Formosa Journal of Science and Technology (FJST)
Vol. 3, No. 11, 2024: 2515-2526

# The Role of Internet of Things (IoT) on Human Resources in Industry 4.0

Oktafina Noor Ulfa
Universitas Negeri Yogyakarta
**Corresponding Author:** Oktafina Noor Ulfa, oktafinanoorulfa@gmail.com

A R T I C L E I N F O

*Keywords:* Technology, IoT, Human Resources, Industry 4.0

*Received : 30, October*
*Revised : 14, November*
*Accepted : 28, November*

©2024, Ulfa: This is an open-access article distributed under the termsof the Creative Commons Atribusi 4.0 Internasional.

A B S T R A C T

The rapid advancement of technology has had a significant impact on various sectors. Human resources are now required to develop technical and data-driven skills to support the adoption of technologies that connect devices for real-time data sharing, playing a crucial role in enhancing the efficiency and effectiveness of organizational operations. This research aims to analyze the role of the Internet of Things (IoT) on human resources in the Fourth Industrial Revolution (Industry 4.0). The research method employed is a literature review, gathering data from various academic sources such as journals, articles, books, and other relevant materials. The findings of this study indicate that the implementation of IoT can improve operational efficiency through real-time monitoring. Overall, IoT holds great potential for optimizing human resource management in the era of Industry 4.0; however, organizations must carefully manage the associated impacts.

ISSN-E: 2964-6804
DOI: https://doi.org/10.55927/fjst.v3i11.12350
https://journal.formosapublisher.org/index.php/fjst

## INTRODUCTION

The rapid development of technology has had a profound impact on various sectors, including the industrial sector. The current era of Industry 4.0 aligns with rapid changes, digitalization, and the utilization of automation in machinery, enabling many companies to make decisions effectively and efficiently. This has allowed for optimized production processes and product development.

Amidst these significant changes, human resources (HR) play a pivotal role in the successful adoption and utilization of technology within organizations. In the era of Industry 4.0, human resources are not only faced with organizational culture changes but are also expected to adapt to the demand for new, more technical, and data-driven skills. The role of HR now extends beyond managing employees, encompassing digital transformation management and the development of skills to address the emerging challenges associated with new technologies.

Digitalization is inherently linked to the internet, which has become an essential need for modern society and has had far-reaching effects on daily life. With the open access to communication through internet networks, people are able to unite in both space and time, making geographical distance seem irrelevant. Over time, technology has been widely adopted and leveraged by industries to create opportunities and address challenges currently faced by employees.

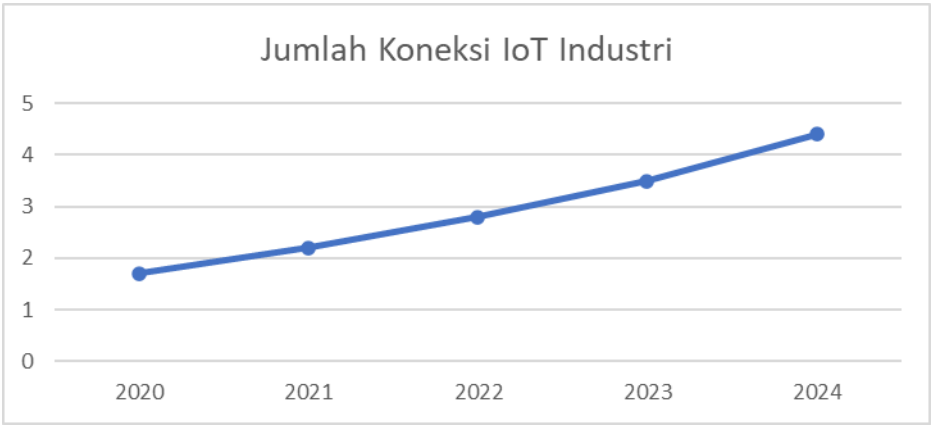



Figure 1. Number of IoT Industry Connections (in billions)
Source: Personal Design

The Internet of Things (IoT) has become an increasingly popular and widely discussed topic among its users, including organizations and businesses connected to technology. This technology is playing an increasingly important role in transforming human life and is having a significant impact on organizations and human resource management.

The Internet of Things (IoT) is a transformative force that connects devices and physical systems, enabling the exchange and communication of data in real-time. IoT has led to the development of applications in the industrial sector, including the use of IoT for room monitoring and management, early warning systems, and sensors connected to the IoT network that can monitor employee

health. Overall, IoT has become a breakthrough innovation in the industrial sector, as it enhances work efficiency and effectiveness.

The main objective of this study is to understand and analyze the role of the Internet of Things (IoT) in human resource management within organizations in the rapidly advancing technological era. This research aims to help comprehend and describe the flow of connectivity intelligence in Industry 4.0 and provide detailed information regarding the implementation of IoT and its impact on human resource functions and the competitiveness of digital business development.

Based on previous research, there are indications of *research gaps* from studies that have been conducted, namely as follows:

1. Research conducted by Rian Partido Situmorang (2024) states that IoT creates new jobs, especially in technology, data analysis, and cybersecurity.
2. According to Suparjiman, et al (2023), mentioning that there are limited human resources who have skills and competencies in IoT is a challenge in HR management.

In the research gap above, it can be seen the difference in the results of research conducted by previous researchers.

## THEORETICAL REVIEW

### *Human Resources (HR)*

Human resources within an organization or company are considered the primary assets in achieving the goals of the organization. HR refers to productive individuals who play a crucial role as drivers in executing organizational activities. Human resources are both a science and an art that manages the relationships and roles of employees to achieve efficiency and effectiveness in supporting the goals of the organization, employees, and society (Rahawarin and Jumlad, 2022). Organizations that invest in HR development tend to have more competent, motivated employees who are prepared to face change (Ramadhani, M.A., et al., 2023).

### *Organization*

An organization is a cohesive entity that is systematically coordinated, with defined boundaries that have been mutually agreed upon to achieve a specific goal. An organization can also be defined as a collection of systems that are interconnected to achieve a particular purpose or carry out its functions (Fithriyyah, 2021). It is the framework for the division of labor and communication among a group of individuals who hold specific positions and collaborate in an organized manner to achieve established objectives (Prof. Dr. Mr. Pradjudi Armosudiro, 2021).

### *Industry 4.0*

The world has now entered the era of Industry 4.0, where technology has become an essential and inseparable part of everyday human life. Industry 4.0 encompasses all aspects of production in the industry by integrating digital

technology and the internet with traditional industries. Industry 4.0 emphasizes speed and availability of information with six main pillars: artificial intelligence (AI), the Internet of Things (IoT), cloud computing, super apps, and broadband networks (Wijaya, 2023).

***Internet of Things (IoT)***

IoT technology has brought about a significant revolution in the industrial sector. The Internet of Things (IoT) is a concept in which an object has the ability to send data through a network without requiring direct interaction between humans or between humans and computer devices (Ishak, 2023). IoT consists of software, sensors, networks, and actuators that collect and transfer data. The utilization of IoT is essential to maximize the quality of organizations.

Several key components within the Internet of Things (IoT) include:

1. IoT Devices and Sensors

   IoT consists of web-enabled smart devices that utilize embedded systems.

   - Sensors and Communication Hardware: These are used to collect, transmit, and respond to data from the surrounding physical environment, such as temperature, humidity, motion, pressure, or air quality.
   - Processors: These are used to process data, control devices, manage connectivity, and ensure that devices function efficiently and securely.
   - Actuators: These convert data and signals from the system into physical actions that can be observed. With the ability to control various devices and systems automatically, actuators enable better automation, energy efficiency, and comfort in IoT applications.

2. Connectivity

   IoT devices can communicate with each other through internet networks. These devices share sensor data by connecting to an IoT gateway, which acts as a central hub where IoT devices can send their data. Before sharing, the data can also be sent to edge devices where it is analyzed locally.

   - Wi-Fi: Used to connect IoT devices to the internet, enabling devices to access data or communicate with servers/cloud.
   - Bluetooth, especially BLE (Bluetooth Low Energy): Used for short-range communication between devices with very low power consumption.
   - Zigbee: A mesh network protocol that allows devices to connect and communicate with each other, reducing reliance on a single central access point.
   - Near Field Communication (NFC): Allows data communication between devices within very close proximity, usually just a few centimeters.
   - Cellular Networks (4G, 5G): Used to connect IoT devices that are located far from Wi-Fi or local network sources.

3. Data Analysis

   Relevant data is used to identify patterns, provide recommendations, and detect potential issues before they escalate. Analyzing data locally reduces the amount of data sent to the cloud, which can help reduce bandwidth consumption.
   - Gateway: A device that connects sensors and IoT devices to a broader network. It can also perform local data processing before sending it to the cloud.
   - Edge Devices: Devices that bring data processing closer to the location of the sensors or devices, reducing latency and dependency on the cloud.
4. User Interface (UI)

   User interfaces (UI) are widely used for managing IoT devices. Websites or mobile applications can serve as a UI to manage, control, and register smart devices.
5. Communication Protocols

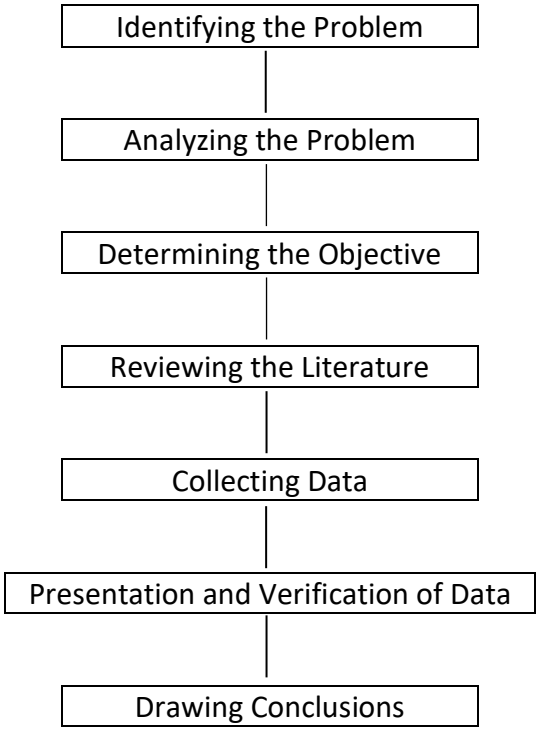
   Communication protocols in IoT govern how IoT devices interact, exchange data, and communicate with each other over a network.
   - MQTT (Message Queuing Telemetry Transport): A lightweight protocol commonly used in real-time applications and communication between IoT devices and servers.
   - CoAP (Constrained Application Protocol): A protocol for IoT devices with limited resources, highly efficient for applications requiring low power communication and bandwidth.
   - HTTP/HTTPS: Web-based protocols used for data communication between devices and cloud servers.

## METHODOLOGY

This research is categorized as qualitative research, focusing on the role of IoT in Human Resources. The research method used is a literature study, which involves a series of processes including data collection from literature, reading, noting, and managing research materials (Saifudin, 2024). In this study, data is gathered from academic journals, scholarly writings, articles, and other sources relevant to the research topic.

The initial stage involves the collection of information regarding the use of IoT in human resource management, the advantages and disadvantages of IoT implementation, and the implications for future HR management. Once the data is gathered from the literature, the next step is to systematically organize the data and conduct a descriptive analysis. This research emphasizes the importance of empirical observation, focusing on the collection and analysis of objective data based on the research aspects in accordance with the formulated problems. Subsequently, the data is presented and reviewed again to serve as the basis for drawing conclusions.

To clarify the research methodology, a framework has been developed that outlines the steps to be taken in this study. This framework serves as a series of flows and illustrations of the steps to be undertaken, which may influence the research outcomes. The framework used in this study is as follows:




**RESULTS**

In this study, the researcher found several findings regarding the impact of the Internet of Things (IoT) on Human Resources. The use of online platforms and mobile applications connected to IoT has proven to improve efficiency in the employee recruitment process. Internet-connected devices make it easier for job candidates to access and submit applications, while companies can use data from IoT devices to monitor and evaluate candidates, including online activity, digital skills, and even digital footprints.

IoT provides the ability to monitor employee performance within an organization in real time. Sensors and IoT devices can be used to collect data on productivity, working hours, and employee health. This data can be used by HR managers as a basis for making more informed decisions regarding employee development, performance evaluations, and wellness programs. Furthermore, IoT also impacts HR management by automating the use of connected devices and data-based systems to perform specific tasks.

With increased automation, employees need to focus more on activities that are not easily done by machines, such as work that requires cognitive abilities. This shows that changes in the character, needs and culture of the Company in the future will civilize the role of the employee. Employees are no longer in an environment that puts them at risk, both physical and psychological risks.

In certain industries, IoT plays a role in enhancing workplace safety. Devices such as motion sensors, surveillance cameras, and temperature sensors can be installed to monitor the risk of workplace accidents and hazardous conditions, providing alerts or notifying managers if conditions are unsafe. Additionally, IoT can integrate data from time management systems with other devices to help organizations manage work schedules and employee performance. This technology enables organizations to optimize the allocation of human resources more efficiently.

The Fourth Industrial Revolution is evidenced by the growth of industrial digitalization, supported by factors such as the expansion of connectivity and the emerging correlations between humans and machines. The great potential of Industry 4.0 arises from the interaction of humans and machines that are driven by a new generation of industrial robot collaboration, fast learning and sophisticated. Collaboration of human-machine interactions that make the system better than just focusing on humans with humans or machines with machines alone. According to Ansari, Erol and Sihn (2018), defining human-machine interaction with the concept of mutual learning, which is a two-way process that causes a reciprocal, dependent exchange, action, or influence of human and machine collaboration, which gives birth to new concepts, enriches existing ones, or improves skills and abilities in relationships with each group. Technology actively contributes to mastering the elements within business operations. Various challenges arise from the processes and outcomes of implementing controls by individual companies. To maintain human resource performance, employees must possess both soft skills and hard skills that are essential to ensure they are not replaced by technology.

Here are some impacts of IoT on human resource management:

1. Better decision-making: By using data from IoT sensors, companies can monitor employee performance, productivity, and work quality in real time. This enables organizations to make more accurate decisions regarding resource allocation, training, and employee development programs.
2. Cost reduction: IoT helps companies identify and reduce waste in HR operations. For instance, monitoring employee availability in real time can help organizations avoid overstaffing or understaffing, which can significantly save costs.
3. Improved employee experience: IoT helps businesses monitor employee health and intervene early if issues arise. For example, by monitoring employee stress levels in real time, companies can offer targeted health programs to reduce stress and improve employee satisfaction.
4. Faster decision-making: IoT data enables companies to make faster and more accurate decisions about various aspects of HR operations. For example, by monitoring employee availability in real time, organizations can quickly identify resource shortages and take necessary steps to address them.

5. More efficient work experience: IoT can help companies streamline their HR operations and make the employee work experience more efficient. For instance, by monitoring employee productivity in real time, organizations can identify areas where employees might be facing challenges and provide additional training or support.

Overall, the Internet of Things holds great potential to transform the way companies manage their human resources. By collecting and analyzing data in real time, organizations can make better decisions, reduce waste, enhance employee well-being, and improve the overall work experience.

In addition to the opportunities that have been described, challenges in managing Human Resources in the IoT era include limited labor with skills and competencies in IoT, changes in work patterns caused by IoT can affect HR performance and productivity. The complexity of IoT technology can make it difficult to manage human resources who do not have a technology background. Cyber security is also a challenge in managing HR in IoT, because every device connected to the internet is vulnerable to cyberattacks. In addition, it costs a lot of money to train and develop human resources who are competent in operating IoT.

Based on the opportunities and challenges of IoT in the industry 4.0 era, it is necessary to re-skill and train human resources tailored to future needs and skills. Some steps that can be taken are as follows:

1. Initiate a human resource management policy

   Germany, which is the leading country in facing the industrial revolution 4.0, is not only due to the readiness factor, but because Germany is the first country to adopt and open Education and training centers including pre-age 18 education, higher education and vocational training (Mayusda, 2018). This is a supporting aspect of HR readiness in the short and long term in facing this era.
2. Re-skilling, re-education, and re-training programs

   Another obstacle in creating competent human resources is not only to recruit and develop the skills needed, but also to reduce the mismatch of job desks with employees. Re-skilling, re-education and re-training are very influential for jobs that require speed with technology. Not only that, education and training must fulfill various cognitive abilities, creativity levels and other skills relevant to the jobdesk.
3. Education institution and industry partnerships

   Continuous training and professional development is another important factor in achieving Industry 4.0 goals, as it will significantly change the job profile and skills of human resources. As a result, partnerships between organizations, companies and educational institutions will be important in the future. Therefore, there is a need for open access to science and engineering studies, as well as more adequate capacity for knowledge transfer and skills aspects. In addition, it is also necessary to encourage innovation in the industrial sector through enhancing the capabilities of future resources.

## CONCLUSIONS AND RECOMMENDATIONS

The development of Industry 4.0 is an inevitable reality that must be faced wisely. Industry 4.0 presents significant opportunities, but it also brings challenges and risks that must be addressed.

The Internet of Things (IoT) plays a critical role in the Fourth Industrial Revolution, particularly in the transformation of Human Resource (HR) management. By integrating IoT devices into HR operations, organizations can collect and analyze data in real-time, allowing for more informed decision-making across various HR functions. Furthermore, by leveraging advanced technology, IoT helps organizations improve operational efficiency, employee well-being, safety, and human resource development. The use of IoT in HR also supports organizations in becoming more responsive to employee needs, thereby enhancing productivity and overall job satisfaction. However, IoT also presents challenges and risks that must be managed. Data security, employee privacy, and workplace culture changes are key concerns that require careful attention. Organizations need to ensure that IoT technology is implemented thoughtfully, with a focus on employee well-being and rights to avoid potential negative impacts.

The rapid advancement of IoT within organizations requires employees to continuously develop technical skills, adapt to automation, understand data security principles, and maintain an open attitude toward change. By strengthening digital literacy, data analysis skills, and the ability to adapt to new technologies, employees can remain competitive and contribute to the success of organizations in the increasingly connected era of Industry 4.0. Although technology can enhance efficiency, the sophistication of continuously connected tools can also increase the risk of digital stress and burnout due to higher productivity expectations. Therefore, organizations must consider work-life balance factors and provide mental health support for employees as they navigate this fast-paced transformation.

## FURTHER STUDY

The limitations of this study only examine the role of IoT on Human Resources in the Industry 4.0 Era. Suggestions for future research are to be able to develop this research by adding other variables that might expand and deepen the study related to Human Resource Management with IoT, and can be developed using quantitative methods by digging up information directly on the organization.

**REFERENCES**

Ansari, Erol, Sihn. 2018. Rethinking Human-Machine Learning in Industry 4.0: How Does the Paradigm Shift Treat the Role of Human Learning?. *Elsevier*, 23, 117-122.

Budiyanto, Utomo, Titin Fatimah dan Pipin Farida. 2021. Pengenalan Internet of Things (IoT) sebagai Upaya Peningkatan Kualitas Pegawai Kementerian Pendidikan dan Kebudayaan. *KRESNA: Jurnal Riset dan Pengabdian Masyarakat*, 1(1), 82-86.

Fithriyyah, Mustiqowati. 2021. *Dasar-Dasar Teori Organisasi*. Jakarta: Irdev.

FTMM Unair. 2023. Perkembangan Industri 4.0: Antara Peluang dan Tantangan. https://ftmm.unair.ac.id/perkembangan-industri-4-0-antara-peluang-dan-tantangan. Diakses pada tanggal 17 November 2024.

Indobot Academy. 2023. Contoh Penerapan Internet of Things di Lingkungan Kantor. https://blog.indobot.co.id/contoh-penerapan-internet-of-things-di-lingkungan-kantor. Diakses pada tanggal 13 November 2024.

Ishak, Dedi Setiawan, dan Hary Naek. 2023. Implementasi Internet of Things (Iot) Untuk Mendeteksi Keberadaan Karyawan Perusahaan Berbasis Nodemcu. *Jurnal Cyber Tech Stmik Triguna Dharma*, 5(2), 81-89.

Judijanto, Loso., dkk. 2024. Analisis Peran Teknologi Internet of Things (IoT), Literasi Digital, dan Kolaborasi Industri dalam Meningkatkan Kualitas SDM dalam Industri Manufaktur di Indonesia. *Jurnal Multidisiplin West Science*, 3(1), 56-68.

Kontan. 2024. Ekosistem Meningkat, Pasar Internet of Things (IoT) di Indonesia Terus Bertumbuh. https://industri.kontan.co.id/news/ekosistem-meningkat-pasar-internet-of-things-iot-di-indonesia-terus-bertumbuh. Diakses pada tanggal 17 November 2024

Mayusda, Idriwal. 2018. Manajemen Sumber Daya Tersisih Pada Era Disrupsi Industri. https://idriwalmayusda.web.ugm.ac.id/2018/10/28/manusia-

sumber-daya-tersisih-pada-era-disrupsi-industri. Diakses pada tanggal 23 November 2024

Primakara University. 2024. Memahami Era Industri 4.0 Beserta Prospek Karirnya. https://primakara.ac.id/blog/info-teknologi/era-industri-4. Diakses pada tanggal 17 November 2024.

Purba, Nabillah. 2021. Revolusi Industri 4.0: Peran Teknologi Dalam Eksistensi Penguasaan Bisnis dan Implementasinya. *Jurnal Perilaku dan Strategi Bisnis*, 9(2), 91-98.

Rahawarin, C. Y., & Walid, J. 2022. Analisis Pengembangan Sumber Daya Manusia Melalui Pelatihan Untuk Meningkatkan Kinerja di PT. Gapura Angkasa Bandara Udara Sentani Jayapura. *Jurnal Multidisiplin Madani (MUDIMA)*, 2(4), 1-14.

Ramadhani, M. A., dkk. 2023. Manajemen Sumber Daya Manusia: Mengoptimalkan Potensi dan Kinerja Organisasi. Jambi: Sonpedia Publishing Indonesia.

Saifudin, Mohamad, Model Pelatihan Dan Pengembangan Sumber Daya Manusia di Era Digital. Pendas : Jurnal Ilmiah Pendidikan Dasar, 9(3), 292-300.

Situmorang, Rian. 2024. Internet of Things (IoT) dalam Teknik Elektro: Menghubungkan Dunia Digital dan Fisik. *Circle Archive*, 1(6), 1-7.

Sudiantini, Dian., dkk. 2023. Penggunaan Teknologi Pada Manajemen Sumber Daya Manusia di Dalam Era Digital Sekarang. *Digital Bisnis: Jurnal Publikasi Ilmu Manajemen dan E-Commerce*, 2(2), 262-269.

Suparjiman, dkk. 2023. Pengelolaan Sumber Daya Manusia Pada Era Internet of Things. Bali: Penerbit Intelektual Manifes Media.

Ulum, Oktalisha., dkk. 2024. Dampak Internet of Things (IOT) Terhadap Manajemen Sumber Daya Manusia. *HUMANIS (Humanities,Management and Science Proceedings)*, 4(2), 1-8.

Wijaya, Budi. 2023. Peranan Teori Hukum pada Peradapan Digital Revolusi Industri 4.0. *Jurnal Kewarganegaraan*, 7(2), 1-15.