

Practices of Managerial Analytics in IoT-based Sustainable Employee Training and Organizational Performance at the Bank and Financial Institutes

Md. Mohsin Kabir, Mohammad Saddam Hosen, Mohammad Thoufiqul Islam, Shamal Chandra Hawlader

Abstract: *The study has analyzed managerial analytics integrated with the Internet of Things (IoT) that has mobilized sustainable employee training and organizational performance in the banking sector. The intention is to evaluate the managerial analytics practiced by Bangladeshi banks and financial institutes (FIs) and their impact on employees' training and performance. The present research investigates the implementation of sustainable employee training initiatives and effectiveness in working fields using IoT, the historical extant training practices of the organization, and the relationship between managerial analytics factors that affect the banking system. Here in this study, a scenario-based approach was used to demonstrate the integration of smart training for employees with IoT using managerial analytics tools, and a cross-sectional research strategy was also experienced among the related employees of Bangladesh in Dhaka city. And 143 purposive sampling metadata were analyzed. We offer a model for evaluating the efficacy of managerial analytics on employees, which enhances operational and learning outcomes. The study's results confirmed the validity of the proposed model for evaluating the training of employees. The findings have identified the indicators- training content and attitude as analytical patterns, and IoT technology and monitoring as technological that significantly impacts the employees' performance. It emphasizes the managerial analytics concept that facilitates training and development for employees with newly required competencies in the banking sector through IoT. Managerial analytics integrated into IoT-based employee training is significantly effective among operations and promotes smart performance observation in the banking sector. These insights offer valuable guidance to bankers, policymakers, and managerial analysts striving to incorporate sustainable practices into their operations to foster long-term growth in the banking sector.*

Keywords: Sustainable, Managerial Analytics, IoT, Training, Implementation, Evaluation



I. INTRODUCTION

Only a small number of financial institutes (FIs) and banks have been able to derive value from their sustainable employee training through managerial analytics.

Traditional existing employees' training [74] and performance evaluation in the banking sector gap evaluation causes widely developing countries to use managerial analytics (MA) integrated Internet of Things (IoT) not used. To enhance sustainable training in the banking sector with managerial data of intelligent IoT analytics is comprised of training technology, intelligent systems, service, and management [35]. It subsequently investigated the in-depth training provided by intelligent managerial data analytics for management based on IoT [5]. The training covered various topics, including soft skills, leadership, induction, sales, quality, technical products, diversity, and teamwork [24].

Integrating managerial data analytics and IoT is on the brink of revolutionizing the performance of organizations, employees, and staff and the instruction of banking, finance, e-commerce [14], and web services [62]. Managerial data is not of significant value in the absence of big data analytics, much like operations without the substantial advancements of the banking sector [1]. Nevertheless, the commercial value of big management training is enhanced by applying organizational training, thorough instruction [63], smart leadership, and the intelligence of employees in developing IoT-based managerial practices [1], [39].

The combined impact of employee training and the enhanced capabilities of organizational performance has inevitably resulted [71] in a substantial increase in IoT-delivered training [15], including multimedia learning environments, e-instruction, and guidance sustainability [46].

Most trainer teams cannot guarantee effective employee training [8] and a clear vision for the banking sector's future without effective managerial analytics and organizational performance models in the FI's training [89]. Significant resources are allocated to efficiently utilize the IoT system and network in most current employee's performance assessment processes [54]. The FIs and banks cannot completely exploit this IoT technology, which results in a loss of quality and consistent assessment to meet the growing demands of their customers [64]. Consequently, the most pressing issue is the development of an automated and effective tool for evaluating [3], [89] the efficiency and efficacy of organizational performance [27].

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The primary goal is to provide sustainable employee training and observe or evaluate organizational performance at financial institutes in Bangladesh that are supported by managerial analytics, which is beneficial in the modern workplace [21].

- To measure the level of employees' performance and training implementation using IoT-based managerial analytics.
- To evaluate the managerial analytics acceleration in employee training environments in multi-type financial institutes.
- To assess the IoT-developing facilities in managerial analytics tools for monitoring through employee training and performance in the banking sector.
- To propose an actionable strategic model based on IoT using managerial analytics and suggestions for promoting and enhancing the integration of sustainable employee training in Bangladesh.

II. LITERATURE REVIEW

A. Practices of Managerial Analytics in the Banking Industry

Managerial analytics is the application of advanced computational techniques and data analysis with IoT methods to facilitate decision-making processes within banking organizations [68]. The financial institutions and banks of the 21st century are undergoing a significant transformation in employee engagement [40], human resource development, managerial policy boards, and the development of their employees' performance to become competitive. Consequently, the primary lesson for banks is developing a company's human resources bolsters its long-term quality [23].

Ernst and Koll (2024) emphasized that managerial analytics tools not based on the Internet of Things (IoT) frequently fail to provide information relevant to higher-quality objectives [16]. They underscored the significance of modifying the quality models integrated into these tools [22] to more effectively align employee training with banks' specific requirements and development processes [90].

Lee et al. (2023) examined bank officers' perspectives on data-driven decision-making, examining their experiences [41] and how data can enhance the decision-making process in agile IoT-based software companies [52]. Nasar et al. (2021) findings suggested that practitioners regard this decision-making method [53] as promising despite its unrealized potential for employee training and development [17]. Tabesh et al. (2019) conducted an empirical study to examine organizations' challenges and benefits when implementing managerial data-driven practices [81]. For example, the authors did not concentrate on the managerial decision-making process in software initiatives. Kang and Park (2019) investigated the decision-making process for employees training in agile teams, identifying the factors influencing decision-making during training performance [32] and daily reporting with sprint duration [65], experience, resource availability, and meeting performance [13]. Taufiq et al. (2020) emphasized business analytics data in software project management [83], identifying the factors that influence managers' decision-making process [33], and

assessing the performance metrics of employees in the operation and management risk assessment factors.

B. Smart IoT-based Sustainable Employees Training in Banking System

Anbazhagan et al. (2023) both connected that integrating sustainable employee training based on smart IoT into a merged banking system can significantly improve training efficiency, personalization, and sustainability [7]. Nižetić et al. (2020) reveal that a method employs IoT technologies to establish dynamic, responsive training environments customized to the objectives of the bank [55] and financial institutions and the requirements of the employees [61]. IoT can assist in customizing corporate training programs for employees [59]. Human resources (HR) administrators can capture meaningful data related to employee performance appraisals to plan [34],[46],[90] organize and coordinate a training program for all employees [87]. Private banks and financial institutions have contemplated merging inferior banking operations to enhance operational efficiency and financial health [28]. For example, there have been attempts to merge banks such as Janata Bank, Agrani Bank, and Rupali Bank in Bangladesh; The Daily Star (2024) reported mergers have not always been successful [84]. The merged banking system has been implemented to enhance competitive positioning and broaden market reach by employing managerial analytics to enhance employee performance [76].

C. Operational and Employee Performance Analytics

Tanasescu et al. (2024) demonstrated employees' performance data to identify top performers, training requirements, and career development opportunities in financial institutes [82]. Assist in optimizing personnel levels and succession planning by forecasting turnover rates and staffing requirements [78]. They scrutinized operational processes to pinpoint inefficiencies and opportunities for enhancement [91], including optimizing branch operations or reducing loan application processing times. Analyze the supply chain to enhance operational efficiency and risk assessment for institutions engaged in supply chain financing [11]. In the banking sector, managerial analytics practices facilitate more informed decision-making, enhance operational efficiency, assure regulatory compliance [81], and increase customer satisfaction by fostering a data-driven culture and incorporating sophisticated analytical techniques [66].

D. Training Effectiveness Impact on Enhancing Employee Engagement

Managerial analytics can be applied to evaluate the effectiveness of training programs by analyzing post-training performance data [54], [77]. The efficacy of training initiatives can be assessed through metrics such as enhanced job performance, increased customer satisfaction, and reduced error rates, which provide real-time feedback [49].

Morton et al. (2019) emphasized that employee engagement and satisfaction with training programs can be quantified using analytical tools [51].

The engagement metrics of personalized training programs are instrumental in determining whether [30] the training meets employees' professional development requirements and how they perceive it [37].

E. IoT-based Smart Training Environments Using Managerial Analytics

Integrating managerial analytics and IoT technologies into existing training systems can be complex [26]. Li et al. (2020) articulated that financial institutions must guarantee compatibility and interoperability between legacy and new systems [42]. This may necessitate a substantial investment in infrastructure and training for information technology [51], [81] and HR personnel. Smart environments facilitated by the IoT frequently integrate software technologies [31], including automated training control and performance observation systems, which are used to assess employees' capabilities [69]. This reduces operational costs and contributes to environmental sustainability [9]. Stergiou and Sannis (2022) found that organizations must guarantee compatibility and interoperability between legacy and new systems [80]. This may necessitate a substantial investment in infrastructure and training for IT and HR personnel [43], [57]. A cultural transformation within the organization is necessary to implement IoT-based smart training environments. Both employees and management must embrace new methods of learning and functioning [60]. Efficient change management strategies, such as training, support, and explicit communication, are indispensable for successful implementation [12].

F. Utilizing Managerial Analytics to Optimize Training Efficiency

Kraus et al. (2020) results reveal that managerial analytics significantly improves training efficiency by utilizing data-driven insights to optimize training programs [38]. Financial institutions can identify specific training requirements and customize programs by collecting and analyzing data from various internal banking departments, including performance metrics [85], engagement levels, and feedback [20]. Simsek et al. (2020) focused on a method that guarantees that training is pertinent and focused, effectively addressing the skills deficiencies of employees [75]. Real-time data analytics improves the learning experience by making instantaneous adjustments during training sessions [25]. Predictive analytics also assists in the prediction of future training needs, guaranteeing ongoing improvement [4]. Furthermore, managerial analytics enables organizations to accurately

measure the impact of their training initiatives by providing detailed reporting and visualization tools, which facilitate the assessment of training effectiveness [58]. Integrating these analytical techniques enables companies to establish training environments [44] that are more efficient, effective, and adaptive, promote continuous improvement, and align with banking performance [45].

G. Actionable Strategies for Employee Training Using Managerial Analytics

McIver et al. (2018) workforce analysis reveals that the banking sector has experienced substantial enhancements in training efficiency and effectiveness due to the IoT's favored actionable strategies for employee training, which utilize managerial analytics [47]. Minbaeva, (2018) discovered that data-driven personalization is essential [48]. Training programs can be customized to accommodate the distinctive requirements of each employee by employing analytics to evaluate individual learning styles, performance histories, and specific skill deficiencies [2]. This customization of employee performance results in more engaging and effective learning experiences, as employees receive training directly addressing their development areas [79].

Organizations can foresee skill shortages and create training courses to fill them by examining patterns and trends in employee performance data [86], [73]. This forward-thinking guarantees the workforce's ability to adapt and prepare for future problems [10]. Real-time feedback mechanisms, facilitated by managerial analytics [70], offer immediate insights into training effectiveness [72]. Fauziyah et al. (2019) gamification study shows that trainers' ability to adjust content and delivery systems on the move, as a result of continuous monitoring through analytics, improves the overall learning experience [18]. Furthermore, exhaustive reporting tools facilitate the assessment of the influence of training programs on organizational objectives and employee performance [36], guaranteeing accountability and alignment. Analytics-driven benchmarking enables organizations to evaluate the efficacy of their training on industry standards [6], thereby identifying opportunities for innovation and improvement. These actionable strategies guarantee that employee training is targeted, efficient, and in accordance with the organization's strategic ideas [88].

Finally, we employ the extant IoT-based managerial analytics to examine the impact of sustainable employee training in financial and bank instructions. The literature review is summarized in **Table 1**, which is provided below.

Table 1. Aspects of the Literature Review Findings

Authors	Method	Results/Findings
Appelbaum et al. (2017) [8]	MADA framework	This paper contributes to the existing literature by examining the influence of business analytics on managerial accounting from the perspectives of enterprise systems and business intelligence.
Shah et al. (2017) [73]	Survey Method	Employee factors may be limited, so the study proposes using big data principles, implementation approaches, and management commitment requirements to better assess employee attitudes and behaviors as part of HR predictive analytics.
McIver et al. (2018) [47]	Appropriate Research Methods, Multiple Approach	The study results show how important it is to use real-time analytics to quickly adjust to changing business needs and make the workforce more productive.

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Authors	Method	Results/Findings
Al-Hitmi and Sherif, (2018) [5]	Qualitative Method	Although IoT-enabled monitoring was perceived as ubiquitous, monitoring every movement and recording conversations, the proliferation of the technology among employees who believed it to be the new reality in the workplace.
Ghasemaghaei et al. (2018) [20]	Survey and Data Quality Measured	The findings indicate that the quality of decisions is significantly enhanced by all aspects of data analytics competency. It is intriguing that all dimensions, except data volume, significantly enhance decision-making efficiency.
Nocker and Sena, (2019) [56]	Talent Analytics, Theoretical Approach	Talent analytics creates value. If an organization can establish a causal relationship between training expenditure and profitability, it can create a training strategy to influence profitability.
Kang and Park, (2019) [32]	Heuristics Study Design	A study focused on judgment and decision-making must be recognized, and the education and training system must be strengthened to improve bank employees' rational choice and judgment.
Salleh and Janczewski, (2019) [68]	BDS, Questionnaire Survey Method	In the adoption of big data solutions (BDS), employees' security education, training, and awareness were among the identified factors given consideration.
Simsek et al. (2020) [75]	CAM Framework	Analytical modeling was used to make personnel decisions using design science and CAM as the kernel theory. Machine learning was used to train an employee training model that predicts free agent contract signing.
D. Li et al. (2020) [42]	MA-MEC, OSS	This security system monitors the local and global behavioral changes in the communication of IoT devices.
Moyeenudin and Anandan, (2021) [52]	HRM tools analysis	HRM uses IoT to recruit employees and use virtual platforms for recruitment and training to determine their knowledge of the company's policies, rules, and regulations.
Sievers et al. (2021) [74]	Scenario-based Designs	IoT-based organizations may neglect employee growth and organizational structure training in favor of competitive advantage, business profit, and growth.
Abdussamad et al. (2022) [1]	Systematic Review	The involvement of the IoT in organizations and businesses has altered the working function of HR, as well as the process of engaging employees in organizational training.
Alexopoulos et al. (2022) [4]	Cross-sectorial Study, Case Design	The results of the study demonstrate effective methods for conducting Big Data analytics and offering solutions that enhance the engagement of bank employees, who are the true decision-makers.
Anbazhagan et al. (2023) [7]	Surface Methodology	Research indicates that the IoT impacts the performance of both employees and organizations, thereby elucidating the complex relationship between productivity and technological integration.
Aziz et al. (2023) [10]	BDA, Survey Method	Research shows that big data analytics improves operational efficiency and decision-making in Malaysian banks. These improvements boost firm performance, including profitability and competitiveness.
Godavarthi et al. (2023) [23]	IoT and Blockchain Incorporation	The study suggests that industry managers should focus on HRM indicators like collaboration, involvement, actualization, perception, and teamwork to improve their leadership quality and intentionally impact employee performance.
Rique et al. (2023) [66]	Qualitative Research CCM, Case Study	They discovered that data-driven insights from software analytics improve managerial decision-making. The research also emphasizes organizational readiness and training for successful adoption of analytical tools.
Bany Mohammed et al. (2024) [13]	Empirical Approach	Organizations that align BIA initiatives with strategic goals and provide training and infrastructure are more likely to improve their BIA capabilities and make data-driven decisions.
Tanasescu et al. (2024) [82]	CRISP-DM methodology	This work has introduced various methods and compared them to construct a machine learning algorithm that can predict the performance scores of employees within an organization.

III. METHODOLOGY

The scenario-based approach was used to demonstrate the impact of an evolving IoT-based system on training for the employees in financial institutes [67]. A scenario narratively describes a sequence of actions and events by illustrating the activities a user performs for employee engagement. Scenarios are particularly effective as a design method for managerial analytics interactions, as they facilitate comprehension of the conditions under which potential users typically conduct specific training and their performance (Figure 1). Survey interviews are the foundation of theory-based problem scenarios, which enable a structured model analysis of the current situation. Secondly, a cross-sectional study was conducted among the related employees of Bangladesh from June 5-25, 2024, to consider the employees' training and organizational performance appraisal in banks

and financial institutes (FIs). The English version of ten self-administered questionnaires was distributed to 143 male and female participants who were purposely selected based on their experiences in the banks and FIs of Bangladesh. This study employs linear regression to analyze the primary data for the effects of IoT-based managerial analytics. The statistical analysis was conducted using the Statistical Package for Social Sciences (SPSS) version-26 software, an integral model applicable to the research subject [19]. Descriptive statistics and linear regression assess the models' fit for the impact of each evaluated construct and the overall model [50], with the dependent variables being employees' work experiences and age group.

We concentrated on the employee training scenarios, illustrating how IoT can be employed to resolve advantage scenarios and demonstrating how current managerial analytics practices can be converted into novel behavioral patterns shows in Figure 1.

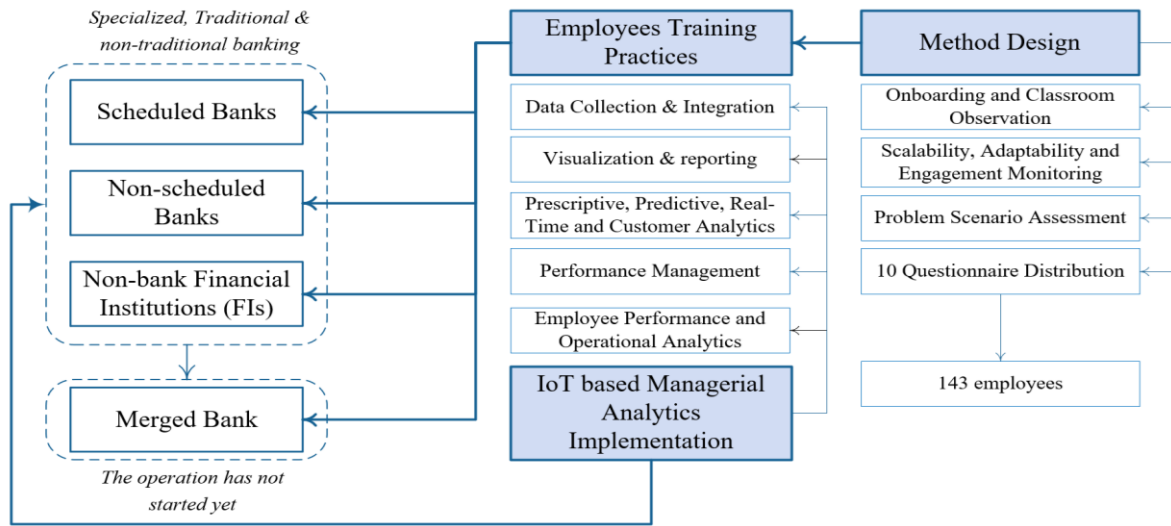


Figure 1. The Interconnections Between the Numerous Stages of the Research Process are Illustrated

IV. RESULTS

Managerial analytics systematically analyzes data to enhance employee performance, provide better training, and facilitate decision-making. It incorporates various technologies, techniques, and tools to analyze data and produce actionable insights using an IoT model.

This section, **Figure 2**, delves into the performance and computational efficiency of the learning model framework in the testbed construction, the training process of employees, managerial analytics, IoT, and the current design.

Managerial Analytics: The initial scenario involves the synergistic accumulation of MA data to establish a robust system that improves employee training by utilizing real-time data collection, advanced observation, personalized learning, and immersive experiences. In the banking sector, these components guarantee that training is efficient, engaging, and consistent with the organization's objectives. The second scenario involves the efficient storage and organization of data to guarantee its accessibility for analysis [14]. Employees' efficacy and working conditions, including their use of cloud storage solutions, data warehouses, data lakes,

and databases. The third scenario involves the analysis of historical data from employees to comprehend past performance, identify patterns, and diagnose trends or past performance [62]. They are integrating managerial business intelligence tools with statistical models and machine learning algorithms to forecast future results based on the training data of previous employees [46]. Lastly, it is imperative to establish data governance policies to guarantee the consistency and precision of training data. Encryption, secure access controls, and adherence to pertinent data protection regulations are implemented to safeguard sensitive managerial section and employee data. The primary components of managerial analytics consist of a comprehensive data collection, processing, analysis, and visualization methodology [40]. Banks and financial institutions can make data-driven decisions and acquire profound insights into the operations of their employees by utilizing these components. Employee training in managerial analytics facilitates the development of personalized [22] and effective training programs, increases engagement, and enhances overall performance, all while ensuring data governance and security preservation.

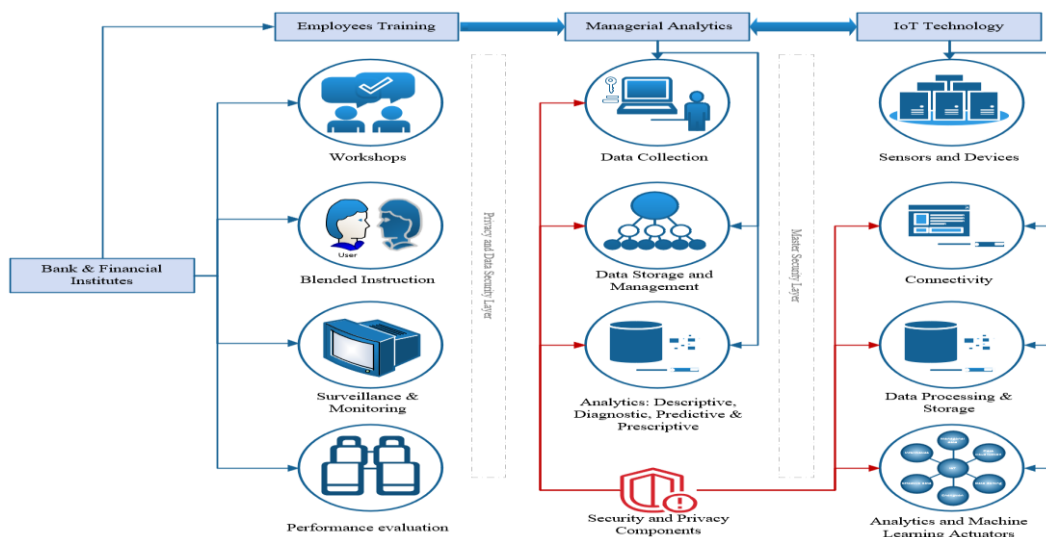


Figure 2. Shows the Main Components of Managerial Analytics with IoT

Internet of Things (IoT) Technology: The managerial analytics are interconnected with IoT components that collaborate to collect, transmit, process, and act on data [7]. These components are essential for improving the efficiency and effectiveness of employee training in the financial sector. **Figure 2** illustrates that an IoT system's primary data collection points are sensors and devices integrated with managerial analytics (MA). They assess and capture various data from the environment or the bank's employees. The second scenario pertains to the communication channels that connect data processing systems, sensors, and devices. Various network protocols and technologies can be employed to accomplish connectivity. The third scenario necessitates the processing and storage of data to extract valuable insights. MA can occur in centralized systems (cloud computing) or locally (edge computing). The storage of the enormous quantities of data produced by IoT devices is a component of this component [59]. Efficient data storage solutions guarantee that employees can easily access the data they need for training.

Ultimately, the data is processed by the employee's data analytics and machine learning algorithms to identify patterns, generate insights [80], and make predictions regarding their performance and decision-making. MA is essential for the development of customized training programs and the provision of real-time feedback. Consumers use the platforms to interact with the IoT system as user interfaces. Employees' training observation interfaces are intended to be intuitive and offer actionable insights derived from the processed data [24]. The manager implements actions that are informed by the insights and processed data of the MA. Ultimately, data security and privacy are of the utmost importance in IoT systems. From the moment of collection to the point of processing and storage, these components ensure the confidentiality and integrity of data.

Employee's Training Pattern with MA integrated IoT: A successful online training program for employees necessitates a comprehensive blueprint for the business objectives of the learning requirements of banks and financial institutions. This blueprint should include a thorough needs analysis, clear objectives, pertinent course topics, and appropriate training platforms integrating with the Internet of Things. MA is essential for creating engaging training content emphasizing multimedia utilization for diverse learning styles, personalized learning paths, and interactive learning. The integration of resources ensures a dynamic training experience, a user-friendly learning management system, and manager interaction in a robust IoT training toolkit.

Implementing the IoT-based training program involves conducting a pilot test [60], meticulously launching and monitoring progress, continuously revising course content, and ensuring that training aligns with professional development, engagement strategies [70], progress tracking, and rewards to enhance employee performance.

Employees acquire pertinent skills and knowledge through formal, social, and on-the-job training [90]. By understanding the various blended learning models' advantages and disadvantages, we can create more engaging and effective employee training programs [72]. This guide will offer an employee a practical, scenario-by-scenario process for generating blended training experiences that integrate in-

person and IoT learning for the organization.

Trainers and employees receive immediate feedback through interfaces within their device applications through real-time monitoring. Surveillance monitoring technology based on the Internet of Things (IoT) can be invaluable for accident and near-miss training. By analyzing footage of such a reporting breach, employees can better comprehend the circumstances that led to the incident and how to prevent similar occurrences. This approach fosters a safety culture and proactive risk assessment among managers [56]. Real-world scenarios are one of the most effective methods for training employees. Surveillance screens capture each moment in real-time, offering many training examples. Utilize these recordings to illustrate the appropriate and incorrect methods for managing various employee situations, including both positive and negative interactions. Managerial analytics incorporated technology can monitor employee compliance and progress by tracking their participation in training modules and generating reports [20]. This data-driven approach enables management to identify and address training gaps promptly.

MA-based IoT is a cloud-based employee performance review tool that provides managers and employees with automated performance review and employee evaluation forms. This tool is designed to efficiently and effectively align goals, provide real-time performance feedback [85], and promote employee learning and development [75]. The user interface is fully customizable and automated, and it includes performance evaluations in the banking sector, 360-degree feedback, and custom reporting to provide a comprehensive, all-in-one performance management solution.

Managerial Analytics in IoT-based Sustainable Employees Training Impact: 143 employees who were working at banking sites in different departments with different levels of positions in various banks and FIs, and they are (officer, cash officer, data entry officer, Sr. officer, principal officer, chief credit officer etc.) considered as final respondents in Dhaka, Bangladesh. **Table 2** shows that questionnaire distribution among male participants there 30.95% (26-33 years old), 7.94% (18-25 years old), 29.37% (34-41 years old), 10.32% (42-49 years old) and 4.76% (above 58 years old). Partially female participants are 52.42% (26-41 years old), 11.76% (18-25 years old), 23.53% (42-49 years old) and 5.88% women ages group 58+. Most respondents do not implement 38.46% of banks and FIs implemented IoT-based solutions in employee training. Their participant age range is 50-57 years. 42.86% (26-33 age group) agree that the companies use real-time data collected through IoT devices to adjust training programs on the fly, and often, 39.13% (34-41 age group). Bank and FI face challenges in implementing IoT and managerial analytics for employee training, such as Resistance to change from employees, 42.86% (34-41 age group). IoT and managerial analytics impacted overall employee performance and productivity by 50% and Significantly declined (26-33 and 50-57 age groups). In the long run, 42.42% of IoT-based smart training solutions are unsustainable and costly (34-41 age group).

IoT and managerial analytics affected employee engagement and satisfaction with training programs by 50%, significantly decreasing (18-25 age group). Banks and FIs

enhance employee training using IoT and managerial analytics by 40%, reducing reliance on IoT and analytics (34-41 age group).

Table 2. Employees' ages by MA Variables Influenced their Training and Performance in the Banking Sector

Variable (N = 143)		Ages Group (%)					
		18-25	26-33	34-41	42-49	50-57	58+
Gender	Female	11.76	29.41	29.41	23.53		5.88
	Male	7.94	30.95	29.37	10.32	16.67	4.76
Bank and FIs implemented IoT-based solutions in employee training	Fully implemented across all training programs	12.50	25.00	37.50		12.50	12.50
	Not Implemented	7.69	15.38	15.38	23.08	38.46	
	Planning to implement	6.12	32.65	34.69	8.16	12.24	6.12
	Partially implemented in some training programs	9.59	32.88	27.40	13.70	12.33	4.11
IoT-based technologies in improving the efficiency of employee training programs	Ineffective						
	Neutral	16.67		33.33	16.67	16.67	16.67
	Effective	3.13	37.50	37.50	15.63	6.25	
	Very effective	8.65	30.77	26.92	10.58	17.31	5.77
Managerial analytics enabled personalized training experiences for employees	To a great extent	6.67	33.33	20.00	13.33	20.00	6.67
	To some extent		33.33	29.63	7.41	29.63	
	Neutral	10.53	34.21	28.95	13.16	5.26	7.89
	To a limited extent	11.11	26.98	31.75	12.70	12.70	4.76
Companies use real-time data collected through IoT devices to adjust training programs on the fly	Always	14.29	42.86	21.43	7.14	14.29	
	Rarely	5.56	27.78	27.78	22.22	16.67	
	Often	13.04	26.09	39.13	8.70	13.04	
	Never	8.11	27.03	29.73	10.81	13.51	10.81
	Sometimes	5.88	33.33	27.45	11.76	15.69	5.88
Banks and FIs utilize predictive analytics to anticipate training needs and skill gaps.	Neutral			75.00		25.00	
	Very effectively	9.09	36.36	9.09		45.45	
	Very ineffectively	12.12	24.24	30.30	12.12	15.15	6.06
	Ineffectively	6.98	32.56	34.88	6.98	11.63	6.98
The company faces challenges in implementing IoT and managerial analytics for employee training	Effectively	7.69	34.62	25.00	19.23	9.62	3.85
	Resistance to change from employees	28.57	14.29	42.86	14.29		
	High implementation costs	13.64	31.82	22.73	22.73	4.55	4.55
	Data privacy and security concerns	3.45	34.48	27.59	6.90	20.69	6.90
	Lack of skilled personnel to manage and interpret data	5.56	36.11	33.33	8.33	13.89	2.78
IoT and MA impacted overall employee performance and productivity	Integration with existing systems	8.16	26.53	28.57	12.24	18.37	6.12
	Neutral	50.00					
	Significantly declined		50.00			50.00	
	Declined		25.00	33.33	16.67	16.67	8.33
	Significantly improved	2.38	26.19	30.95	21.43	11.90	7.14
IoT-based smart training solutions in the long run	Improved	11.76	34.12	28.24	7.06	15.29	3.53
	Neutral		20.00	40.00			40.00
	Very unsustainable and costly	15.38	30.77	15.38	15.38	15.38	7.69
	Unsustainable and costly	9.09	21.21	42.42	9.09	18.18	0.00
	Sustainable and cost-effective	4.55	40.91	27.27	9.09	13.64	4.55
IoT and managerial analytics affected employee engagement and satisfaction with training programs	Very sustainable and cost-effective	10.42	29.17	25.00	16.67	14.58	4.17
	Neutral		100				
	Significantly decreased	50.00	25.00	25.00			
	Decreased	4.00	28.00	40.00	20.00	4.00	4.00
	Increased	7.14	28.57	26.19	11.90	21.43	4.76
Bank and FIs enhancement of employee training using IoT and managerial analytics	Significantly increased	8.57	31.43	28.57	10.00	15.71	5.71
	Reducing reliance on IoT and analytics			40.00	20.00	40.00	
	No plans to continue using IoT and analytics		33.33	16.67	16.67	33.33	
	Re-evaluating the strategy	16.00	16.00	32.00	12.00	16.00	8.00
	Maintaining the current level of use	11.43	31.43	25.71	14.29	11.43	5.71
Expanding the current use of IoT and analytics		5.56	37.50	30.56	9.72	12.50	4.17



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The regression model summary **Table 3** provides a standard correlation of the R 0.231 values. The R² value represents a strong correlation of 0.053, which indicates employees' work experiences (dependent variable). Also, **Table 3** shows that the predictor variables explain at least 18% of the variance in employee experiences (adjusted R²= 0.18), and the model standard error of estimation is 2.71068. IoT implies that improved predictor variables and managerial analytics led to a 53% general improvement in Bangladesh's FIs and banking sector.

Table 3. Model Summary

R	R ²	Adjusted R ²	Std. Error of the Estimate
.231	.053	0.018	2.7106

Analysis of variance **Table 4** to determine whether our regression model predicts the employee's work experiences, their significance value of <0.028 is less than .05, indicating that our regression model is significant.

Table 4. Analysis of variance

	Sum of Squares	df	Mean Square	F	Sig.
Regression	54.751	10	5.475	.745	.028
Residual	969.906	132	7.348		
Total	1024.657	142			

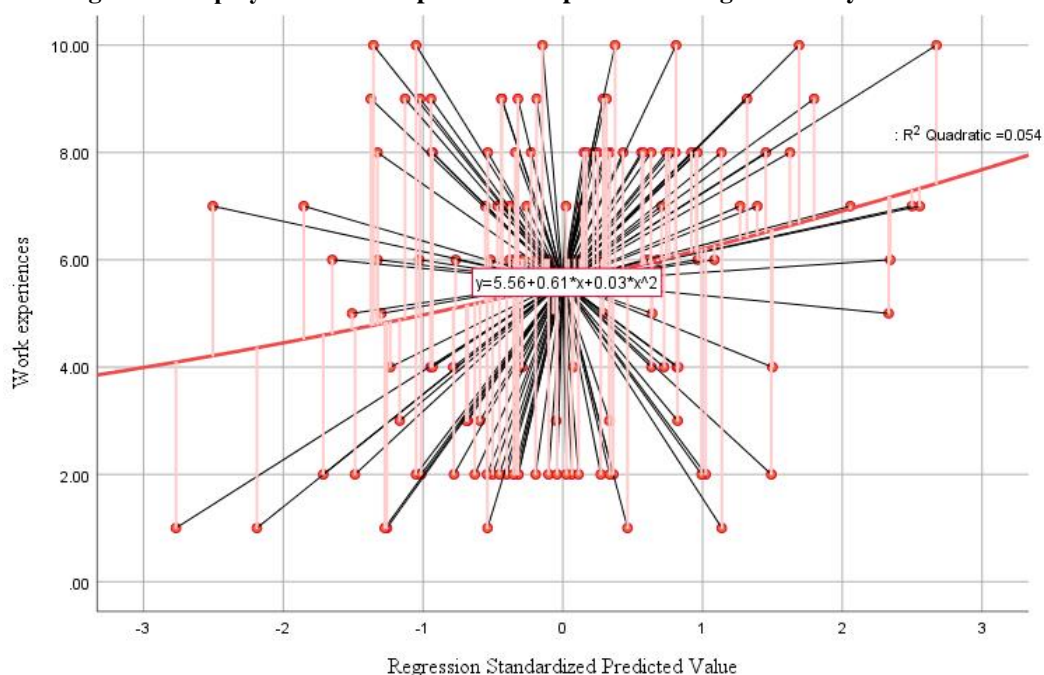
Table 5. Linear regression coefficients (coeff.)

Variable	Unstandardized coeff.		Std. coeff.	t	Sig.
	β	Std. Error	β		
(Constant)	3.830	1.676		2.286	.024
Current Implementation	.259	.314	.071	.824	.012
Effectiveness of Training	.087	.412	.019	.212	.032
Personalization of Training	-.285	.227	-.109	-1.253	.012

Variable	Unstandardized coeff.		Std. coeff.	t	Sig.
	β	Std. Error	β		
Real-Time Feedback and Adjustments	.109	.187	.052	.581	.062
Predictive Analytics Usage	.079	.172	.040	.461	.046
Challenges Faced	.307	.193	.138	1.587	.015
Impact on Employee Performance	.135	.264	.044	.511	.010
Employee Engagement and Satisfaction	.201	.194	.090	1.032	.004
Future Plans & Improvements	-.132	.181	-.062	-.728	.068

Coefficient Table 5 indicates that for every 1 unit increase in employee work experiences, we predict their current MA implementation will increase by .259 units. Employees' work experiences 1 unit increase the effectiveness of training by 0.87 impacts on managerial analytics. Similarly, work experiences 1 unit increase, which is -0.285, negatively impacting personalization training on MA. Also, Table 5 dependent variable is a 1 unit increase, and real-time feedback with adjustments is a 0.109 increase. Predictive analytics usage is 0.79. It impacts MA if work experiences increase by 1 unit. The challenges employees face are 0.307; if work experiences, 1 unit increase. Dependent variable 1 unit increased between 0.135 impact on employee performance. Employee engagement and satisfaction is 0.201 increase if their work experiences 1 unit increase. Every unit of employee work experiences 1 unit increase if the bank and FI's plans and improvements -132 impact managerial analytics.

Figure 3. Employee's Work Experiences Impact on Managerial Analytics Factors



In this linear regression scatterplot (**Figure 3**), the y-axis is 5.56+061, and the x-axis is 0.03². It also provides the equation correctly; R² is quadratically good (0.054).

V. DISCUSSION

Combining Internet of Things (IoT) technology and management analytics transforms employee training and organizational performance in financial institutions. This convergence combines real-time data collecting, predictive analytics, and automated systems to offer a more efficient, personalized, and long-lasting training environment. IoT devices like smart badges and wearables track employees' movements and interactions. This data gives real-time feedback, suggesting areas for improvement and enabling rapid changes. For example, banking operations personnel can receive timely suggestions based on client interactions, improving their performance and customer happiness.

Managerial analytics uses data from various sources to personalize training programs to individual employee needs. Tailored training modules are developed by assessing performance indicators, learning styles, and career goals, enabling better engagement and skill development. Predictive models utilize historical and real-time data to predict training requirements and performance outcomes. This facilitates predicting skill gaps, optimizing training schedules, and aligning training initiatives with organizational objectives. Financial institutions can thereby improve the agility and responsiveness of their workforce to market changes. IoT-enabled platforms decrease the dependence on tangible training materials and venues, reducing costs and environmental impact. Analytical banking data and qualitative information tools provide immersive training experiences that do not necessitate travel or extensive physical resources. The integration of IoT data with performance management systems enables continuous performance monitoring and the development of more precise appraisals. Managers can identify exceptional performers, monitor their progress toward objectives, and make well-informed decisions regarding incentives and promotions.

These practices enhance the efficacy of employee training and the organization's overall performance by cultivating a more motivated, adaptable, and skilled workforce. Financial institutions implementing these technologies can anticipate increased efficiency, reduced costs, and a more robust alignment between employee capabilities and strategic objectives.

VI. CONCLUSION

The present study underscores the transformative effect of integrating managerial analytics with the Internet of Things (IoT) on organizational performance and employee training. Real-time data collection and monitoring are facilitated by IoT, which enables the development of personalized and adaptive training programs that are tailored to the unique requirements and observation paces of individual employees in the banking sector. This results in improved retention of knowledge and improved skill acquisition. Leveraging IoT-generated data, managerial analytics offers insights into the efficacy of training and employee performance, enabling the continuous optimization and enhancement of training modules. The sustainable training environment is cultivated by the synergy between managerial analytics and IoT, which ensures the efficient utilization of resources, the reduction of waste, and the promotion of a culture of continuous learning

and development. This method improves organizational performance and enhances employee competencies in financial institutions, where precision and efficiency are paramount. These practices generate data-driven insights that facilitate strategic decision-making, enhance operational efficiency, and ultimately contribute to the institution's long-term sustainability and competitive advantage. Consequently, integrating managerial analytics with IoT in employee training is a critical strategy for promoting sustainable growth and ensuring high performance in financial institutions.

DECLARATION STATEMENT

The research presented in this paper is the result of a collaborative effort. Each author contributed significantly to the conceptualization, data collection, analysis, and interpretation of findings. Their combined expertise and dedication enriched the study, offering valuable insights into the effectiveness of managerial analytics in IoT-based sustainable employee training and organizational performance at financial institutes.

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Authors Contributions	All authors have equal participation in this article.

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