healthcare professionals at HR facilities in Northeast and Eastern India are over 35, while a tiny majority (51.8%) are under 35. This demographic distribution indicates that a considerable segment of the workforce is comparatively youthful. This suggests an increased probability of digital literacy and technological adaptation among these staff, which may enhance the acceptance and effective utilization of Internet-based products and IoT in healthcare environments. The nearly equal distribution underscores the necessity for inclusive training and change management measures to guarantee that technological efforts such as IoT are accessible and advantageous for all age demographics [29] [30]. The research sought to establish the education level of the respondents, with results shown in Fig. 3. The majority of the respondents had an associate degree, with only 27.8% not having an associate degree. It indicates that the respondents have enough education to understand the Internet of Things and employee engagement in their facilities.

Fig. 4 shows that 38.9% of respondents have 5 to 10 years of healthcare experience, while most employees in Northeast and Eastern India have over 10 years [31]. This experience is vital for effectively implementing technologies like the Internet of Things (IoT). Experienced health professionals possess institutional knowledge and adaptability, aiding IoT integration [32]. Moreover, studies suggest that greater work experience boosts employee engagement, as seasoned employees tend to be more confident and innovative. Thus, healthcare workers' experience not only supports IoT adoption but also enhances engagement and organizational performance [33].

Fig. 5 shows the operational histories of the healthcare facilities in the study. A large majority of respondents (80.7%) indicated their facilities have been operating for over 10 years, while only 19.3% reported a shorter duration. This suggests that most human resources departments in Northeast and Eastern India's healthcare sector are well-established, indicating strong administrative structures and extensive institutional knowledge. These factors are essential for integrating innovative technologies like the Internet of Things (IoT). Furthermore, the long operational history of these facilities provides a solid foundation for assessing long-

term changes in employee engagement, especially regarding digital advancements. Consequently, the maturity of these organizations enhances the credibility and depth of the study's findings on the relationship between IoT adoption and employee engagement outcomes.

The research sought to establish the level of agreement on statements relating to employee engagement and IoT among HR facilities in the healthcare sector in Northeast and Eastern India. The findings are shown in Table I. The findings showed that most of the respondents, on the other hand, strongly agreed that teams of health professionals in a health facility can effectively work together through IoT (42.6%) and that their HR facilities invested in the time and effort to train the leaders to serve as examples in engagement (31.9%). The majority agreed that the IoT policy calls for employee engagement (64.8%) and that IoT increased the levels of employee engagement (61.9%). They also agreed that IoT increased information management (57.0%), IoT enhanced communication among employees (54.4%), and built trusting interpersonal relationships among teams in their facilities (52.6%).

The findings indicate that although IoT is viewed as beneficial for enhancing team collaboration and knowledge sharing among healthcare personnel—especially regarding patient-related information (46.3%) and enhanced cooperation (44.1%)—its implementation is constrained by specific structural and policy-related obstacles. A considerable percentage of respondents recognized the presence of IoT-related policies (36.7%) and security measures (36.3%) in their facilities; nonetheless, a substantial majority did not consider these policies to be independent (59.3%). Furthermore, over half (54.1%) expressed disagreement about the assertion that social networking has improved communication inside their healthcare institutions. The findings suggest that although IoT enhances certain facets of employee engagement and operational efficiency, its complete potential is hindered by inflexible policies, restricted autonomy, and insufficiently utilized digital communication tools. This underscores the necessity for more flexible, participatory, and communication-centric IoT methods within healthcare HR environments.

The ANOVA results indicate a p-value of 0.026, which is below the standard significance threshold of 0.05, so leading to the rejection of the null hypothesis that asserts IoT has no impact on human resource management practices concerning employee engagement. Consequently, it can be inferred that IoT exerts a statistically significant influence on HRM practices, including teamwork, communication, and autonomous policy, which subsequently affect employee engagement within HR facilities in the healthcare sector in Northeast and Eastern India.

VI. CONCLUSION

In the healthcare industry in Northeast and Eastern India, the incorporation of the Internet of Things (IoT) into HR facilities

has become a game-changing innovation that improves organizational effectiveness and employee performance. The Internet of Things facilitates more dynamic and personalized work environments, enhancing employee satisfaction and engagement. The Internet of Things (IoT) enhances human resources tasks by enabling real-time data sharing, automating processes, and promoting seamless communication, thereby supporting employee development, performance monitoring, decision-making, and workplace collaboration. These skills enable HR departments to cultivate a more responsive and engaging work culture, hence enhancing talent retention and workforce productivity. Moreover, improvements in IoT, in conjunction with artificial intelligence (AI) and machine learning, furnish HR managers with actionable insights that improve decision-making and optimize resource allocation. The enhanced connectivity facilitated by IoT promotes remote participation, allowing employees to cooperate across many locations, thus reinforcing cooperation and organizational unity. The findings are methodologically validated by observable enhancements in employee interaction, communication efficiency, and engagement metrics within the study's parameters. Employee engagement is largely dependent on effective communication, and in the healthcare industry in Northeast and Eastern India, technologies like IoT, AI, and machine learning are revolutionizing the way relationships are formed within HR facilities. These solutions facilitate real-time collaboration, idea exchange, and resource allocation—optimizing daily operations and improving the employee experience. HR managers benefit from effortless oversight of mobile personnel and the generation of comprehensive people analytics to facilitate data-driven decision-making.

The amalgamation of these technologies generates comprehensive data on workforce behavior and procedures, assisting HR teams in formulating more precise engagement plans and correctly assessing engagement levels. The lack of independent policy frameworks constrains their complete potential. To realize the advantages, HR departments must prioritize the integration of IoT technologies, develop resilient Internet communication frameworks, and formulate explicit, independent regulations for the governance of AI, IoT, and machine learning. This will cultivate a more nimble, interconnected, and empowered workforce.

ACKNOWLEDGMENT

The SJSGC fellowship was provided by UGC, for which the authors are grateful. Also expressed appreciation to the administrative staff for permitting the gathering of data from different healthcare institutions.

CONFLICT OF INTEREST

None

REFERENCES

- [1] B. Harney, and K. Monks, *Strategic HRM: Research and Practice in Ireland*. Dublin: Orpen Press, 2014.
- [2] C. Gowen, K. L. McFadden, and W. J. Tallon, "On the centrality of strategic human resource management for healthcare quality results and competitive advantage," *Journal of Management Development*, vol. 25, no. 8, pp. 806-826, 2006, doi: <https://doi.org/10.1108/02621710610684277>.
- [3] S. M. Kabene, C. Orchard, J. M. Howard, and M. A. Soriano, "The importance of human resources management in health care: A global context," *Human Resources for Health*, vol. 4, no. 1, p. 20, 2006, doi: <https://doi.org/10.1186/1478-4491-4-20>.
- [4] C. A. Figueroa, R. Harrison, A. Chauhan, and L. Meyer, "Priorities and challenges for health leadership and workforce management globally: A rapid review," *BMC Health Services Research*, vol. 19, no. 239, 2019, doi: <https://doi.org/10.1186/s12913-019-4080-7>.
- [5] A. Mule, S. Naik, V. Noranha, and M. Mule, "Online multispecialty hospital management system," *International Journal of Science and Research (IJSR)*, vol. 6, no. 2, pp. 46-48, 2017.
- [6] I. Popovici, P. P. Morita, D. Doran, and S. E. Lapinsky, "Technological aspects of hospital communication challenges: An observational study," *International Journal for Quality in Healthcare*, vol. 27, no. 3, pp. 1-6, 2015, doi: <https://doi.org/10.1093/intqhc/mzv016>.
- [7] D. Egerova, L. Eger, H. Jirincova, and V. A. Taha, "Integrated talent management challenge and future for organizations in Visegrad countries," *Visegrad Fund*, 2013.
- [8] A. Waal, M. Weaver, T. Day, and B. Heijden, "Silo-busting: Overcoming the greatest threat to organizational performance," *Sustainability*, vol. 11, no. 23, pp. 1-9, 2019, doi: <https://doi.org/10.3390/su11236860>.
- [9] Cornerstone, "The challenging state of employee engagement in healthcare today – and strategies to improve it," Cornerstone, 2021. Accessed: Jul. 12, 2021. [Online]. Available: <http://go.cornerstoneondemand.com/rs/sonar6/images/csod-wp-healthcare-employee-engagement.pdf>
- [10] K. Shafique, B. A. Khawaja, F. Sabir, S. Qazi, and M. Mustaqim, "Internet of Things (IoT) for next-generation smart systems: A review of current challenges, future trends and prospects for emerging 5G-IoT scenarios," *IEEE Access*, vol. 8, pp. 23022-23040, 2020, doi: <https://doi.org/10.1109/ACCESS.2020.2970118>.

- [11] R. P. Singh, M. Javaid, A. Haleem, and R. Suman, "Internet of Things (IoT) applications to fight against COVID-19 pandemic," *Diabetes & Metabolic Syndrome: Clinical Research & Review*, vol. 14, no. 4, pp. 521-524, 2020, doi: <https://doi.org/10.1016/j.dsx.2020.04.041>.
- [12] S. Abubakari, "The influence of the Internet of Things on employee's engagement among generation Y at the workplace," *Global Business and Management Research*, vol. 1, no. 11, p. 428, 2019.
- [13] S. Abubakari, "Improving business effectiveness using Internet of Things," *Journal of Computer and Information Science*, vol. 1, no. 1, pp. 1-5, 2019.
- [14] J. R. Burnett, and T. C. Lisk, "The future of employee engagement: Real-time monitoring and digital tools for engaging a workforce," *International Studies of Management & Organization*, vol. 49, no. 1, pp. 108-119, 2019.
- [15] M. Kranz, "Success with the Internet of Things requires more than chasing the cool factor," *Harvard Business Review*, 2017. [Online]. Available: <https://hbr.org/2017/08/success-with-the-internet-of-things-requires-more-than-chasing-the-cool-factor>
- [16] The National Institute for Occupational Safety and Health, "Stress at Work," CDC, 2020. Accessed: Jul. 13, 2021. [Online]. Available: <https://www.cdc.gov/niosh/docs/99-101/default.html>
- [17] Corporate Wellness Magazine, "Workplace stress: A silent killer of employee health and productivity," *Corporate Wellness Magazine*, 2021. Accessed: Jul. 13, 2021. [Online]. Available: <https://www.corporatewellnessmagazine.com/article/workplace-stress-silent-killer-employee-health-productivity>
- [18] B. Gaur, V. K. Shukla, and A. Verma, "Strengthening people analytics through wearable IOT device for real-time data collection," *2019 International Conference on Automation, Computational and Technology Management (ICACTM)*, 2019, pp. 1-6.
- [19] A. N. Venkatesh, "Connecting the dots: Internet of things and human resource management," *American International Journal of Research in Humanities, Arts and Social Sciences*, pp. 2328-3734, 2017.
- [20] S. Strohmeier, "Smart HRM – A Delphi study on the application and consequences of the Internet of Things in human resource management," *The International Journal of Human Resource Management*, vol. 31, no. 18, pp. 2289-2318, 2020, doi: <https://doi.org/10.1080/09585192.2018.1443963>.
- [21] B. Rodic-Trmcic, A. Labus, Z. Bogdanovic, and M. Despotovic-Zrakic, "Development of an IoT system for students' stress management," *Electronics and Energetics*, vol. 31, no. 3, pp. 329-342, 2018, doi: <https://doi.org/10.2298/FUEE1803329R>.
- [22] W. F. Cascio, and R. Montealegre, "How technology is changing work and organizations," *Annual Review of Organizational Psychology and Organizational Behavior*, vol. 3, no. 1, pp. 349-375, 2016, doi: <https://doi.org/10.1146/annurev-orgpsych-041015-062352>.
- [23] H. Nienaber, and N. Martins, "An employee engagement instrument and framework building on existing research," *Mediterranean Journal of Social Sciences*, vol. 5, no. 20, pp. 486-496, 2014, doi: <https://doi.org/10.5901/mjss.2014.v5n20p485>.
- [24] A. Golestani, M. Masli, N. S. Shami, J. Jones, A. Menon, and J. Mondal, "Real-time prediction of employee engagement using social media and text mining," *2018 17th IEEE International Conference on Machine Learning and Applications*, 2018, pp. 1384-1387, doi: <https://doi.org/10.1109/ICMLA.2018.0022>.
- [25] P. K. Chug, and Vibhuti, "Enhancing employee engagement through a novel mathematical model in the hospitality sector of India," *Indian Journal of Management*, vol. 10, no. 8, 2017, <https://dx.doi.org/10.17010/pijom%2F2017%2Fv10i8%2F117425>.
- [26] W. Wang, L. Chen, M. Xiong, and Y. Wang, "Accelerating AI adoption with responsible AI signals and employee engagement mechanisms in health care," *Information Systems Frontiers*, 2021, doi: <https://doi.org/10.1007/s10796-021-10154-4>.
- [27] R. E. Sari, S. Min, H. Purwoko, A. Furinto, and D. Tamara, "Artificial intelligence for a better employee engagement," *International Journal of Business Studies*, vol. 13, no. 2, pp. 173-188, 2020, doi: <https://doi.org/10.21632/irjbs>.
- [28] J. W. Cresswell, and J. D. Cresswell, *Research Design: Qualitative, Quantitative and Mixed Methods Approaches*. New York: SAGE Publication, 2018.
- [29] J. C. Day, and C. Christnacht, "Women hold 76% of all health care jobs, gaining in Higher-paying occupations," American Census Bureau, Aug. 14, 2019. Accessed: Jul. 15, 2021. [Online]. Available: <https://www.census.gov/library/stories/2019/08/your-health-care-in-womens-hands.html>
- [30] R. Macik, "The adoption of the Internet of Things by young consumers – An empirical investigation," *Environmental & Socio-Economic Studies*, vol. 17, no. 2, pp. 363-388, 2017, doi: <https://doi.org/10.25167/ees.2017.42.13>.
- [31] L. Wiechetek, and J. Banas, "Do young people want the Internet of Things? A comparative study of computer

- science, management and psychology students,” *International Technology, Education and Development Conference*, 2017, pp. 4090-4100, doi: <https://doi.org/10.21125/inted.2017.0990>.
- [32] A. Karan, H. Negandhi, S. Hussain, T. Zapata, D. Mairembam, H. D. Graeve, J. Buchan, and S. Zodpey, “Size, composition, and distribution of health workforce in India: Why, and where to invest?,” *Human Resources for Health*, vol. 19, no. 29, 2021, doi: <https://doi.org/10.1186/s12960-021-00575-2>.
- [33] I. Nappi, and G. C. Ribeiro, “Internet of Things technology applications in the workplace environment: A critical review,” *Journal of Corporate Real Estate*, vol. 22, no. 1, 2020.
- [34] T. Maylett, M. Wride, and G. Rowat, *The Employee Experience: How to Attract Talent, Retain Top Performers, and Drive Result*. New York: Gildan Media, 2019.
- [35] S. Taneja, M. G. Pryor, and L. A. Toombs, “Frederick W. Taylor’s scientific management principles: Relevance and validity,” *Journal of Applied Management and Entrepreneurship*, vol. 16, no. 3, pp. 60-78, 2011.
- [36] C. C. Chikere, and J. Nwoka, “The systems theory of management in modern-day organizations - A study of Aldgate Congress Resort Limited Port Harcourt,” *International Journal of Scientific and Research Publications*, vol. 5, no. 9, pp. 1-7, 2015.