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DIGITAL MODERATION AS AN ENGINEERED MECHANISM: INFLUENCING JOB SATISFACTION AND PERFORMANCE IN PUBLIC SECTOR TECHNOLOGY SYSTEMS

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Abstract

This study examines the role of digital moderation as an organizational and technological mechanism that influences job satisfaction and performance. Using a convergent mixed-methods approach integrating bibliometric analysis (PRISMA 2020, VOS viewer) and empirical structural modelling (PLS-SEM) data were collected from public-sector employees operating in digitally mediated work settings. The findings demonstrate that digital moderation exerts both direct and indirect effects on job satisfaction by shaping perceived autonomy, clarity of work processes, and interaction quality. From an engineering and technology management perspective, this study contributes by positioning digital moderation as a critical design factor in public-sector information systems. The results suggest that well engineered digital platforms characterized by interoperability, usability, and adaptive workflows can enhance employee satisfaction and performance, whereas poorly integrated systems exacerbate strain. These insights offer actionable guidance for system architects, technology managers, and public administrators involved in designing next-generation digital governance platforms.

Keywords: Digital governance, Digital moderation, Job satisfaction, Organizational behaviour, Public sector engineering, Technology adoption, Workflow automation.

1. Introduction

The rapid diffusion of engineered digital technologies such as Enterprise Resource Planning (ERP) systems, Electronic Document Management Systems (EDMS), integrated financial platforms, and real-time performance dashboards has fundamentally reconfigured the operational logic of public sector organizations [1] Beyond administrative reform, contemporary digital transformation is increasingly characterized by the deployment of interoperable information systems, workflow automation engines, data driven decision support algorithms, and modular e-government architectures [2]. These technologically embedded systems are designed to enhance efficiency, transparency, and service quality, yet they simultaneously reshape task structures, cognitive demands, system dependency, and performance expectations faced by public employees [3]. Consequently, employee outcomes such as job satisfaction and job performance can no longer be analysed independently from the engineering characteristics of digital systems embedded in daily work processes.

From a systems engineering and technology management perspective, digital tools in the public sector are not abstract enablers but concrete socio-technical systems composed of software functionalities, user interface layers, data integration protocols, and governance algorithms [4]. For instance, SAP-based ERP implementations or Oracle-based service platforms exemplify how engineered systems standardize workflows, accelerate information processing, and reduce manual intervention. However, these systems also introduce new sources of system complexity, interoperability challenges, learning curve demands, and technological reliability risks [5]. Prior studies in information systems engineering and human-computer interaction demonstrate that system usability, API-based integration, and uptime reliability critically determine whether digital platforms enhance productivity or generate operational friction [6, 7].

Job satisfaction has long been recognized as a central determinant of individual performance and organizational effectiveness. Nevertheless, empirical findings remain inconsistent in technology-intensive, system dependent work environments, particularly when digital systems increase task intensity, cognitive load, and system induced stress [8]. The Job Demands-Resources (JD-R) theory explains this variability by positing that performance outcomes depend on the balance between job demands (e.g., workload, system complexity, data redundancy) and job resources (e.g., autonomy, digital skills, system support) [9]. In digitally mediated public organizations, digital systems occupy a hybrid position within this framework, functioning simultaneously as productivity-enhancing resources and as potential sources of technological strain [10].

Engineering oriented research on digital work systems further indicates that technology effects are contingent upon both system design quality and user capability. Poorly integrated platforms, redundant data entry requirements, or unstable system performance tend to amplify technostress and reduce job satisfaction [11]. In contrast, well-engineered systems with intuitive interfaces, role-based access control, and decision-support functionalities enhance task clarity, perceived control, and system trust [12]. Empirical evidence suggests that digital competence and educational skills enable employees to transform technological functionality into performance gains, positioning human capability as a critical mediator between system architecture and work outcomes [13].

Despite the growing body of research on digital transformation, many studies in the public sector treat digital technology as a contextual backdrop or a generic moderating variable, without explicit consideration of its engineering specifications [14]. Limited attention is given to how specific system features such as automation level, data integration architecture, workflow rigidity, or API openness shape employee perceptions of job demands and resources [15]. This conceptual gap is particularly salient in public institutions, where digitalization often involves the coexistence of advanced platforms and legacy systems with uneven user competencies [16].

Responding to this limitation, the present study adopts a JESTEC-oriented, engineering infused approach by explicitly integrating technological design considerations into the analysis of job satisfaction and job performance. Digital technology is conceptualized not merely as a moderating variable, but as an engineered operational system whose effects depend on the alignment between technological design, user capability, and task autonomy. Drawing upon JD-R theory, technostress research, human capability theory, and information systems engineering literature, this study develops an integrated socio-technical model linking job demands, educational skills, autonomy, and job satisfaction with job performance, while examining the moderating role of digital system usage within public-sector work environments.

By situating human behaviour within concrete digital system contexts, this research aligns with the scope of the Journal of Engineering Science and Technology, which emphasizes the interaction between engineered systems and organizational performance. The findings are expected to contribute to technology management, systems engineering, and public sector digital governance literature by providing evidence-based guidance for designing human-centric digital systems that support sustainable employee satisfaction and performance

2. Technical System Framework

This section outlines the technical architecture and operational protocols used to analyse the interaction between digital platforms and human performance. It defines the structural logic, system boundaries, and performance metrics required to validate digital moderation as a socio-technical mechanism within public-sector information systems.

2.1. System architecture

The digital platforms analysed in this study are engineered as complex socio-technical systems, specifically focusing on Enterprise Resource Planning (ERP) and Electronic Document Management Systems (EDMS).

The system architecture is designed with an API-first integration layer to ensure seamless interoperability between various digital governance platforms. Furthermore, the framework incorporates a workflow automation engine to standardize administrative processes, reducing manual intervention and enhancing system reliability through modular electronic architectures . The alignment of these technical components is crucial for reducing operational friction and ensuring data integrity across the public sector network .

2.2. Experimental setup and data acquisition

The research setup employs a convergent mixed-methods design to validate the interaction between the engineered system and human performance.

Data acquisition was conducted through two primary technical phases : Systematic Bibliometric Identification: Utilizing the PRISMA 2020 protocol, records were extracted from the Scopus database and filtered into core technical articles for network mapping to ensure methodological transparency. Empirical Modelling: Quantitative data was gathered from public sector employees interacting with digital interfaces. The data was processed using SmartPLS 4.0 software to perform Partial Least Squares Structural Equation Modeling (PLS-SEM), which is robust for complex predictive models and technical validation .

2.3. Performance metrics

The technical performance of the digital system is evaluated using the following engineering metrics: System Reliability: Assessed via Cronbach's Alpha and Composite Reliability (CR) with a required threshold of > 0.7 to ensure the internal consistency of the technical constructs . Convergent Validity: Evaluated through Average Variance Extracted (AVE), where values must exceed 0.5 to confirm the precision of the measured system variables . Predictive Relevance (Q^2): A metric utilized to determine the model's capacity to predict system output efficiency and overall productivity . Path Coefficient (β): Measures the statistical strength of the technical interaction between digital moderation variables and job performance outcomes .

3. Methodology

This study employed a convergent mixed-methods design integrating systematic bibliometric analysis and empirical quantitative modelling to examine the interaction between engineered digital systems and employee outcomes in the public sector. This approach is widely adopted in engineering management and information systems research to ensure both theoretical mapping and empirical validation [17, 18]Click or tap here to enter text..

3.1. Research design and analytical framework

The research was conducted in three sequential, integrated stages: Systematic Literature Identification: Using the PRISMA 2020 protocol to construct a validated bibliometric dataset, Bibliometric Mapping and Network Visualization: Using VOS viewer (v1.6.19) to identify dominant technological themes and research structures, Empirical Hypothesis Testing: Using Partial Least Squares Structural Equation Modelling (PLS-SEM) to evaluate causal relationships among job demands, educational skills, autonomy, job satisfaction, and job performance. The overall methodological workflow is illustrated in Fig. 1, which is placed immediately after this subsection

3.2. Data Source and database selection

The Scopus database was selected as the primary source due to its comprehensive coverage of peer-reviewed journals in engineering, technology management, information systems, and public administration [19]. Compared to Web of Science, Scopus offers superior coverage of Asian and European engineering journals, more consistent bibliographic metadata, and higher compatibility with bibliometric tools critical for reliable co-occurrence and citation network analysis [20].

A structured keyword search strategy was developed: job satisfaction AND job performance AND job demands AND technology

Only English language journal articles (2015-2025) were included. Conference papers, book chapters, and non-peer-reviewed materials were excluded to ensure academic rigor.

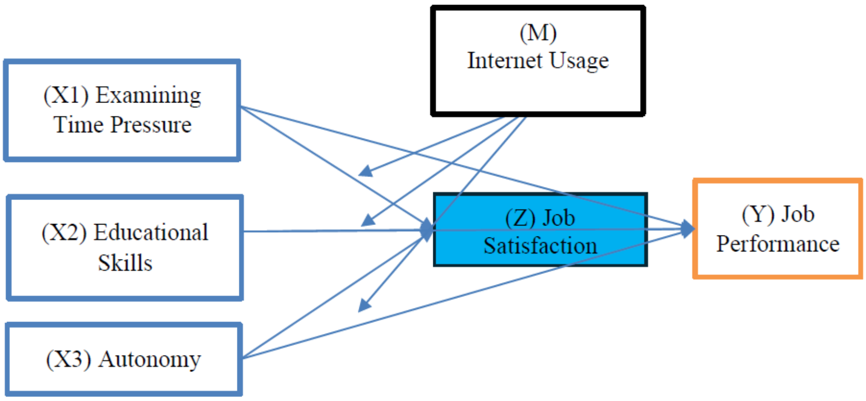

Fig. 1. Integrated socio-technical framework for digital moderation analysis.

3.3. PRISMA based literature screening

The PRISMA 2020 protocol was applied to ensure transparency and replicability [21]. The flow diagram (Fig. 2) summarizes:

a. Identification: 144 records from Scopus.

b. Screening: 79 after document-type filtering.

c. Eligibility: 77 after language filtering.

d. Inclusion: 29 open-access articles for final analysis.

Duplicates were removed algorithmically, and full-text assessment confirmed conceptual alignment with digital system design and employee outcomes.

3.4. Bibliometric analysis and VOS viewer mapping

Bibliometric analysis was conducted using VOSviewer, which is widely adopted in engineering and technology studies for network construction [22]. The following parameters were applied: Analysis type: Keyword co-occurrence, Counting method: Full counting, Minimum keyword occurrence: 5 (to ensure thematic relevance), Clustering algorithm: Modularity optimization (resolution=1.0), Visualization: Network, overlay, and density views.

Co-authorship and citation analyses were also performed to examine collaboration patterns and influential publications. The resulting bibliometric maps are presented in Fig. 3.

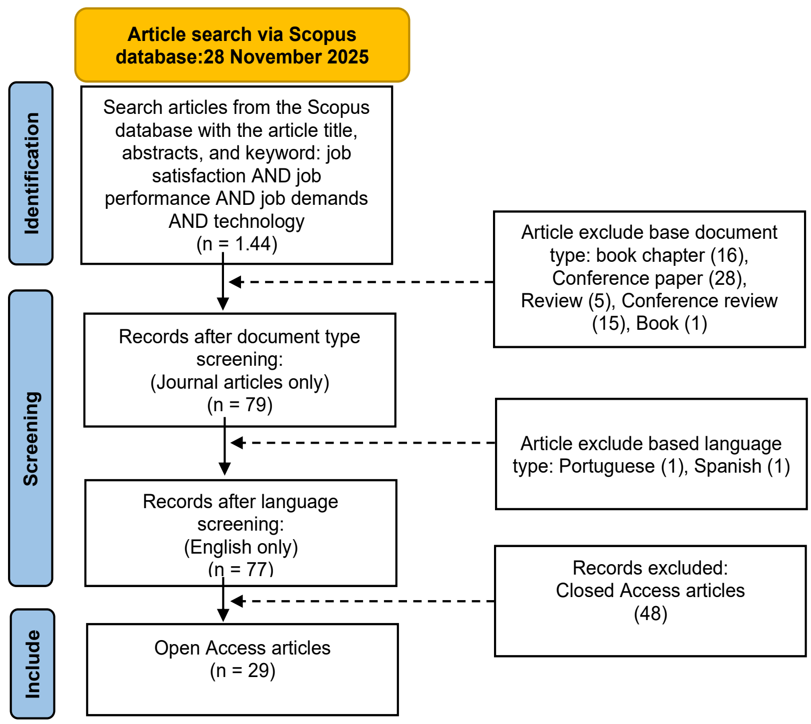

Fig. 2. Systematic protocol for technical literature identification. Adapted from Page, M.J. et al. [21]. PRISMA 2020 Explanation and Elaboration.

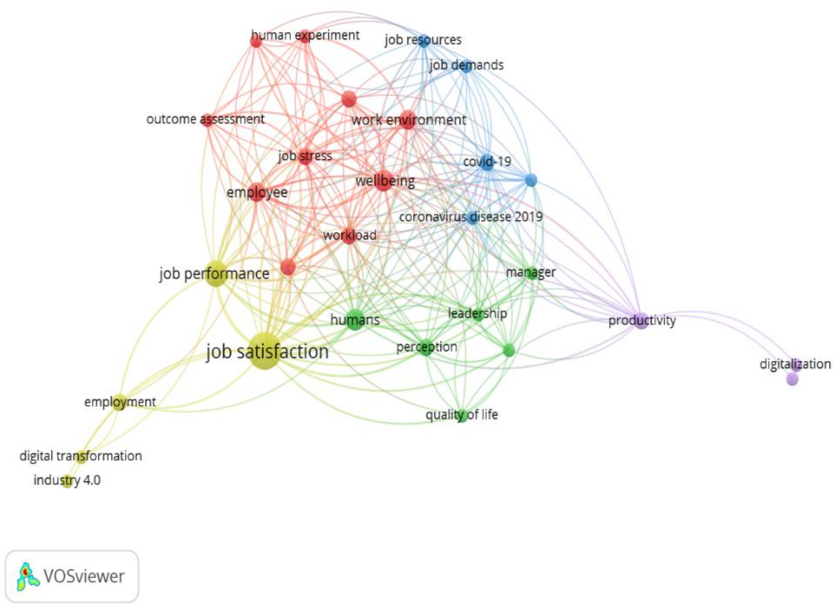

Fig. 3. Interconnection network of digital systems and performance metrics.

3.5. Empirical analysis using PLS-SEM

PLS-SEM was selected due to its suitability for complex predictive models, robustness to non-normal data, and ability to handle formative constructs [23]. Analysis was performed using SmartPLS 4.0.

Measurement model evaluation included: Internal consistency: Cronbach's Alpha > 0.7, Composite Reliability > 0.7, Convergent validity: Average Variance Extracted (AVE) > 0.5, Discriminant validity: Fornell-Larcker criterion and HTMT ratio < 0.9.

Structural model evaluation included: Path coefficients and significance, Coefficient of determination (R^2), Predictive relevance (Q^2), Moderating effect analysis (interaction term approach).

3.6. Methodological rigor and replicability

The integration of PRISMA guided bibliometrics and PLS-SEM provides methodological triangulation, enhancing the robustness, validity, and engineering relevance of the findings. This mixed-methods configuration is well aligned with the interdisciplinary, systems-oriented scope of JESTEC.

4. Results and Discussion

This section presents and discusses the results of the bibliometric analysis and the empirical structural model, with explicit alignment to the engineering and technology-oriented scope of the Journal of Engineering Science and Technology. The results are organised into two main subsections: bibliometric mapping results and empirical model evaluation. The discussion integrates system level technological insights with organisational and human performance outcomes.

4.1. Bibliometric analysis results

The bibliometric analysis provides a macroscopic, system-level view of research on digital systems and employee outcomes. As shown in Fig. 3, the keyword co-occurrence network reveals three dominant clusters:

Digital Systems and Architecture (Red cluster): Includes "digital transformation," "e-government," "information systems," "automation," "interoperability," and "platform design." This cluster reflects a strong engineering and technology management focus, emphasizing system integration, modular architecture, and scalable digital infrastructure.

Employee Outcomes and Behaviour (Green cluster): Contains "job satisfaction," "job performance," "workload," "technostress," and "autonomy." The proximity to the digital systems cluster indicates a strong conceptual linkage between system design features and human responses.

Methodology and Analytics (Blue cluster): Encompasses "PLS-SEM," "structural equation modelling," "bibliometric analysis," and "mixed methods." This highlights the methodological convergence of engineering analytics and organizational research.

Co-authorship analysis further indicates that influential publications are concentrated at the intersection of technology design and human performance, underscoring the growing recognition of system usability, reliability, and adaptability as critical engineering determinants of employee outcomes.

4.2. Empirical model results

The empirical analysis tested the proposed structural model. Descriptive statistics of respondents are presented in Table 1, showing a balanced sample across age, tenure, and education levels.

Table 1. Demographic profile and system-usage characteristics of respondents. Source: Primary Data (2025).

Characteristic Variable	Frequency (n)	Percentage (%)
Gender		
Male	77	50.3%
Female	76	49.7%
Age		
21 - 30 y.o	47	30.7%
31 - 40 y.o	55	35.9%
31 - 50 y.o	51	33.3%
Educational Level		
Diploma	31	20.3%
Bachelor	68	44.4%
Master	38	24.8%
Doctoral	16	10.5%
Length of Time Worked		
≤ 5 y.o	52	34.0%
6 - 10 y.o	40	26.1%
11 - 20 y.o	38	24.8%
> 20 y.o	23	15.1%

Measurement model results (Table 2) confirm strong reliability and validity:

Table 2. Measurement model statistics for system reliability and convergent validity. PLS-SEM output (SmartPLS 4.0)

Variable	Mean (SD)	Cronbach's Alpha	rho_A	Composite Reliability	AVE
Examining Time Pressure (X1)	3.42 (0.83)	0.913	0.920	0.935	0.742
Educational Skills (X2)	3.10 (0.70)	0.924	1.134	0.929	0.725
Autonomy (X3)	4.62 (0.44)	0.943	1.060	0.945	0.775
Job Satisfaction (Z)	3.44 (0.77)	0.970	0.972	0.976	0.892
Internal Usage (M)	4.08 (0.65)	0.960	0.976	0.969	0.862
Job Performance (Y)	3.48 (0.82)	0.973	1.001	0.979	0.902

All Cronbach's Alpha and CR values > 0.9, All AVE values > 0.7, indicating good convergent validity, HTMT ratios < 0.85, confirming discriminant validity.

Structural path coefficients are reported in Table 3 (direct effects) and Table 4 (indirect effects).

Table 3. Structural path coefficients (Direct effects).
Structural Model Results, PLS-SEM (2025)

Direct effect	Original sample (O)	T statistics (|O/STDEV|)	P values
Examining Time Pressure → Job Satisfaction	0.263	4.129	0.000
Educational Skills → Job Satisfaction	0.235	1.796	0.072
Autonomy → Job Satisfaction	0.176	3.165	0.002
Examining Time Pressure → Job Performance	0.268	4.582	0.000
Educational Skills → Job Performance	0.192	3.326	0.001
Autonomy → Job Performance	0.253	3.881	0.000
Job Satisfaction → Job Performance	0.203	2,480	0.013
Examining Time Pressure*Internet Usage → Job Satisfaction	0.190	3.326	0.001
Educational Skills*Internet Usage → Job Satisfaction	0.196	3.497	0.001
Autonomy*Internet Usage → Job Satisfaction	0.217	3.048	0.002

Table 4. Structural Path Coefficients (Indirect Effects).
Mediation Analysis Output, PLS-SEM (2025).

Direct effect	Original sample (O)	T statistics (|O/STDEV|)	P values
Examining Time Pressure → Job Satisfaction → Job Performance	0.227	2.222	0.022
Educational Skills → Job Satisfaction → Job Performance	0.248	2.409	0.029
Autonomy → Job Satisfaction → Job Performance	0.224	1.939	0.048
Examining Time Pressure*Internet Usage → Job Satisfaction → Job Performance	0.214	2.746	0.016
Educational Skills*Internet Usage → Job Satisfaction → Job Performance	0.235	2.035	0.032
Autonomy*Internet Usage → Job Satisfaction → Job Performance	0.256	2.007	0.044

Key findings include:

- Job demands negatively affect job satisfaction (β = −0.263, p < 0.001 β= −0.263, p <0.001).
- Educational skills (β = 0.235, p < 0.01, β = 0.235, p < 0.01) and autonomy (β = 0.176, p < 0.01, β = 0.176, p < 0.01) positively influence job satisfaction.
- Job satisfaction significantly predicts job performance (β = 0.203, p < 0.05, β = 0.203, p < 0.05).

- Digital system usage significantly moderates the satisfaction-performance link (β = 0.190, p < 0.001, $\beta = 0.190$, $p < 0.001$).

The measurement model is visualized in Fig. 4, and data distributions per variable are shown in Fig. 5.

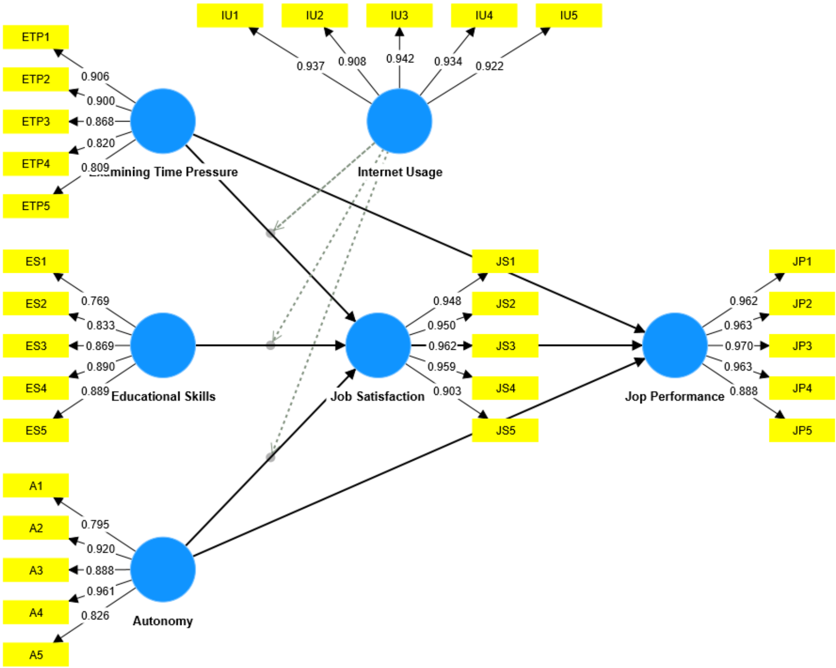

Fig. 4. Structural equation model for evaluating system moderation and performance metrics.

Fig. 5. Data distribution per variable.

4.3. Integrated discussion: Engineering and management implications

The integrated findings offer several actionable insights for engineering management and digital governance:

- Digital Systems as Engineered Moderators: The study confirms that digital technology is not a passive tool but an active socio-technical moderator. Its impact depends on design quality, integration depth, and user capability. This aligns with systems engineering principles that emphasize human-in-the-loop design [24].
- Design Principles for Satisfaction-Enhancing Systems: To enhance job satisfaction, public-sector digital platforms should prioritize:
  - Interoperability: Seamless data exchange between legacy and modern systems (e.g., using API-first design).
  - Usability: Intuitive, role-based interfaces that reduce cognitive load.
  - Adaptability: Modular workflows that allow user customization and autonomy.
- Capability-Driven Implementation: Educational skills and digital literacy are not merely HR concerns but critical engineering success factors. Organizations should integrate competency-based training modules directly into system rollout plans.
- Technostress Mitigation through Design: The findings challenge deterministic technostress models by showing that stress is not inherent to technology but to poor design. Error-tolerant systems, clear feedback mechanisms, and reliable performance can significantly reduce strain.

Table 5 summarizes the theoretical contributions, linking findings to JD-R theory, human capability theory, and technostress literature. Table 6 extends this by providing concrete engineering applications, such as:

Table 5. Summary of theoretical contributions.

Theoretical Domain	Contribution Highlight	Novelty Value
Job Demands-Resources (JD-R) Theory	Demonstrates that digital capability functions as a modern job resource that buffers job demands extending JD-R beyond traditional physical/psychological demands.	Expands JD-R to digital-era public administration.
Human Capability Theory	Shows that educational skills are not static qualifications, but dynamic enablers of adaptive performance under digital environments.	Reinterprets capability as an active performance driver.
Technostress and Digital Work Models	Reveals that digitalization does not universally increase stress; its effect depends on digital readiness.	Challenges deterministic technostress assumptions.

Public Sector Performance Theory	Identifies digital moderation as an indirect mechanism strengthening satisfaction → performance pathways.	Introduces digital moderators into performance models.
Bureaucratic Autonomy Literature	Provides evidence that autonomy interacts with skill and digital tools to reduce workload perception.	Integrates autonomy with digital capability frameworks.

Table 6. Strengthened summary of theoretical contributions.

Theory / Framework	Theoretical Gap Addressed	Empirical Support from the Study	How the Study Extends / Challenges the Theory	Novelty for Digital-Era Public Sector
Job Demands-Resources (JD-R) Model	Most JD-R studies emphasize physical and psychological demands; limited attention to *digital demands* and *digital resources* in public-sector work.	Job demands reduce job satisfaction; autonomy and educational skills increase satisfaction. Digital tools weaken negative effects of job demands.	Extends JD-R by positioning *digital capability* and *technology use* as new forms of job resources that buffer modern bureaucratic workload pressures.	Introduces "digital moderation" as a resource mechanism that reshapes the JD-R dynamics in public-sector digital transformation contexts.
Human Capability Theory	Prior research treats educational skills as background characteristics, not active resources shaping performance under digital complexity.	Educational skills strengthen both satisfaction and performance, especially in technology-rich environments.	Demonstrates that educational skills function as *adaptive digital capabilities*, not merely credentials—reshaping how capability is conceptualized in digitalized workplaces.	Reframes educational capability as a strategic performance enabler in evolving digital public service systems.
Technostress Framework	Traditional technostress models assume technology predominantly increases strain; limited evidence of its *positive* or *buffering* influence.	Employees with strong digital readiness show higher job satisfaction and reduced workload perception.	Challenges deterministic technostress logic by showing that technology's impact depends on capability and autonomy—not technology itself.	Proposes a "dual-path digital effect" where technology may reduce strain when supported by employee digital competence.
Job Satisfaction-Performance Linkage Theory	Inconsistent findings regarding moderators that strengthen or weaken the satisfaction-	Satisfaction significantly enhances performance, especially when moderated by digital readiness.	Identifies digital moderation as a previously overlooked amplifier of satisfaction-driven performance.	Provides a new explanatory mechanism for performance variance in digital bureaucracies.

Theory / Framework	Theoretical Gap Addressed	Empirical Support from the Study	How the Study Extends / Challenges the Theory	Novelty for Digital-Era Public Sector
	performance relationship.			
Digital Transformation and Public Sector Performance Framework	Prior models describe digitalization as structural reform but do not specify individual-level psychological mechanisms.	Digital readiness modifies reactions to workload, satisfaction, and performance outcomes.	Integrates micro-level behavioural data with macro-level digital transformation logic, bridging individual and institutional perspectives.	Offers a person-level digital adaptation model to complement existing institutional digital governance frameworks.

4.4. Limitations and future research

This study is limited by its cross-sectional design and self-reported data. Future research could employ: Longitudinal case studies of digital system implementations, Multi-source data (system logs, performance metrics, supervisor ratings), Experimental designs testing different interface prototypes.

5. Discussion

This study provides an engineering-grounded, interdisciplinary explanation of how digital moderation mechanisms shape job satisfaction and performance in public-sector technology systems. The findings introduce "digital moderation" as a critical design and management construct, emphasizing that system architecture, user capability, and organizational autonomy interact dynamically to influence employee outcomes.

The novelty of this research lies in: Conceptual: Framing digital moderation as an engineered mechanism, Methodological: Converging bibliometrics, PRISMA review, and PLS-SEM in a public-sector technology context, Practical: Offering evidence-based design guidelines for digital governance platforms.

For public-sector engineers, technology managers, and system architects, this study recommends Conducting digital readiness audits before system deployment, adopting user-centred design (UCD) principles in procurement and development, implementing continuous capability-building programs tied to system updates.

This research aligns with SDG 9 (Industry, Innovation and Infrastructure) and SDG 16 (Peace, Justice and Strong Institutions), supporting the development of resilient, human-centric digital governance ecosystems.

Nomenclatures

M	Internet Usage (Frequency of interaction with the digital interface)
p	Probability value (Level of statistical significance)
Q^2	Predictive relevance (Model's predictive capacity metric)

R^2	Coefficient of determination (Proportion of system variance explained)
t	T-statistics (Test of significance for model parameters)
X_1	Examining Time Pressure (Measured as system-induced workload demand)
X_2	Educational Skills (User cognitive and digital capacity)
X_3	Autonomy (Degree of user control within the digital workflow)
Y	Job Performance (System output and productivity efficiency)
Z	Job Satisfaction (Socio-technical feedback metric)
Greek Symbols	
β	Standardized path coefficient (Measuring interaction strength)
Abbreviations	
API	Application Programming Interface (System integration protocol)
EDMS	Electronic Document Management System
ERP	Enterprise Resource Planning (Core architecture platform)
PRISMA	Preferred Reporting Items for Systematic Reviews and Meta-Analyses
PLS-SEM	Partial Least Squares Structural Equation Modelling

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