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Article

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Webtop applications as productivity enablers: A study on employee performance in modern workplaces

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ABSTRACT

The rapid digital transformation in the telecommunication industry has underscored the importance of webtop applications as productivity enablers. This study examines the impact of key webtop application features—User Interface Usability (UIU), System Integration (SI), Real-Time Data Access (RTDA), and Collaboration Features (CF)—on Employee Productivity (EP) in Bangladesh's telecommunication sector. Grounded in the Task-Technology Fit (TTF) theory, the study investigates the mediating role of Knowledge Sharing (KS) and the moderating role of Technology Training Availability (TTA). Using a quantitative research approach, data were collected through structured surveys from 384 employees in the telecommunication industry and analyzed using Smart-PLS 4.0. The findings reveal that all webtop application features significantly enhance EP, with KS mediating these relationships. TTA positively moderates the effects of RTDA and CF but shows a negative moderation for UIU and no significant impact for SI. The study's novelty lies in its comprehensive exploration of webtop applications within a developing economy, addressing both the technological and human dimensions of productivity. Recommendations include fostering a culture of knowledge sharing, optimizing training programs to match technological complexity, and investing in feature-rich, integrated systems to enhance organizational performance. This research offers actionable insights for managers, policymakers, and academics, providing a robust framework for leveraging digital tools to enhance productivity in modern workplaces. The study contributes to the theoretical discourse by extending the TTF framework and provides a practical roadmap for technology adoption and workforce development in rapidly digitalizing industries.

1. Introduction

The digital transformation of contemporary workplaces has fundamentally reshaped how organizations operate, employees collaborate, and productivity is achieved (Kadi, 2024; Omol, 2024). One of the critical enablers of this transformation is the proliferation of webtop applications—cloud-based platforms that facilitate seamless task execution, real-time information access, and cross-functional

collaboration (Kosalge, 2024; Obi et al., 2024). These tools have become increasingly central in knowledge-intensive, fast-paced sectors such as telecommunications, where operational agility and information-driven decisions are paramount (Slimani et al., 2024). In the context of developing economies like Bangladesh, where organizations face unique technological and infrastructural constraints, the potential of webtop applications to enhance employee productivity (EP) remains underexplored. As telecommunications firms undergo digital transformation,

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there is a pressing need to understand how specific features of these tools influence performance in real-world organizational settings. Despite their increasing adoption, few empirical studies have examined the comprehensive impact of webtop applications on productivity, particularly through the lens of task alignment, knowledge flows, and training support mechanisms. EP is a fundamental indicator of organizational success (Sari & Sagala, 2024), especially in sectors driven by technology and rapid service delivery (Bashar et al., 2024). However, the presence of digital tools alone does not ensure performance gains. Instead, it is the alignment between technology functionalities and the actual tasks employees perform that determines productivity outcomes. This alignment is best understood through the TTF theory, which posits that technology improves individual performance when it effectively supports the tasks at hand (Goodhue & Thompson, 1995). Unlike adoption-based models such as the Technology Acceptance Model (TAM) or the Unified Theory of Acceptance and Use of Technology (UTAUT), which emphasize user perceptions or behavioral intentions, TTF is rooted in the pragmatic evaluation of technological utility and performance outcomes.

Building on recent work by Hanafizadeh and Alipour (2025), which emphasizes the importance of contextual fit and theoretical reasoning in emerging technology research, this study advocates for the use of TTF as the most suitable framework for assessing productivity outcomes in digitally evolving industries. In particular, webtop applications are not optional consumer technologies; instead, they are workplace tools with built-in task support mechanisms, making TTF ideal for capturing their organizational relevance. Moreover, unlike TAM or UTAUT, TTF enables researchers to go beyond adoption and investigate actual productivity by focusing on whether webtop applications meet task-specific requirements such as data access, integration, usability, and collaboration. In this study, we focus on four core features of webtop applications: UIU, SI, RTDA, and CF. Each of these features offers distinct functionality that may support task performance in telecommunications. For example, UIU facilitates intuitive interactions and reduces cognitive load; SI allows seamless interaction between systems to streamline workflows; RTDA empowers decision-making with timely and accurate data; and CF supports dynamic teamwork and knowledge flow. While these dimensions have been individually addressed in past research (e.g., Chatterjee et al., 2023a; Wang et al., 2023), their integrated impact on productivity, particularly in emerging markets, remains largely understudied. This study extends the traditional TTF framework by incorporating two additional theoretical elements that provide a deeper understanding of how digital tools impact performance. First, we introduce KS as a mediating variable, based on its recognized role in enabling learning, innovation, and task coordination (Lee & Chen, 2023; Wang et al., 2023). Webtop applications facilitate knowledge exchange by breaking down organizational silos, offering real-time communication channels, and creating shared digital workspaces. These functionalities create the conditions for KS to flourish, potentially enhancing the effect of technology features on productivity.

Second, we include TTA as a moderating variable, acknowledging the pivotal role of employee training in enhancing digital competence and tool utilization (Ahmed, Khan, & Rehman, 2023; Hassan et al., 2022). In emerging economies like Bangladesh, where digital literacy varies widely across organizational roles, training can either strengthen or weaken the relationship between technology and productivity. For instance, while intuitive tools may require minimal instruction, more complex features, such as system integration or collaborative platforms, may demand a structured onboarding process. Despite growing interest in digital skills development, the conditional role of training availability in shaping task-technology fit has not received adequate empirical attention in the literature. The Bangladeshi telecommunication sector presents a particularly compelling context for this investigation. It is one of the country's most rapidly evolving industries, marked by high competition, increasing service demands, and accelerated digital adoption. At the same time, organizations face infrastructural limitations, diverse employee capabilities, and gaps in digital readiness. These

contextual challenges underscore the importance of examining how webtop applications function not just as technical tools, but as socio-technical systems that interact with workforce dynamics. Understanding this interaction requires a framework like TTF that is both task-centric and context-sensitive.

While global studies have addressed web-based productivity tools in high-income contexts, their findings cannot be directly applied to emerging markets due to contextual differences in resource availability, training systems, and work practices (Chowdhury et al., 2023; Zhang et al., 2023). Our study addresses this gap by providing an empirically grounded analysis of how webtop application features contribute to EP in a developing economy. By integrating both technological features and organizational enablers (KS and TTA) within the TTF framework, we offer a comprehensive model for understanding digital transformation at the employee level. Therefore, the central objective of this study is to investigate the extent to which webtop application features (UIU, SI, RTDA, and CF) influence employee productivity in the telecommunication industry of Bangladesh. We examine this relationship through the mediating role of knowledge sharing and the moderating role of technology training availability, grounded in the extended Task-Technology Fit theory. By doing so, we contribute both theoretically, by expanding the applicability of TTF in emerging economies, and practically, by providing actionable insights for managers, HR professionals, and policymakers seeking to enhance workforce efficiency through the strategic implementation of digital tools and the design of effective training.

1.1. Operational definition

The operational definitions of key variables in this study specify how each construct is measured within the research context. Variables such as User Interface Usability, System Integration, Real-Time Data Access, Collaboration Features, Knowledge Sharing, Technology Training Availability, and Employee Productivity are defined based on validated scales tailored to the telecommunication sector.

User Interface Usability (UIU): The extent to which webtop applications are user-friendly, intuitive, and designed to facilitate ease of navigation and task performance for employees in the workplace.

System Integration (SI): The capability of webtop applications to seamlessly connect with other organizational systems, enabling efficient workflows, data synchronization, and unified operations across various functional areas.

Real-Time Data Access (RTDA): The ability of webtop applications to provide employees with immediate, accurate, and up-to-date information, supporting effective decision-making and timely task completion.

Collaboration Features (CF): Functionalities within webtop applications, such as messaging, shared workspaces, and project tracking tools, designed to promote teamwork, communication, and collaborative productivity among employees.

Employee Productivity (EP): The measurable efficiency and output of employees in achieving organizational goals, influenced by their ability to utilize webtop applications effectively in their daily tasks.

Knowledge Sharing (KS): The process by which employees exchange expertise, information, and best practices through webtop applications, fostering collaboration, learning, and innovation within the organization.

Technology Training Availability (TTA): The provision of accessible and structured training programs to help employees develop the skills required to use webtop applications and optimize their productivity effectively.

1.2. Underpinning theory: Task-Technology fit (TTF) theory

The TTF theory, introduced by Goodhue and Thompson (1995), posits that technology contributes to improved individual performance only when its functionalities align effectively with the tasks users are

required to perform. This alignment is particularly relevant in assessing the impact of webtop applications—digital tools specifically designed to enhance task execution, facilitate real-time decision-making, support seamless collaboration, and streamline workflows. Compared to models such as the Technology Acceptance Model (TAM) and the Unified Theory of Acceptance and Use of Technology (UTAUT), which emphasize user perceptions and adoption behaviors, TTF provides a performance-oriented lens. It moves beyond users' willingness to adopt a technology and instead focuses on whether that technology enables better task execution. This distinction is crucial in organizational contexts, such as the telecommunication industry of Bangladesh, where employees are often required to use workplace technologies as part of their job responsibilities rather than by choice. Drawing on the framework suggested by Hanafizadeh and Alipour (2025), which encourages theory borrowing in emerging technology contexts based on assumptions, reasoning mechanisms, and contextual adaptability, we argue that TTF is the most appropriate theoretical model for this study. Webtop applications, by their nature, are designed to align with work processes, making TTF especially suitable for understanding their impact on employee productivity. The theory's flexibility also allows for contextual enhancements, which is essential in developing economies where digital readiness and organizational dynamics differ from those in developed contexts. This study contributes to the theoretical development of TTF in two key ways. First, we introduce KS as a mediating variable, providing insight into how webtop application features (User Interface Usability, System Integration, Real-Time Data Access, and Collaboration Features) indirectly influence productivity through collaborative knowledge exchange. Second, we incorporate TTA as a moderating variable, recognizing that the degree to which employees are trained affects how well technology aligns with their task demands. These additions extend the explanatory scope of TTF by embedding both technological and human-centric enablers into the model. By employing TTF in this context, the study offers a comprehensive framework for evaluating webtop applications as productivity tools. It not only reaffirms the centrality of task-technology alignment but also introduces novel conceptual linkages relevant to emerging market environments and digitally transforming industries.

1.3. Literature review and hypotheses development

The Literature Review and Hypothesis Development section synthesizes existing research on webtop applications and employee productivity, highlighting gaps in understanding task-technology alignment. Guided by Task-Technology Fit theory, this section develops hypotheses linking key technological features, knowledge sharing, and training availability to productivity outcomes in the telecommunication industry context.

1.4. User interface usability (UIU) and employee productivity (EP)

UIU plays a crucial role in enhancing EP, particularly in technology-driven workplaces. Intuitive and user-friendly interfaces reduce the cognitive load on employees, enabling them to focus more on their tasks rather than navigating complex systems (Hassan et al., 2022). The TTF theory suggests that technology is more effective when its features align with the requirements of tasks (Goodhue & Thompson, 1995). UIU ensures that employees can seamlessly interact with webtop applications, thus improving efficiency and minimizing errors. Studies have shown that user-friendly interfaces promote employee engagement, streamline task completion, and improve overall performance (Chatterjee et al., 2023b). In the telecommunication sector, where quick decision-making and task execution are critical, UIU facilitates better alignment between tasks and technology, ultimately driving productivity improvements (Ahmed, Latif, & Rehman, 2023). Therefore, the following hypothesis is proposed:

H1. UIU has a positive impact on EP.

1.5. System integration (SI) and employee productivity (EP)

SI is a critical determinant of how effectively technology can enhance EP. Integration ensures that webtop applications operate seamlessly with other systems, enabling smooth data flow and reducing the need for repetitive tasks (Wang et al., 2023). According to the TTF theory, aligning technological features with work requirements is essential for achieving optimal performance outcomes (Goodhue & Thompson, 1995). SI fosters this alignment by streamlining workflows and minimizing operational silos, which are known barriers to efficiency. In industries like telecommunications, where operational complexity is high, integrated systems reduce delays, improve data accuracy, and enhance task coordination (Zhao et al., 2023). Research has also demonstrated that well-integrated technological platforms significantly improve task performance and decision-making capabilities (Ahmed, Qureshi, & Khan, 2023). Thus, the following hypothesis is proposed:

H2. SI has a positive impact on EP.

1.6. Real-time data access (RTDA) and employee productivity (EP)

RTDA has become increasingly significant in enhancing EP, particularly in industries requiring rapid decision-making and operational efficiency. Providing employees with immediate access to accurate, up-to-date information eliminates delays, reduces errors, and enhances task execution (Wang et al., 2023). The TTF theory, which emphasizes the alignment between task requirements and technological capabilities, supports this relationship. RTDA ensures that employees can make informed decisions quickly, aligning with the high-speed demands of telecommunication environments (Goodhue & Thompson, 1995). Recent studies indicate that real-time information not only improves operational workflows but also enhances employees' ability to anticipate and address challenges effectively (Chatterjee et al., 2023a). Additionally, tools that offer RTDA create a competitive advantage by promoting a responsive work environment, which further drives productivity (Ahmed, Khan, & Rehman, 2023). Thus, the hypothesis is proposed:

H3. RTDA has a positive impact on EP.

1.7. Collaboration features (CF) and employee productivity (EP)

CF in webtop applications are vital for fostering teamwork and improving EP in modern workplaces. Effective collaboration tools, such as shared workspaces and instant messaging platforms, enable employees to communicate seamlessly, coordinate tasks, and share ideas efficiently (Chen, Li, & Zhao, 2023; Hanafizadeh et al., 2023). TTF theory emphasizes that aligning technological capabilities with task demands significantly enhances performance outcomes (Goodhue & Thompson, 1995). CF promotes this alignment by bridging communication gaps and ensuring that team members can collaborate in real-time, regardless of their physical location. In dynamic industries like telecommunications, collaboration tools also enable faster problem-solving and decision-making, which are critical for maintaining operational agility (Zhao et al., 2023). Furthermore, these features facilitate knowledge exchange, which amplifies collective productivity (Ahmed, Khan, & Rehman, 2023). Therefore, the hypothesis is proposed:

H4. CF has a positive impact on EP.

1.8. Knowledge sharing (KS) as a mediator

UIU enhances knowledge-sharing behaviors by providing intuitive platforms for employees to exchange ideas efficiently. TTF theory supports this dynamic by emphasizing that a well-designed interface

reduces the effort required to share knowledge, thus fostering collaboration and improving task performance (Goodhue & Thompson, 1995). Employees equipped with easy-to-navigate tools are more likely to utilize them for exchanging information, ultimately improving employee productivity (Zhang et al., 2023). Moreover, in knowledge-driven industries such as telecommunications, intuitive interfaces directly contribute to enhancing the breadth and speed of organizational knowledge dissemination, thereby driving further productivity gains (Chen, Liu, & Zhao, 2023). Thus, the hypothesis is proposed:

H5. KS mediates the relationship between UIU and EP.

SI fosters seamless information flow, enabling employees to share knowledge more effectively. According to TTF theory, integrated systems facilitate task completion by ensuring that employees have access to interconnected resources that promote collaboration and learning (Goodhue & Thompson, 1995). Empirical studies reveal that integrated systems significantly improve the quality and speed of knowledge sharing, which, in turn, enhances employee productivity (Lee & Chen, 2023). In the telecommunications industry, SI minimizes silos, creating opportunities for employees to collaborate across departments and address challenges efficiently (Ahmed, Khan, & Rehman, 2023). Therefore, the following hypothesis is proposed:

H6. KS mediates the relationship between SI and EP.

RTDA facilitates rapid knowledge exchange, enhancing productivity through better decision-making and collaboration. Aligned with TTF theory, RTDA provides employees with immediate access to critical insights, enabling them to share relevant information effectively (Goodhue & Thompson, 1995). Studies indicate that real-time data systems amplify knowledge flow within teams, creating a collaborative environment that enhances task performance (Hanafizadeh et al., 2022; Wang et al., 2023). In high-demand industries like telecommunications, where responsiveness is crucial, RTDA facilitates faster knowledge sharing, leading to improved outcomes (Chen, Liu, & Zhao, 2023). Thus, the hypothesis is proposed:

H7. KS mediates the relationship between RTDA and EP.

CF in webtop applications directly enhance knowledge-sharing behaviors by providing tools such as shared workspaces and communication channels. TTF theory supports this relationship, emphasizing that collaboration tools must align with task requirements to facilitate effective information exchange and teamwork (Goodhue & Thompson, 1995). Evidence suggests that collaborative tools significantly enhance the breadth and depth of knowledge-sharing activities, resulting in a positive impact on employee productivity (Liu et al., 2023). In the telecommunications industry, where teamwork is essential, collaboration features play a critical role in enabling employees to address challenges and innovate collectively (Ahmed, Khan, & Rehman, 2023). Therefore, the hypothesis is proposed:

H8. KS mediates the relationship between CF and EP.

1.9. Technology training availability as a moderator

UIU significantly impacts EP, but its effectiveness is amplified when employees are provided with adequate technology training. Training programs enhance employees' understanding and navigation of user-friendly interfaces, ensuring they can fully leverage the tool's capabilities (Hassan et al., 2023). TTF theory suggests that alignment between task requirements and technology features is optimized when users are well-trained to utilize the technology effectively (Goodhue & Thompson, 1995). Empirical studies have highlighted that technology training reduces resistance to adoption and improves employee efficiency, particularly in fast-paced industries such as telecommunications (Chowdhury et al., 2023). Thus, the hypothesis is proposed:

H9. Technology Training Availability (TTA) moderates the

relationship between UIU and EP.

SI enhances productivity by streamlining workflows and facilitating efficient data flow, but its effectiveness depends on employees' familiarity with integrated systems. Technology Training Availability (TTA) ensures that employees can utilize the integrated systems optimally, reducing errors and maximizing productivity (Ahmed, Khan, & Rehman, 2023; Hanafizadeh et al., 2023). TTF theory suggests that the fit between systems and tasks is contingent on user expertise, which training fosters (Goodhue & Thompson, 1995). Research has shown that training programs tailored to integrated systems lead to improved alignment of technology with operational needs, particularly in industries that manage complex systems, such as telecommunications (Zhang et al., 2023). Thus, the hypothesis is proposed:

H10. Technology Training Availability (TTA) moderates the relationship between SI and EP.

RTDA is a critical driver of productivity, but its full potential is realized when employees are adequately trained to interpret and utilize real-time insights. Technology training enhances data literacy, enabling employees to make timely and informed decisions (Lee, Park, & Kim, 2023). TTF theory emphasizes that the effective use of real-time data tools depends on users' ability to align them with task requirements (Goodhue & Thompson, 1995). Evidence suggests that employees with proper training in data systems exhibit significantly higher efficiency, particularly in decision-driven industries such as telecommunications (Chatterjee et al., 2023a). Thus, the hypothesis is proposed:

H11. Technology Training Availability (TTA) moderates the relationship between RTDA and EP.

CF enable team interactions and knowledge sharing, but their impact on productivity increases when employees receive training on using collaborative tools effectively. Training ensures employees understand and adopt the full spectrum of collaborative functionalities, promoting efficient teamwork (Chen, Wang, & Lin, 2023). TTF theory asserts that the alignment between collaboration tools and task needs is enhanced through user competency, which training supports (Goodhue & Thompson, 1995). Studies indicate that trained employees are better equipped to utilize collaborative platforms, resulting in higher productivity in team-oriented industries such as telecommunications (Wang et al., 2023). Thus, the hypothesis is proposed:

H12. Technology Training Availability (TTA) moderates the relationship between CF and EP.

1.10. Proposed research framework

The proposed research framework (Fig. 1) illustrates the relationships between webtop application features—UIU, SI, RTDA, and CF—and EP, with KS mediating their effectiveness in enhancing productivity. Additionally, TTA moderates these relationships, strengthening the impact of these features in organizations with robust training programs. Grounded in the TTF theory, the framework emphasizes how the alignment of technology features with task requirements, supported by effective knowledge exchange and employee training, enables optimal productivity outcomes. This model highlights the critical role of tailored digital tools and competency development in driving performance improvements in the telecommunication industry.

2. Methodology

2.1. Instrument development and pilot study

Since no pre-existing survey instrument adequately captured the variables of interest for this study, we developed measurement items specifically tailored to our research objectives. A systematic, rigorous process ensured the validity, reliability, and contextual suitability of the

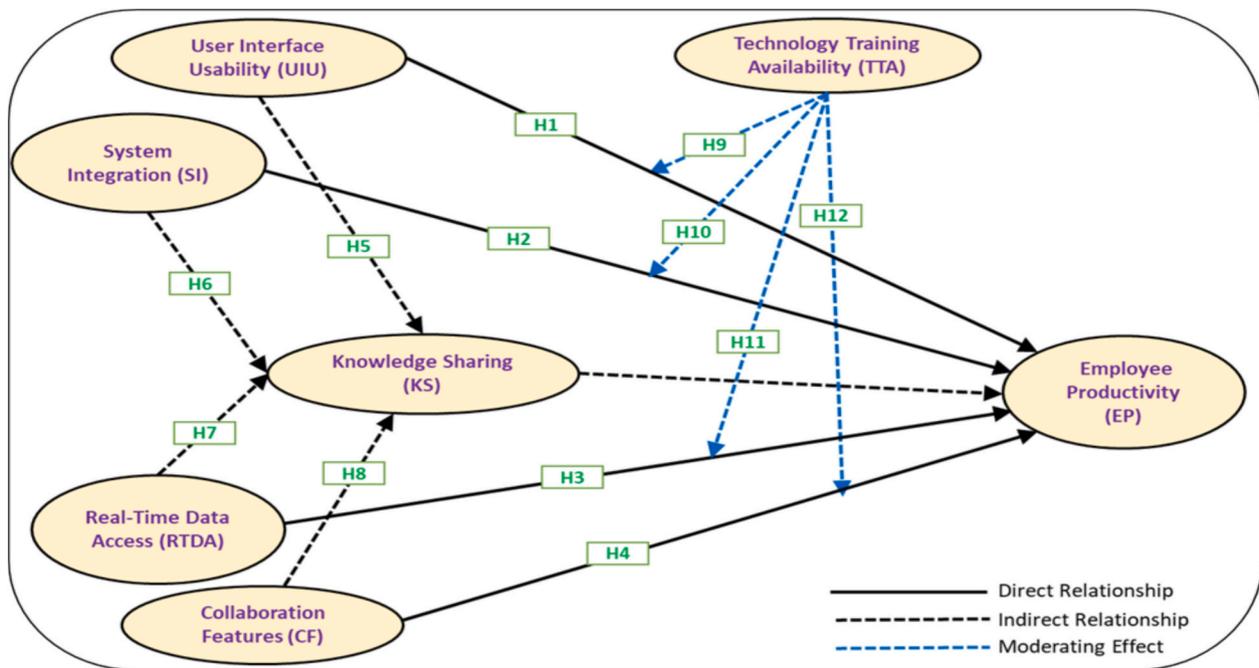


Fig. 1. Proposed conceptual framework.

instrument. Five items were crafted for each construct, covering all relevant dimensions comprehensively. The development process involved brainstorming and in-depth consultations with subject-matter experts, including technology experts, human resource professionals, organizational behavior and management experts, academics and researchers, and telecommunication industry specialists. Feedback from these experts refined the items for clarity, relevance, and alignment with the constructs. Language specialists reviewed the questionnaire to eliminate ambiguities and double-barreled questions, while three academic researchers in Data Analysis and Systems Specialists validated the theoretical alignment of the constructs. A 5-point Likert scale ensured consistency in responses. The questionnaire underwent iterative refinement based on feedback from telecom employees for clarity and applicability. A pilot study with 110 respondents confirmed internal consistency, with Cronbach’s Alpha values well above the acceptable threshold of 0.7: UIU = 0.922, SI = 0.887, RTDA = 0.866, CF = 0.921, KS = 0.946, TTA = 0.919, and EP = 0.971. Exploratory Factor Analysis (EFA) using SPSS v26 further validated the instrument, yielding a Kaiser-Meyer-Olkin (KMO) value of 0.762 and a significant Bartlett’s Test ($p < 0.000$). Communalities exceeded 0.4 and seven factors with eigenvalues >1 explained 80.239 % of the cumulative variance. The Rotated Component Matrix revealed no cross-loadings, confirming the constructs’ distinctiveness. The final questionnaire and rotated component matrix are provided in the supplementary file. These results affirm that the instrument is valid, reliable, and robust, making it suitable for use in the main study.

2.2. Sampling and data collection

The target population for this study comprised employees working in telecommunication companies across Bangladesh who actively use webtop applications in their daily work tasks. These individuals represented key functional areas such as IT, customer service, sales and marketing, and operations—domains where digital tools are embedded in routine processes. The broader population was estimated at approximately 50,000 employees across major telecom operators in the country.

A two-stage sampling strategy was adopted. In the first stage, purposive sampling was used to select the top three mobile network

operators—Grameenphone Ltd., Robi Axiata Ltd., and Banglalink Digital Communications Ltd. These firms were chosen due to their overwhelming market share, extensive digital infrastructure, and early adoption of enterprise-level cloud solutions (Ashrafuzzaman, 2024). Collectively, they account for over 95 % of Bangladesh’s mobile subscriber base (186.5 million, according to Association of Mobile Telecom Operators of Bangladesh (AMTOB), 2025), positioning them as representative anchors of the national telecommunications landscape. Grameenphone, for instance, has detailed in its 2022 ESG Report its strategic implementation of webtop platforms to streamline workflows (Grameenphone Ltd, 2022). Robi Axiata and Banglalink have similarly published digital transformation strategies that prioritize productivity through integrated application ecosystems.

To further support their selection as representative cases, these firms are recognized as South Asian digital frontrunners by the GSMA Intelligence (2022) and United Nations ESCAP (2023a). These global indices affirm that the digital maturity of these firms mirrors the transformation trajectories of telecom giants in other emerging economies such as India, Vietnam, and Nigeria. Thus, findings from these companies provide analytically transferable insights into webtop application use and productivity in similar market environments. Their geographic spread, employee diversity, and cross-departmental digital tool adoption enhance the study’s capacity to explore task-technology alignment in complex, digitally progressive settings typical of emerging economies.

In the second stage, convenience sampling was used to recruit employees from relevant departments within the selected companies. Recruitment targeted employees with hands-on experience using webtop applications. Survey invitations were distributed through internal communication channels, including corporate emails and intranet postings, after formal organizational approvals were secured. To increase response rates, periodic reminders were issued.

Data collection occurred over a two-month window (August–September 2024) under strict adherence to ethical research guidelines and confidentiality protocols. Of the 456 responses initially collected, 439 were deemed complete and valid after screening for consistency and completeness. The final sample size meets the criteria recommended by Krejcie & Morgan (1970) for a population of this scale and ensures statistical robustness for subsequent analysis. The resulting dataset offers a strong empirical base for examining the influence of webtop

application features, knowledge sharing, and training availability on employee productivity within the digital transformation landscape of Bangladesh’s telecom industry.

2.3. Demographic profile of the respondents

The demographic profile of the respondents in this study is diverse and provides a comprehensive view of their characteristics. Regarding age, the largest group was those below 25 years, comprising 160 respondents (36.45 %), followed by 105 (23.92 %) aged 45–54 years, 95 (21.64 %) aged 35–44 years, 46 (10.48 %) aged 25–34 years, and 33 (7.52 %) aged 55 years and above. In terms of gender, 229 respondents (52.16 %) were female, 200 (45.56 %) were male, and 10 (2.28 %) preferred not to disclose their gender. Educational qualifications varied, with 179 respondents (40.77 %) holding a high school diploma, 95 (21.64 %) possessing a master’s degree, 95 (21.64 %) categorized as “others,” and 70 (15.95 %) having a bachelor’s degree. For job designation, 187 (42.60 %) were entry-level employees, 166 (37.81 %) were managers or team leaders, 76 (17.31 %) were mid-level employees, and 10 (2.28 %) were categorized as “others.” Work experience showed that 168 (38.27 %) had less than 1 year of experience, followed by 91 (20.73 %) with 7–10 years, 86 (19.59 %) with 4–6 years, 60 (13.67 %) with 1–3 years, and 34 (7.74 %) with more than 10 years. Department-wise, 133 respondents (30.30 %) were in customer support, 103 (23.46 %) in human resources, 94 (21.41 %) in IT and operations, 60 (13.67 %) in sales and marketing, and 49 (11.16 %) in other roles. Frequency of webtop application use showed that 134 (30.52 %) used it daily, 95 (21.64 %) weekly, 95 (21.64 %) monthly, 65 (14.81 %) several times a week, and 50 (11.39 %) rarely. Lastly, location data indicated that 217 (49.40 %) were from suburban areas, 184 (41.90 %) from urban areas, and 38 (8.70 %) from rural areas. This demographic distribution provides valuable insights into the respondents’ backgrounds and work contexts.

2.4. Common method bias (CMB)

To evaluate the potential presence of common method bias (CMB) in our study, we analyzed both the Heterotrait-Monotrait (HTMT) ratio and the inner variance inflation factor (VIF) values. Consistent with the guidelines provided by Nitzl (2016), correlations exceeding $r > 0.90$ among constructs were considered indicative of possible CMB issues. Our analysis showed that all construct correlations were well below this threshold, with the highest HTMT value recorded at 0.719, confirming the absence of significant CMB concerns. Additionally, we assessed the inner VIF values, as VIFs exceeding 3.30 may indicate potential CMB, following the recommendations of Kock (2015) and Adedeji, Akinlabi, Madushele, & Olatunji (2020). Our structural model analysis revealed that the highest observed VIF was 2.524, comfortably below the recommended threshold of 3.30. These findings provide robust evidence that CMB is not a concern in our dataset, thereby ensuring the validity and reliability of our research conclusions.

Table 1
Means, SD, and Correlations of the study variables.

Constructs	UIU	SI	RTDA	CF	KS	TTA	EP	Mean	SD
UIU	1							3.579	0.828
SI	0.477**	1						3.520	0.665
RTDA	0.354**	0.356**	1					3.647	0.751
CF	0.556**	0.583**	0.368**	1				3.578	0.718
KS	0.488**	0.544**	0.428**	0.553**	1			3.752	0.769
TTA	0.485**	0.409**	0.287**	0.456**	0.252**	1		3.498	0.675
EP	0.574**	0.685**	0.626**	0.643**	0.684**	0.394**	1	3.582	0.819

Note: $n = 384$, * $p < 0.05$, ** $p < 0.01$ (2-tailed).

2.5. Means, SD, and Correlations of the study variables

Table 1 provides an overview of the descriptive statistics and inter-relationships among the study constructs, including User Interface Usability (UIU), System Integration (SI), Real-Time Data Access (RTDA), Collaboration Features (CF), Knowledge Sharing (KS), Technology Training Availability (TTA), and Employee Productivity (EP). The results reveal statistically significant correlations between all variables at the $p < 0.01$ level, highlighting their interconnectedness within the framework of the study. Among the constructs, KS reported the highest mean value of 3.752, reflecting its strong perceived importance among respondents, while SI recorded the lowest mean at 3.520, indicating relatively lower perceptions of integration across systems. These findings shed light on participants’ evaluations of each construct and underscore the varying levels of emphasis placed on them in the context of the Bangladeshi telecommunication industry.

Notably, the strongest correlations were observed between EP and KS ($r = 0.684$), and EP and SI ($r = 0.685$), suggesting that knowledge sharing and system integration are particularly influential in shaping productivity outcomes. EP also showed high correlation with CF ($r = 0.643$), reinforcing the centrality of collaborative digital tools in modern work environments. These significant and theoretically aligned relationships offer preliminary support for the hypothesized direct effects (H1–H4) and justify the subsequent use of structural equation modeling (SEM) to further test the proposed model.

2.6. Data analysis by PLS-SEM using Smart-PLS 4.0

The study employed Partial Least Squares Structural Equation Modeling (PLS-SEM) using Smart-PLS 4.0, a well-established technique for analyzing complex models involving multiple constructs and indicators. PLS-SEM was selected over covariance-based SEM (CB-SEM) due to the complexity of the proposed model, which includes latent variables, mediating and moderating effects, and numerous path relationships. This approach also provides greater flexibility in handling both predictive and theory-developing research objectives (Hair, Howard, & Nitzl, 2020; Hair, Hult, Ringle, & Sarstedt, 2021; Kock, 2015). Although the data in this study exhibited normal distribution, PLS-SEM was deemed more appropriate than CB-SEM because of its superior capacity to manage non-normality, smaller sample sizes, and formative or reflective constructs—characteristics often encountered in behavioral and social science research. Prior to structural analysis, preliminary data screening and common method bias checks were conducted using SPSS version 26.0, ensuring the validity and reliability of the dataset. This included assessments of normality, linearity, and multicollinearity. Subsequently, the hypothesis testing and structural model evaluation were performed using Smart-PLS 4.0, allowing for an in-depth investigation of direct, indirect, and interaction effects among the study variables. The use of PLS-SEM thus enabled a robust analysis of the theoretical framework, offering meaningful insights into the relationships between webtop application features, knowledge sharing, training availability, and employee productivity in the context of Bangladesh’s telecommunication sector.

2.7. Measurement model (outer model) evaluation

To ensure a rigorous assessment of internal consistency and reliability, we employed Cronbach’s Alpha (CA) and Composite Reliability (CR), following the recommendations of Hair et al. (2020). As depicted in Fig. 2 and Table 2, the CA and CR values for all constructs exceeded the established threshold of 0.70, confirming strong internal consistency and reliability across variables. For convergent validity, we adhered to the criteria proposed by Hulland (1999) and Hair et al. (2021), requiring factor loadings (FL) above 0.40 and average variance extracted (AVE) values exceeding 0.50. The results presented in Table 2 demonstrate excellent performance, with all FL values surpassing 0.70 and AVE values well above the minimum benchmark of 0.50. These results provide robust evidence of convergent validity. Overall, the findings affirm that the measurement model adheres to established guidelines for internal consistency, reliability, and convergent validity, ensuring the robustness of the constructs and measurement items.

To evaluate the discriminant validity of our measurements, we utilized two widely recognized methods: the Fornell-Larcker criterion (Fornell and Larcker, 1981) and the heterotrait-monotrait (HTMT) ratio. Specifically, the HTMT ratio was employed to assess the degree of correlation between constructs compared to the correlations within items of the same construct. Following the guidelines established by Henseler et al. (2015), an HTMT value below 0.90 indicates acceptable discriminant validity. Our analysis, as shown in Table 3, revealed that all HTMT values among the latent variables were well below the 0.90 threshold, providing strong support for the distinctiveness of the constructs in our model. These results confirm that the constructs are adequately differentiated from one another, ensuring robust discriminant validity and supporting the overall validity of the measurement model.

2.8. Assessment of the structural (inner) model

After thoroughly evaluating the measurement model, we proceeded to assess the structural (inner) model to ensure its predictive validity and absence of multicollinearity. Three key indicators were examined:

coefficient of determination (R^2), effect size (f^2), and inner Variance Inflation Factor (VIF). The R^2 values indicate the amount of variance explained by the model for each endogenous construct. As shown in the model output, the R^2 value for Employee Productivity (EP) is 0.774, and for Knowledge Sharing (KS), it is 0.437. According to Cohen’s (1989) guidelines, R^2 values of 0.26, 0.13, and 0.02 are considered substantial, moderate, and weak, respectively. Thus, our model demonstrates strong explanatory power, particularly for EP. The effect size (f^2) values were also assessed to determine the practical contribution of each exogenous variable to the endogenous constructs. RTDA exhibited the strongest effect on EP with an f^2 of 0.440, indicating a substantial impact. SI ($f^2 = 0.152$) had a moderate effect, while CF ($f^2 = 0.085$) and UIU ($f^2 = 0.019$) demonstrated weak to modest contributions. For the mediating relationships involving KS, effect sizes ranged from 0.031 to 0.070, indicating small but meaningful mediation effects. These findings offer insight into which digital features contribute most significantly to productivity and underscore the importance of RTDA in the task-technology alignment process. In terms of collinearity, all inner VIF values were well below the commonly accepted threshold of 5.0 (Hair Jr et al., 2017). Specifically, VIF values ranged from 1.231 to 2.524, confirming that multicollinearity is not a concern within the model. This supports the structural integrity of the model and ensures that the estimated path coefficients are reliable and unbiased. Collectively, these results confirm that the structural model meets all key criteria for validity and robustness. With acceptable levels of explained variance, effect sizes, and collinearity diagnostics, the model is well-positioned to yield trustworthy insights, which are elaborated in the hypothesis testing results that follow.

2.9. Hypotheses testing results

Table 4 and Fig. 3 present the results of 12 hypotheses tested using bootstrapping with 10,000 resampling iterations. Each hypothesis examines the relationships between different variables within the model. The Beta (β) values indicate the strength and direction of the relationships, while the t-values and p-values determine their statistical

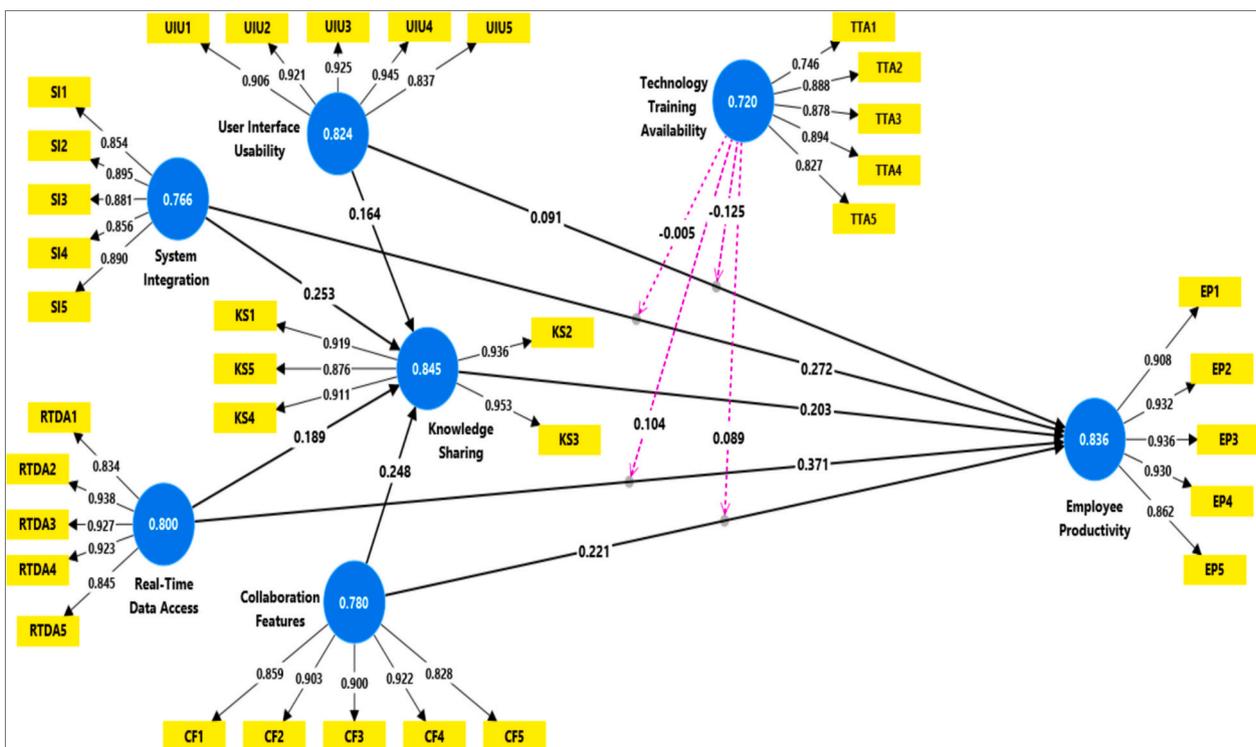


Fig. 2. Measurement model with outer loadings, and AVE values from PLS-Algorithm.

Table 2
Constructs validity and reliability.

Constructs	Items	F.L	CA	CR	AVE
User Interface Usability (UIU)	UIU1: The interface of the webtop application is intuitive and easy to navigate.	0.906			
	UIU2: I can complete my tasks quickly using the webtop application's user interface.	0.921			
	UIU3: The design of the webtop application helps me focus on my tasks.	0.925	0.946	0.947	0.824
	UIU4: I rarely encounter issues or errors when using the webtop application's interface.	0.945			
	UIU5: The webtop application provides helpful instructions and feedback when I use it.	0.837			
System Integration (SI)	SI1: The webtop application integrates seamlessly with other systems I use at work.	0.854			
	SI2: I can easily transfer data between the webtop application and other tools.	0.895			
	SI3: The integration of the webtop application reduces my need for manual data entry.	0.881	0.924	0.924	0.766
	SI4: The compatibility of the webtop application with other systems saves me time.	0.856			
	SI5: I experience fewer workflow disruptions due to the webtop application's integration capabilities.	0.890			
Real-Time Data Access (RTDA)	RTDA1: I have immediate access to up-to-date information through the webtop application.	0.834			
	RTDA2: The webtop application provides accurate data whenever I need it.	0.938			
	RTDA3: Real-time updates on the webtop application help me make timely decisions.	0.927	0.937	0.940	0.800
	RTDA4: The webtop application minimizes delays in accessing critical information.	0.923			
	RTDA5: I can rely on the webtop application for real-time monitoring of my tasks.	0.845			
Collaboration Features (CF)	CF1: The webtop application allows me to communicate effectively with my colleagues.	0.859			
	CF2: I can easily share files and resources using the webtop application.	0.903	0.929	0.931	0.780
	CF3: The webtop application enhances teamwork by providing collaborative tools.	0.900			

Table 2 (continued)

Constructs	Items	F.L	CA	CR	AVE
Knowledge Sharing (KS)	CF4: I feel more connected to my team through the webtop application's features.	0.922			
	CF5: The collaboration tools in the webtop application make project management more efficient.	0.828			
	KS1: The webtop application helps me share knowledge and expertise with colleagues.	0.919			
	KS2: I frequently use the webtop application to exchange ideas with my team.	0.936			
	KS3: The webtop application encourages me to document and share useful information.	0.953	0.954	0.956	0.845
Technology Training Availability (TTA)	KS4: My colleagues and I use the webtop application to discuss and solve problems.	0.911			
	KS5: The webtop application facilitates knowledge sharing across different departments.	0.876			
	TTA1: My organization provides sufficient training on how to use the webtop application.	0.746			
	TTA2: The training sessions have improved my confidence in using the webtop application.	0.888			
	TTA3: I feel adequately supported by my organization in learning about new features.	0.878	0.902	0.903	0.720
Employee Productivity (EP)	TTA4: The training materials provided for the webtop application are comprehensive.	0.894			
	TTA5: Regular training sessions keep me updated on the webtop application's functionalities.	0.827			
	EP1: The webtop application helps me complete tasks more efficiently.	0.908			
	EP2: I feel more productive since using the webtop application.	0.932			
	EP3: The webtop application reduces the time required to perform routine tasks.	0.936	0.951	0.951	0.836
	EP4: My overall work performance has improved due to the webtop application.	0.930			
	EP5: I can handle a higher workload effectively using the webtop application.	0.862			

Notes: CR: Composite Reliability; AVE: Average Variance Extracted; CA: Cronbach's Alpha.

Table 3
Discriminant validity- HTMT.

Constructs	CF	EP	KS	RTDA	SI	TTA
CF						
EP	0.684					
KS	0.588	0.719				
RTDA	0.395	0.663	0.452			
SI	0.629	0.730	0.579	0.381		
TTA	0.497	0.424	0.271	0.312	0.448	
UIU	0.592	0.605	0.513	0.377	0.510	0.524

significance. For mediating hypotheses, the lower limit (LL) and upper limit (UL) of the confidence intervals are reported to validate the mediation effects. Additionally, the effect size (f^2) of each significant relationship is reported to assess the practical significance of the results, based on **Cohen's (1989)** criteria—0.02 = weak, 0.15 = medium, and 0.35 = substantial.

Hypothesis 1. (H1), which explores the relationship between User Interface Usability (UIU) and Employee Productivity (EP), is supported with a positive $\beta = 0.091$, $t = 2.418$, and $p = 0.016$. The effect size ($f^2 = 0.019$) indicates a weak practical impact, suggesting that while UIU positively affects productivity, its contribution is modest in magnitude. **Hypothesis 2 (H2)**, testing the relationship between System Integration (SI) and EP, is supported ($\beta = 0.272$, $t = 5.359$, $p = 0.000$) and yields an effect size of $f^2 = 0.152$, indicating a medium practical effect. This

implies that integrated systems make a more meaningful contribution to productivity. **Hypothesis 3 (H3)**, which evaluates Real-Time Data Access (RTDA) and EP, shows a strong and significant relationship ($\beta = 0.371$, $t = 4.468$, $p = 0.000$), with an effect size of $f^2 = 0.440$, which qualifies as substantial. This suggests that RTDA is the most influential predictor of employee productivity among the study variables. **Hypothesis 4 (H4)**, which assesses the impact of Collaboration Features (CF) on EP, is supported ($\beta = 0.221$, $t = 3.293$, $p = 0.001$), and the effect size ($f^2 = 0.085$) indicates a weak to moderate practical effect.

For the mediating hypotheses involving Knowledge Sharing (KS), **Hypothesis 5 (UIU → KS → EP)** is supported ($\beta = 0.033$, $t = 2.453$, $p = 0.047$, $CI = 0.004-0.102$), with a weak effect size ($f^2 = 0.031$), suggesting partial mediation with minor practical impact. **Hypothesis 6 (SI → KS → EP)** is also supported ($\beta = 0.051$, $t = 2.779$, $p = 0.036$, $CI = 0.015-0.139$), with $f^2 = 0.070$, reflecting a weak to moderate effect. **Hypothesis 7 (RTDA → KS → EP)** is supported ($\beta = 0.038$, $t = 2.480$, $p = 0.045$, $CI = 0.003-0.123$) with a weak effect ($f^2 = 0.051$), while **Hypothesis 8 (CF → KS → EP)** is also supported ($\beta = 0.050$, $t = 2.494$, $p = 0.041$, $CI = 0.008-0.159$), and effect size ($f^2 = 0.060$) suggests a small but notable contribution. All mediating effects are partial, as the direct effects remain significant.

Regarding the moderation hypotheses, **Hypothesis 9 (TTA × UIU → EP)** is significantly negative ($\beta = -0.125$, $t = 2.943$, $p = 0.003$), indicating that higher levels of training may reduce the positive impact of UIU, likely due to overtraining or cognitive overload with already

Table 4
Hypotheses testing result.

Hypotheses	OS/Beta	SD	95 % B. Corrected C. Interval		T	P	Decision	Mediation
			LL	UL				
H1: UIU -> EP	0.091	0.037	0.016	0.163	2.418	0.016	Supported	
H2: SI -> EP	0.272	0.051	0.176	0.373	5.359	0.000	Supported	
H3: RTDA -> EP	0.371	0.083	0.198	0.506	4.468	0.000	Supported	
H4: CF -> EP	0.221	0.067	0.086	0.346	3.293	0.001	Supported	
H5: UIU -> KS -> EP	0.033	0.023	0.004	0.102	2.453	0.047	Supported	Partial
H6: SI -> KS -> EP	0.051	0.029	0.015	0.139	2.779	0.036	Supported	Partial
H7: RTDA -> KS -> EP	0.038	0.030	0.003	0.123	2.480	0.045	Supported	Partial
H8: CF -> KS -> EP	0.050	0.034	0.008	0.159	2.494	0.041	Supported	Partial
H9: TTA x UIU -> EP	-0.125	0.043	-0.201	-0.036	2.943	0.003	Supported	
H10: TTA x SI -> EP	-0.005	0.034	-0.065	0.067	0.140	0.889	Not Supported	
H11: TTA x RTDA -> EP	0.104	0.039	0.025	0.179	2.653	0.008	Supported	
H12: TTA x CF -> EP	0.089	0.043	0.014	0.190	2.091	0.037	Supported	

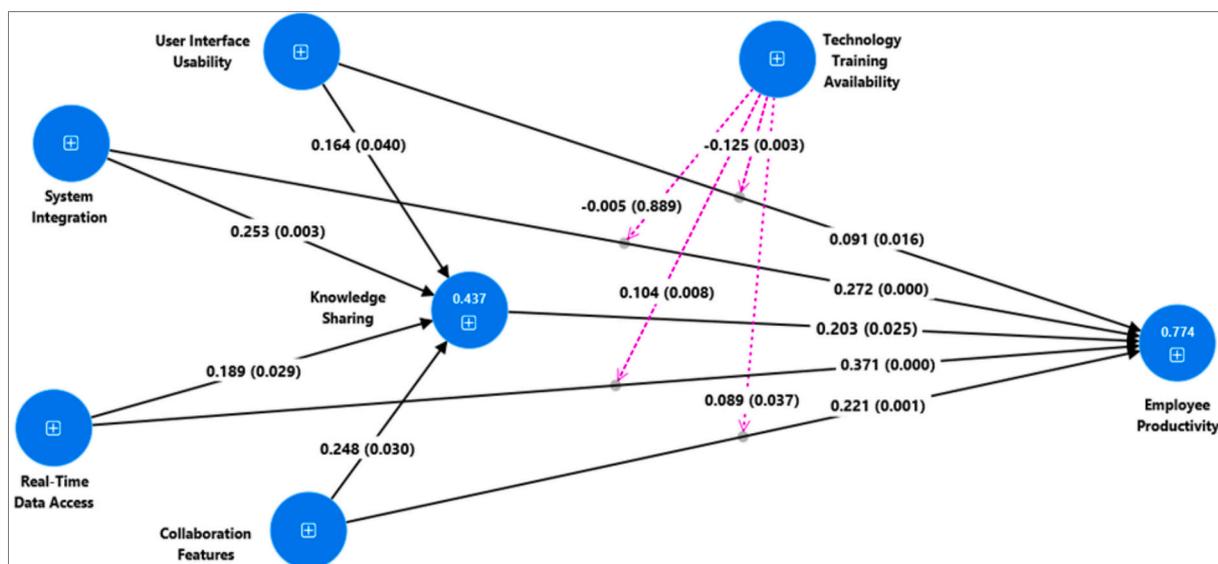


Fig. 3. Structural model with path coefficient (beta) and p-values from bootstrapping test.

intuitive systems. Hypothesis 10 ($TTA \times SI \rightarrow EP$) is not supported ($\beta = -0.005, t = 0.140, p = 0.889$), suggesting training availability does not influence the effect of system integration on productivity—possibly due to integration’s inherent ease of use. Hypothesis 11 ($TTA \times RTDA \rightarrow EP$) is supported ($\beta = 0.104, t = 2.653, p = 0.008$), revealing that training enhances the effect of RTDA on productivity. Hypothesis 12 ($TTA \times CF \rightarrow EP$) is also supported ($\beta = 0.089, t = 2.091, p = 0.037$), indicating that training improves the productivity impact of collaborative features.

These findings not only confirm the statistical significance of the hypothesized relationships but also provide deeper insights into their practical significance, as reflected in the varying effect sizes. RTDA emerges as the most influential variable in both statistical and practical terms, emphasizing the importance of real-time access capabilities in modern digital work environments.

Fig. 4 presents a graph illustrating the moderating effect of TTA on the relationship between UIU and EP. The graph shows that higher levels of TTA amplify the positive impact of UIU on EP, indicating a stronger association. In contrast, lower levels of TTA diminish this relationship, resulting in a weaker effect. To further explore this interaction, separate path analyses were conducted for high TTA levels (1 standard deviation above the mean) and low TTA levels (1 standard deviation below the mean). These analyses provide a nuanced understanding of how the relationship between UIU and EP varies under different TTA conditions, offering deeper insights into the dynamics of this moderation.

Fig. 5 illustrates the moderating effect of TTA on the relationship between RTDA and EP. The graph reveals that higher levels of TTA strengthen the positive impact of RTDA on EP, highlighting a more pronounced association. In contrast, lower levels of TTA reduce this impact, resulting in a weaker relationship. To further investigate this interaction, separate path analyses were performed for high TTA levels (1 standard deviation above the mean) and low TTA levels (1 standard deviation below the mean). These analyses provide a detailed understanding of how the RTDA-EP relationship varies across different TTA conditions, offering deeper insights into the dynamics of this moderation.

Fig. 6 illustrates the moderating effect of TTA on the relationship between CF and EP. The graph demonstrates that higher levels of TTA amplify the positive impact of CF on EP, indicating a stronger and more significant association. Conversely, lower levels of TTA reduce the strength of this relationship, resulting in a less pronounced effect. To further analyze this interaction, separate path analyses were conducted for high TTA levels (1 standard deviation above the mean) and low TTA levels (1 standard deviation below the mean). These analyses provide a

more detailed understanding of how the CF-EP relationship varies across different TTA conditions, offering comprehensive insights into the dynamics of this moderation.

3. Discussion

The results of H1 reveal that UIU has a significant positive effect on EP in the telecommunication industry of Bangladesh. This finding aligns with prior studies indicating that intuitive and user-friendly interfaces reduce cognitive load, enabling employees to perform tasks efficiently and effectively (Hassan et al., 2023). In the context of webtop applications, UIU facilitates smoother navigation and accessibility, which is critical in a high-paced sector like telecommunications, where real-time operations are pivotal. The TTF theory supports this result, emphasizing that the alignment of technology features, such as usability, with task requirements enhances task performance and overall productivity (Goodhue & Thompson, 1995). Moreover, UIU encourages user engagement and reduces resistance to technology adoption, which is particularly relevant in Bangladesh, where digital literacy levels vary widely (Chowdhury et al., 2023). Thus, our findings underline the importance of UIU in optimizing workplace productivity in modern, technology-driven industries. The findings for H2 demonstrate that SI has a significant positive effect on EP in the telecommunication industry of Bangladesh. This result aligns with previous studies that emphasize the importance of integrated systems in streamlining workflows, enhancing information flow, and reducing task redundancy (Ahmed, Khan, & Rehman, 2023). In the context of webtop applications, SI ensures seamless connectivity between tools and processes, enabling employees to manage complex tasks more efficiently, which is critical for the telecommunication sector’s dynamic environment. TTF theory provides a strong justification, suggesting that technology aligned with task requirements facilitates optimal performance (Goodhue & Thompson, 1995). Moreover, integrated systems reduce operational silos and enhance collaboration across teams, which is particularly vital in Bangladesh’s evolving telecommunication industry, where operational efficiency directly impacts service delivery and competitiveness (Zhao et al., 2023). These findings underscore the essential role of SI in enhancing productivity in technology-intensive workplaces.

The findings for H3 reveal that RTDA has a significant positive effect on EP in the telecommunication industry of Bangladesh. This result corroborates prior research emphasizing the importance of immediate access to accurate information in improving decision-making and task efficiency (Chen, Li, & Zhao, 2023). In the context of webtop

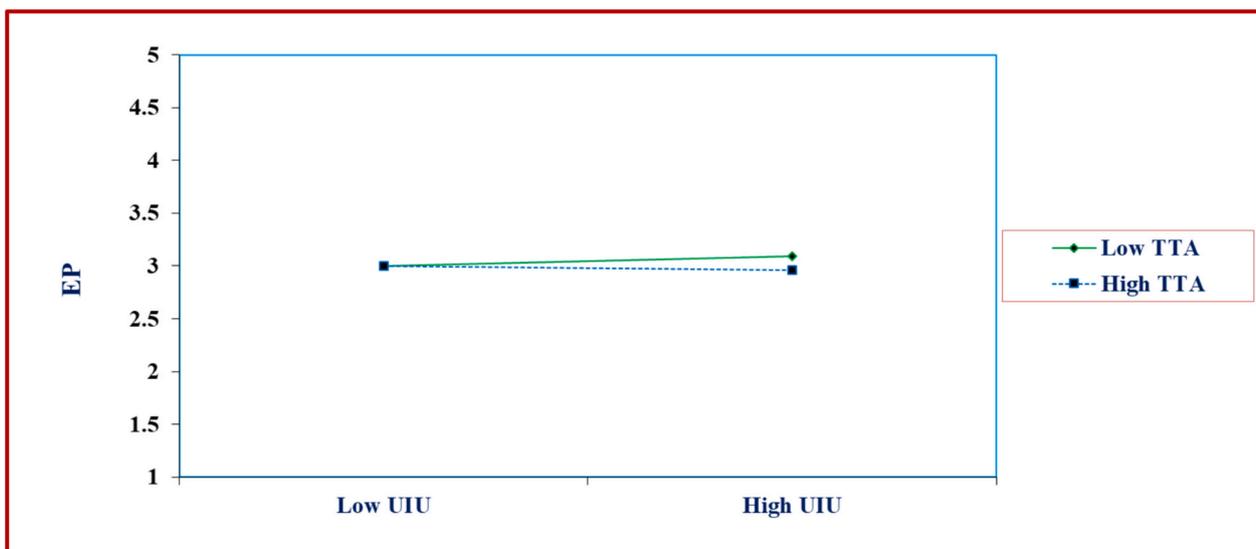


Fig. 4. Interactive effect of TTA in between UIU and EP.

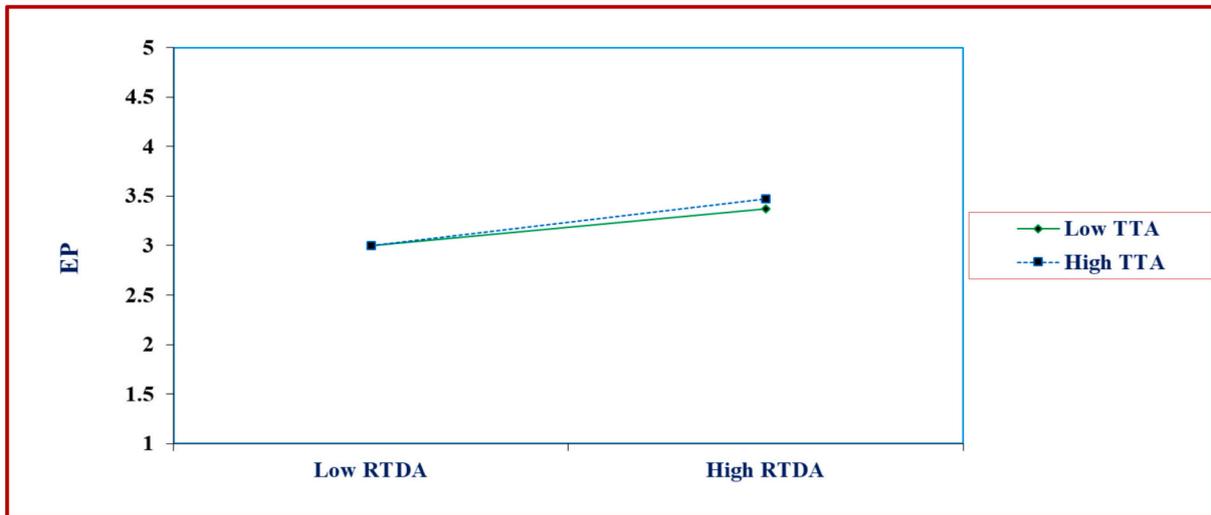


Fig. 5. Interactive effect of TTA in between RTDA and EP.

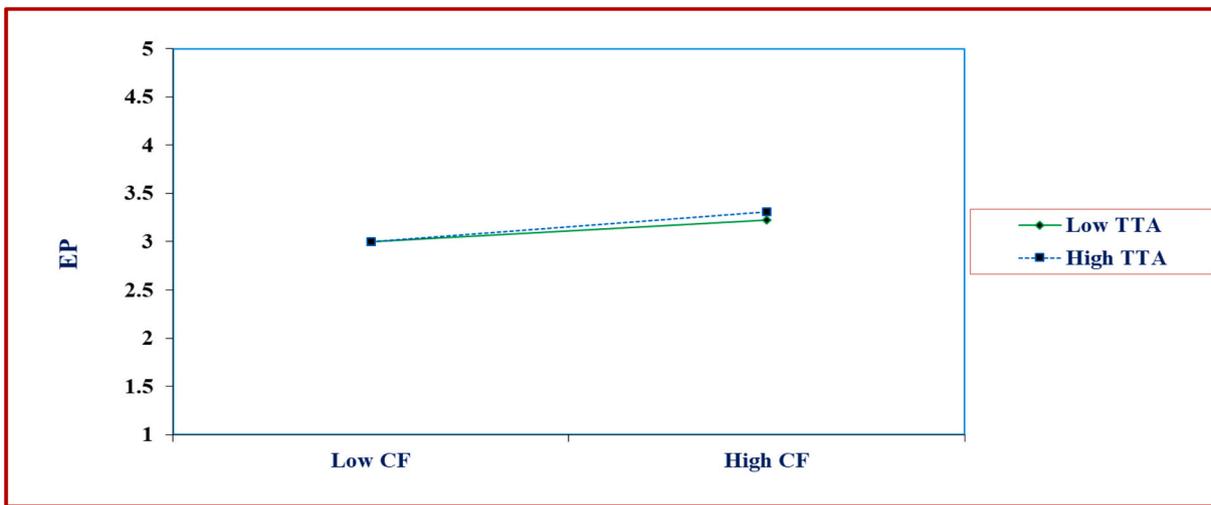


Fig. 6. Interactive effect of TTA in between CF and EP.

applications, RTDA enables employees to respond swiftly to operational demands, reducing delays and enhancing overall productivity—a crucial factor in the fast-paced telecommunication sector. TTF theory supports this finding by asserting that the alignment of real-time capabilities with task requirements enhances performance outcomes (Goodhue & Thompson, 1995). Furthermore, RTDA facilitates proactive problem-solving, allowing employees to anticipate and address challenges effectively, which is particularly important in Bangladesh’s growing telecommunication industry, where timely responses are critical for maintaining competitive advantage (Zhang et al., 2023). These insights underscore RTDA’s pivotal role in optimizing workplace efficiency. The results for H4 indicate that CF significantly positively impact EP in the telecommunication industry of Bangladesh. This finding aligns with prior studies highlighting the role of collaborative tools, such as shared workspaces and instant messaging, in enhancing teamwork and facilitating efficient task execution (Lee, Park, & Wang, 2023). In the context of webtop applications, CF fosters seamless communication and collaboration, which are critical for addressing complex challenges in dynamic sectors like telecommunications. TTF theory provides a theoretical basis, asserting that technology’s effectiveness is maximized when its features align with the collaborative requirements of tasks (Goodhue & Thompson, 1995). Additionally, CF promotes knowledge

sharing and reduces communication barriers, enabling employees to work cohesively, which is particularly relevant for Bangladesh’s rapidly modernizing telecommunication industry, where team synergy is essential for sustaining competitive advantage (Ahmed, Khan, & Rehman, 2023). This underscores CF’s role in driving organizational efficiency and innovation.

The results for H5 reveal that KS significantly mediates the relationship between UIU and EP in the telecommunication industry of Bangladesh. This finding aligns with prior research demonstrating that intuitive and user-friendly interfaces encourage employees to engage more actively in sharing knowledge, fostering collective learning and task efficiency (Zhao et al., 2023). KS bridges the gap between UIU and EP by enabling employees to utilize webtop applications for exchanging ideas and expertise seamlessly, which is vital for industries like telecommunications that require rapid adaptability and problem-solving. Grounded in TTF theory, these results emphasize that technology’s usability enhances its alignment with collaborative task demands, enabling employees to perform more effectively (Goodhue & Thompson, 1995). In the Bangladeshi context, where digital transformation is gaining momentum, UIU-driven KS plays a pivotal role in achieving higher productivity and competitive advantage. The findings for H6 indicate that KS significantly mediates the relationship between SI and

EP in the telecommunication industry of Bangladesh. This result supports existing literature, which highlights that integrated systems facilitate seamless information flow, enabling employees to share knowledge effectively and improve task efficiency (Chen, Li, & Zhao, 2023). KS acts as a conduit through which SI impacts EP, as well-integrated systems reduce silos and promote cross-departmental collaboration, essential in dynamic sectors like telecommunications. The TTF theory justifies this relationship, suggesting that the alignment of integrated systems with collaborative and task requirements enhances performance outcomes (Goodhue & Thompson, 1995). In Bangladesh's evolving telecommunication industry, where operational efficiency is a competitive imperative, SI-driven KS fosters innovation and collective problem-solving, significantly contributing to higher productivity. These findings emphasize the critical role of KS in leveraging the benefits of integrated technologies. The findings for H7 reveal that KS significantly mediates the relationship between RTDA and EP in the telecommunication industry of Bangladesh. This result aligns with existing research showing that access to real-time information enables employees to share relevant and timely knowledge, which enhances decision-making and task execution (Wang et al., 2023). RTDA empowers employees with accurate and immediate data, creating a collaborative environment where information exchange becomes more effective and impactful. TTF theory supports this, highlighting that technologies aligned with the dynamic demands of knowledge-sharing tasks improve performance outcomes (Goodhue & Thompson, 1995). In Bangladesh's fast-paced telecommunication sector, where responsiveness to operational and customer needs is critical, KS acts as a pivotal mechanism linking RTDA with enhanced productivity, fostering a more agile and informed workforce. This underscores the importance of real-time systems in facilitating organizational efficiency. The findings for H8 demonstrate that KS significantly mediates the relationship between CF and EP in the telecommunication industry of Bangladesh. This result is consistent with prior studies showing that collaborative tools foster an environment where employees exchange ideas, share expertise, and solve problems collectively, leading to enhanced productivity (Chen, Li, & Zhao, 2023). CF, such as shared workspaces and communication channels, facilitates seamless interaction, which amplifies the knowledge-sharing process, a critical driver of employee performance. TTF theory reinforces this by asserting that the alignment of collaboration-focused technologies with the needs of teamwork-oriented tasks improves outcomes (Goodhue & Thompson, 1995). In Bangladesh's telecommunication sector, where teamwork is essential for addressing complex challenges, CF-driven KS enables employees to leverage collective intelligence, thereby enhancing operational efficiency and service delivery. This underscores the integral role of collaboration tools in driving organizational productivity.

The findings for H9 indicate that Technology Training Availability (TTA) significantly moderates the relationship between User Interface Usability (UIU) and Employee Productivity (EP), but in an unexpected negative direction, as shown by the negative beta coefficient. This suggests that greater availability of training may, under certain conditions, reduce the positive impact of a user-friendly interface on employee productivity. Theoretically, UIU refers to the intuitive, accessible design of digital systems that typically require minimal user instruction (Chen, Li, & Zhao, 2023). While Task-Technology Fit (TTF) theory emphasizes the alignment between task demands and technological capabilities, it does not explicitly address how overtraining on inherently simple systems might disrupt this alignment. To interpret this counterintuitive outcome, we draw from Cognitive Load Theory, Human-Computer Interaction (HCI), and instructional design literature. Cognitive Load Theory posits that excessive instructional input for simple tasks can overwhelm users' working memory, impairing performance (Mayer, 2009; Sweller, 2011). When training surpasses the demands of an already intuitive system, it can conflict with employees' existing mental models and lower perceived efficiency (Kalyuga, 2007). In high-paced environments such as telecommunications, where speed and

autonomy are highly valued, redundant or rigid training may obstruct workflow and hinder productivity. Additionally, the risk of "training fatigue"—the disengagement that arises from unnecessary or repetitive training—has been well-documented in instructional design research (Sitzmann & Ely, 2011; Yeo, 2008). This disengagement may lead to frustration, especially when users feel confident in navigating the system independently. From an HCI perspective, overtraining can diminish perceived control and autonomy, which are key motivators in technology acceptance and sustained use (Deci & Ryan, 2000; Karahanna et al., 2006). Moreover, excessive training may inadvertently imply a lack of trust in employee competence, undermining intrinsic motivation. Thus, while training remains indispensable for complex or unfamiliar systems, it may be counterproductive when applied uniformly to technologies that are already highly usable. In such cases, overtraining disrupts the task-technology alignment that TTF theory assumes to be beneficial. These interdisciplinary insights expand the explanatory reach of our model, highlighting the need for nuanced training strategies that consider both system complexity and the cognitive readiness of users. Customizing training to match technological intuitiveness may help maintain—and even enhance—the productivity benefits of user-friendly design.

The findings for H10 indicate that TTA does not significantly moderate the relationship between SI and EP in the context of Bangladesh's telecommunication sector. This non-significant interaction suggests that the impact of system integration on productivity may be largely independent of training availability. One possible explanation is that well-integrated systems inherently support streamlined workflows, data synchronization, and process automation—benefits that are embedded in system design and do not heavily depend on user training (Chen, Li, & Zhao, 2023). While training may be necessary for navigating complex tools, the intuitive functionality of integrated systems could reduce the need for additional instruction (Wang et al., 2023). Another interpretation is that SI outcomes may depend more on organizational-level factors, such as IT infrastructure, cross-platform compatibility, or strategic alignment, rather than on individual users' technical proficiency. Thus, the absence of a moderating effect from TTA may reflect a broader structural reality: that training alone cannot compensate for systemic or infrastructural gaps in digital integration (Ahmed, Khan, & Rehman, 2023). Aligned with TTF theory, this result implies that when technology naturally aligns with task requirements—such as through seamless integration—the added value of training becomes minimal. It highlights the need for future models to account for multi-level factors influencing technology adoption and effectiveness. We recommend that future research adopt qualitative or mixed-method approaches to further explore the interaction between training, system usability, and organizational support. These methods can provide richer insights into user experiences and contextual factors that may explain variations in training effectiveness.

The findings for H11 reveal that TTA significantly moderates the relationship between RTDA and EP, with a positive moderation effect. This suggests that training amplifies the benefits of RTDA by equipping employees with the necessary skills to interpret and utilize real-time information effectively. Prior studies have shown that data literacy and training enhance employees' ability to make faster, more informed decisions, leading to improved productivity (Chen, Li, & Zhao, 2023). TTF theory supports this result, emphasizing that aligning technological capabilities, such as RTDA, with task requirements is further strengthened when users are competent in using those technologies (Goodhue & Thompson, 1995). In Bangladesh's telecommunication sector, where rapid decision-making is critical, the availability of training ensures that employees maximize the potential of real-time systems, thereby enhancing their performance and organizational outcomes (Ahmed, Khan, & Rehman, 2023). The findings for H12 indicate that TTA significantly moderates the relationship between CF and EP, with a positive moderation effect. This suggests that the effectiveness of CF in enhancing productivity is amplified when employees are trained to fully

utilize collaborative tools. Prior research has demonstrated that training improves employees' proficiency in using features such as shared workspaces and instant messaging, enabling more effective teamwork and task coordination (Zhang et al., 2023). TTF theory justifies this result by emphasizing that technology must align with task requirements, and user competence further enhances this alignment (Goodhue & Thompson, 1995). In Bangladesh's telecommunication sector, where team-based problem-solving is critical, training ensures employees can leverage CF optimally, fostering efficient collaboration and knowledge sharing (Hassan et al., 2023). This underscores the importance of pairing collaborative tools with adequate training to drive productivity.

3.1. Theoretical implications

This study offers several important theoretical contributions by extending and contextualizing the Task-Technology Fit (TTF) theory within the rapidly digitizing workplace of an emerging economy. While TTF traditionally focuses on the alignment between task characteristics and technological features, our study refines the framework by introducing Knowledge Sharing (KS) as a mediating mechanism and Technology Training Availability (TTA) as a moderating variable. These additions deepen the theoretical understanding of how internal knowledge dynamics and training environments shape the productivity outcomes of digital tool usage. The incorporation of KS bridges TTF with organizational behavior theory, emphasizing that the productivity gains from digital applications are not solely driven by technical alignment but are also amplified through social learning and collaboration processes. This positions KS as a critical enabler in digital workplaces, extending TTF's predictive capability into the social domain. The moderating role of TTA further reveals that training effectiveness is not universally beneficial, particularly for intuitive interfaces. The finding that TTA negatively moderates the UIU-EP relationship challenges conventional assumptions within the TTF model and introduces a novel theoretical insight: that overtraining on highly usable systems may produce unintended consequences such as cognitive overload, reduced autonomy, or user fatigue—dimensions that are not explicitly considered in the original TTF framework. Moreover, by applying and testing the extended TTF model in the underexplored context of webtop applications within the Bangladeshi telecommunications sector, this study contributes to the theory's cross-contextual validation. It highlights TTF's flexibility and relevance in technology-scarce, culturally distinct environments, responding to calls for theory expansion in non-Western, emerging markets. Taken together, these contributions position TTF not as a static model but as a dynamic and adaptable framework—capable of integrating human-centric, organizational, and contextual variables to better capture the evolving interplay between digital systems and employee performance in the modern workplace.

3.2. Practical implications

This study offers several strategic and actionable insights for practitioners, managers, and policymakers seeking to leverage webtop applications to enhance employee productivity, particularly in the telecommunication sector and similar digital-intensive environments. First, training initiatives must move beyond a one-size-fits-all approach. Organizations should implement role-specific, task-aligned training programs. For instance, employees working in data-intensive functions would benefit from targeted training on Real-Time Data Access (RTDA), while customer-facing staff may require focused support on User Interface Usability (UIU) and Collaboration Features (CF). To increase efficiency, companies can employ microlearning modules, interactive tutorials, and in-app tooltips to deliver just-in-time learning in high-paced settings where prolonged formal training is impractical. Second, to maximize the benefits of Knowledge Sharing (KS), organizations must go beyond simply encouraging collaboration. Managers should design

structured digital environments such as department-specific knowledge hubs, moderated discussion forums, and peer-led mentoring programs. Embedding incentive mechanisms—such as recognition programs or performance-based rewards—can further motivate sustained engagement and contribution to collaborative knowledge systems. Third, where System Integration (SI) presents a barrier, the focus should shift toward improving interoperability, interface intuitiveness, and employee participation in system design and feedback processes. Since TTA showed limited moderating influence on SI, organizations should adopt a light-touch training strategy that complements intuitive system interfaces rather than relying on resource-heavy general training. Finally, policymakers and industry regulators can catalyze digital transformation by developing national digital skills frameworks, supporting cross-sector knowledge-sharing initiatives, and incentivizing investments in broadband infrastructure and localized platform design. These efforts are particularly vital in emerging economies like Bangladesh, where disparities in digital readiness across regions and sectors remain significant. Taken together, these practical strategies underscore the importance of aligning technology deployment with organizational processes, user competencies, and contextual realities. By addressing the dynamic interplay between digital features, knowledge exchange, and training design, organizations can unlock the full productivity potential of webtop applications in digitally evolving work environments.

3.3. Limitations and future research directives

This study offers valuable insights into how webtop applications influence employee productivity within the Bangladeshi telecommunication sector; however, several limitations should be noted.

First, although grounded in robust theoretical and empirical analysis, the industry-specific context may limit the generalizability of the findings to other sectors or regions with different levels of digital maturity, infrastructure, and organizational dynamics. While the study focuses on Bangladesh, the challenges examined—such as varied digital literacy, infrastructure limitations, and the rapid pace of technology adoption—are shared by many developing economies across South Asia, Sub-Saharan Africa, and Southeast Asia (Lee and Choi, 2024; GSMA Intelligence, 2022; United Nations ESCAP, 2023b). Benchmarking our findings against global studies (e.g., Chatterjee et al., 2023a; Lee & Chen, 2023) reveals that the core constructs—User Interface Usability, System Integration, Real-Time Data Access, and Collaboration Features—are widely recognized as drivers of productivity in digital workplaces, irrespective of geographic region. Nonetheless, factors such as national IT policy, firm size, and cultural attitudes toward technology use may moderate these relationships. Thus, while our findings offer relevant insights for similar emerging market contexts, their broader applicability should be interpreted with caution. Future research should empirically test this framework in other industries and country contexts—especially in developed economies—to explore cross-cultural and cross-industry convergence or divergence in the relationship between digital tools and productivity. Second, the cross-sectional design of the study restricts causal inference. Longitudinal studies are recommended to examine how the influence of webtop application features—such as User Interface Usability, System Integration, Real-Time Data Access, and Collaboration Features—evolves over time and to capture the sustained effects of Knowledge Sharing (KS) and Technology Training Availability (TTA). Third, the study relied exclusively on self-reported survey data. Although statistical controls such as HTMT ratios and VIF thresholds were applied to minimize common method bias, perceptual measures may still be subject to biases. Employees' subjective evaluations may not fully reflect actual productivity levels. Future studies could incorporate objective performance indicators such as KPIs, task completion rates, or digital system logs, and adopt mixed-method approaches (e.g., interviews or focus groups) to gain deeper insight into user experiences and organizational context. Fourth, the absence of a comparative group

of non-users limits the ability to attribute productivity gains solely to webtop application usage. Future studies could adopt quasi-experimental designs or matched-sample approaches to evaluate the causal impact of these tools more rigorously. Together, these enhancements would deepen theoretical contributions and support more actionable recommendations for digital transformation in diverse organizational settings.

4. Conclusion

This study demonstrates the significant role of webtop applications in enhancing employee productivity within the Bangladeshi telecommunication sector, emphasizing how specific technological features—UIU, SI, RTDA, and CF—align with task demands to improve performance. Grounded in the TTF theory and extended by incorporating KS as a mediator and TTA as a moderator, the research provides a robust framework for understanding digital tool adoption in emerging markets. The findings affirm that effective feature-task alignment, supported by collaborative knowledge exchange, drives productivity. Moreover, the moderating effects of TTA reveal that training must be appropriately tailored—enhancing the effectiveness of complex tools like RTDA and CF, while potentially diminishing the benefits of already intuitive features like UIU. This nuanced insight has implications for both theory and practice, underscoring the importance of contextualized training and integrated system design. The study contributes to the theoretical development of TTF and offers actionable strategies for managers and policymakers navigating digital transformation. Future research should extend this framework across sectors and regions, utilize longitudinal and qualitative approaches, and further explore the socio-technical interplay influencing technology-driven productivity.

CRedit authorship contribution statement

Mohammad Nurul Alam: Writing – original draft, Methodology, Investigation, Formal analysis, Data curation, Conceptualization. **Ra'ed Masa'deh:** Writing – review & editing, Visualization, Validation, Resources, Methodology, Formal analysis. **Hammad S. Alotaibi:** Writing – review & editing, Visualization, Resources, Investigation. **Md Aminul Islam:** Writing – review & editing, Validation, Resources, Investigation, Formal analysis, Conceptualization. **Mohammad Fakhru Islam:** Writing – review & editing, Supervision, Software, Project administration, Methodology, Funding acquisition, Formal analysis. **Imdadullah Hidayat Ur Rehman:** Validation, Software, Resources, Investigation, Data curation. **Fariza Hashim:** Visualization, Validation, Software, Resources, Data curation.

Ethics statement

Not Applicable.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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Appendix A. Supplementary data

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.digbus.2025.100133>.

Data availability

Data will be made available on request.

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