

RESEARCH PAPER

Beyond the Interface: Usability as an Engine for Value Creation in the Public Service Ecosystem

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Abstract. The global digital government agenda emphasizes the importance of user-centered services to maximize Public Value. While most research focuses on citizen-facing systems, this study addresses a critical gap by evaluating the usability and institutional impact of internal platforms used by public servants. We present a comprehensive case study of SplitGov, a federal system responsible for managing shared service contracts and cost allocation in the Brazilian government. Using a triangulated methodology that combines heuristic evaluation, guided navigation, and semi-structured interviews with platform managers, we identify recurring usability barriers related to accessibility, interface consistency, and clarity of feedback. Beyond diagnosing interface-level frictions, the findings reveal how micro-level usability problems generated organizational responses at the meso level and created opportunities for alignment with national digital government policies at the macro level. This extended version incorporates new empirical material, particularly interviews with managers, and advances the theoretical articulation between the Public Service Ecosystem (PSE) model, complexity theory, and sociotechnical perspectives. The results show that usability evaluation can support adaptive governance processes, supporting organizational learning and influencing institutional improvement processes. The study further provides practical guidance to advance UX governance, refine feedback loops, and reinforce the reliability and legitimacy of digital public systems, promoting public value creation.

Keywords: Digital Government, Usability Evaluation, Public Value, Institutional Change, User Experience (UX)

Edited by: Ticianne Darin  | **Received:** 01 December 2025 • **Accepted:** 06 July 2026 • **Published:** 13 July 2026

1 Introduction

The global agenda of digital government has established user-centered public services as a strategic pillar for the modernization of public administration [OECD, 2024]. Both international guidelines and national policies, such as the Brazilian National Digital Government Strategy [Brasil, 2024b], emphasize that digital public services must be accessible, efficient, and aligned with Public Value. In this scenario, Usability and User Experience (UX) transcend their technical origins and are increasingly recognized as key governance tools. They help ensure that state-operated digital systems remain functional, legitimate, effective, and responsive to the real needs of their users [Lindgren and van Veenstra, 2018].

However, the existing literature in Human-Computer Interaction (HCI) applied to Digital Government has largely concentrated on citizen-facing systems (Government-to-Citizen, G2C) [Saveli *et al.*, 2025; Wirtz and Birkmeyer, 2015]. This focus has left a notable research gap concerning the usability and organizational impact of complex internal management systems (Government-to-Government, G2G). These G2G platforms form the core digital infrastructure for critical government processes. Low usability in this domain directly compromises operational efficiency, increases administrative costs, and indirectly degrades the quality of final services delivered to the public [Pereira *et al.*, 2024].

This study seeks to address both a theoretical and practical gap by examining the *SplitGov* platform, a complex federal system employed by the Ministry of Management and Innovation in Public Services (MGI) for managing shared service agreements and cost distribution among public institutions in Brazil. Focusing on how localized usability insights can drive strategic change in public administration, this study addresses the following research question: *How does usability evaluation foster institutional change and Public Value in G2G digital services?*

Our analysis is grounded in the Public Service Ecosystem (PSE) model proposed by [Osborne *et al.*, 2022], which provides a comprehensive framework for understanding value creation across four interrelated levels: submicro (individual experience), micro (interaction with technology), meso (organizational structures), and macro (policy and governance). This model is essential for our study, as it enables us to trace how usability issues identified at the micro level can trigger organizational responses at the meso level and support strategic alignment with Public Value goals at the macro level. By adopting this multi-level perspective, we move beyond interface-level analysis and reveal the systemic effects of usability on institutional learning and adaptation.

The objectives of this study are threefold. First, to present a rigorous usability evaluation of the *SplitGov* platform using complementary methods. Second, to analyze how

the identified user experience issues relate to Public Value creation within the PSE model. Third, to examine the institutional effects of the evaluation, including the incorporation of UX principles into development practices and organizational learning. The empirical findings demonstrate that the usability evaluation yielded specific interface improvements while also contributing to broader cultural and institutional changes. This shift strengthened the organization's capacity to deliver more reliable and legitimate digital services by ensuring the technical team's appropriation of UX principles, thus effectively consolidating and magnifying the creation of Public Value across the entire service ecosystem.

This work represents a significantly extended version of our previous study [Figueiredo *et al.*, 2025], evolving from an initial usability diagnosis to a comprehensive, multi-level analysis of institutional transformation. A key advancement lies in the expansion of the methodological scope, particularly through the inclusion of interviews with platform managers. This addition clarified how usability findings influenced decision-making and system improvement processes. The study also offers empirical validation of the Public Service Ecosystem (PSE) model as a multi-scale analytical framework for Government-to-Government (G2G) systems, illustrating how micro-level UX insights can prompt meso-level organizational changes and macro-level policy alignment.

Moreover, this extended version introduces the concept of *Adaptive Patterns*, which synthesize recurring mechanisms through which the digital ecosystem responds to usability feedback, including friction feedback, distributed workaround, reflexive iteration, and policy translation. It also advances a theoretical articulation between the PSE framework and complexity theory, positioning usability as a dynamic driver of institutional adaptation and systemic learning. Finally, the paper presents a set of practical, multi-level recommendations to improve adaptability, resilience, and Public Value co-creation in internal government platforms. Together, these contributions expand the theoretical, methodological, and practical relevance of the study and offer a replicable framework for analyzing complex sociotechnical systems in the public sector.

This paper is structured as follows: Section 2 presents the theoretical background, discussing the principles of usability and Public Value creation and introducing the reinterpretation of the Public Service Ecosystem model as a complex adaptive system. Section 3 describes the methodological approach of this work. Section 4 presents the main findings and discusses how interaction patterns and usability issues reveal systemic interdependencies within digital public service ecosystems. Section 5 summarizes the key insights and proposes practical recommendations aimed at fostering adaptive and resilient design practices in digital government. Section 6 discusses methodological limitations, and Section 7 concludes by summarizing the study's contributions and suggesting future research directions.

2 Theoretical Framework

Digital transformation in the public sector requires the modernization of technological infrastructures together with a deeper understanding of the human, organizational, and institutional dynamics that shape digital service ecosystems.

In this sense, Human–Computer Interaction (HCI) and User Experience (UX) research provide analytical lenses to explore how usability, inclusion, and co-creation practices contribute to the generation of public value [Mergel *et al.*, 2019; Vial, 2019; Osborne *et al.*, 2022].

Building upon the foundations of our previous study [Figueiredo *et al.*, 2025], this section expands the theoretical discussion by connecting the Public Service Ecosystem (PSE) model with complexity theory and systems thinking, positioning usability as an emergent property of sociotechnical interactions rather than a static design attribute.

2.1 Institutional Advances in Brazil

International and national initiatives have progressively recognized the centrality of user experience in public digital transformation. The OECD's Digital Government Index highlights that mature digital governments integrate accessibility, responsiveness, and continuous learning based on user feedback [OECD, 2024, 2023]. In Brazil, this orientation has gained strength through successive decrees and national strategies, including the Digital Governance Policy (Decree No. 8,638/2016), the Digital Citizenship Platform (Decree No. 8,936/2016), the Digital Government Strategy 2020–2022 (Decree No. 10,332/2020), and the Federal Digital Government Strategy 2024–2027 (Decree No. 12,198/2024). Together, these instruments institutionalize UX and usability as fundamental principles of public management [Brasil, 2016a,b, 2020, 2024b,a].

The Secretariat for Digital Government (SGD) has played a pivotal role in this process by promoting the integration of UX practices into the design, evaluation, and management of public digital services. The concept of “citizen centrality” has evolved from a normative aspiration to a mandatory design requirement, linking usability to accessibility, plain language, and personalization. These initiatives, together with the National Digital Government Strategy (2024–2027), represent a paradigm shift in the State's relationship with citizens: digital transformation is now understood as a process of co-producing meaningful and inclusive experiences that generate public value through interaction.

Table 1 summarizes the main government documents and strategies that have consolidated UX as a structuring dimension of digital governance in Brazil, illustrating the institutional maturity that underpins the ecosystemic approach adopted in this study.

2.2 Related Work on UX and Digital Public Services

User experience (UX) has become a fundamental pillar for the digital transformation of governments worldwide. National research has highlighted the importance of usability for the effectiveness of digital public services. For example, the work of [Pereira *et al.*, 2021] presents an evaluation of the usability of transparency portals of federal universities in Northeast Brazil, identifying that although some portals partially meet quality and usability criteria, access to information remains limited, indicating the need for improvements in the organization and presentation of online content.

The OECD emphasizes practices such as user segmentation, universal design, and co-design as essential for promot-

Table 1. Government Milestones of Citizen-Centered Digital Transformation

Year	Strategy or Document	Contribution to the User Experience in the Public Sector	Reference
2016	Digital Governance Policy	Establishes initial guidelines for digitalization with a citizen focus, promoting governance and interoperability.	[Brasil, 2016a]
2018	E-Digital – Brazilian Strategy for Digital Transformation	Reinforces digital inclusion and equity, focusing on access, connectivity, and population training.	[Brasil, 2018]
2020–2022	Digital Government Strategy (EGD)	Introduces the principle of citizen centrality, institutionalizes UX metrics, and expands the gov.br ecosystem.	[Brasil, 2020]
2024–2027	Federal Digital Government Strategy (EFGD)	Consolidates UX as a strategic requirement, emphasizing accessibility, plain language, and service personalization.	[Brasil, 2024b]
2024–2027	National Digital Government Strategy (ENGD)	Expands the digital transformation agenda across government levels, reinforcing UX principles such as inclusion, accessibility, and co-design.	[Brasil, 2024a]

ing the generation of people-centered public value [OECD, 2023]. In the Brazilian context, these guidelines have been progressively institutionalized through a series of normative and strategic frameworks that reinforce the centrality of citizens in the design and evaluation of digital public services.

Furthermore, reinforcing citizen centrality implies recognizing user experience as situated, relational, and often unequal, requiring approaches sensitive to the diversity of social, cultural, and institutional contexts across the country [Figueiredo *et al.*, 2024a]. This shift broadens the scope of Human–Computer Interaction (HCI) in the public sector, positioning it as an ally in institutional transformation. The acknowledgement of citizen diversity and the need for contextual adaptation is emphasized in initiatives such as the Public Sector Diversity Guide [Viana *et al.*, 2024], which reinforces the importance of inclusive solutions responsive to socioterritorial differences in the design of digital services. This perspective also supports the redesign of public services through a Service Design approach, placing the user at the center of development [Figueiredo *et al.*, 2024b].

Recent studies have also connected service design, agile digital transformation, and public value creation in the public sector, emphasizing iterative learning, stakeholder participation, and responsiveness to changing user needs [Choi and Cucciniello, 2026; Mergel *et al.*, 2020]. From a sociotechnical perspective, these approaches reinforce that digital systems cannot be evaluated only as technical artifacts, since their effectiveness depends on the interaction between people, organizational routines, work practices, and institutional contexts [Baxter and Sommerville, 2011].

Although these studies have advanced the understanding of usability, co-design, and digital transformation in public services, important gaps remain regarding how usability phenomena propagate across organizational and institutional structures in complex public service ecosystems. Existing research has predominantly focused on citizen-facing services and interface-level interaction quality, with comparatively limited attention to Government-to-Government (G2G) systems and their organizational implications. Furthermore, few studies explicitly connect usability evaluation to ecosystemic perspectives capable of explaining how interaction issues influence institutional learning, adaptive governance, and public value creation across multiple levels. This study addresses

these gaps by analyzing usability through the lens of the Public Service Ecosystem (PSE) model and complexity theory, positioning usability as a systemic and adaptive phenomenon that extends beyond interface-level attributes.

2.3 Complexity and Adaptation in Public Service Ecosystems

This work expands the PSE model through the lens of complexity theory and adaptive systems thinking. Public service ecosystems can be understood as interconnected sociotechnical systems, composed of multiple agents, such as users, designers, managers, and policymakers, whose interactions produce emergent patterns of value creation. Such systems are characterized by non-linearity, feedback loops, and self-organization, continuously reshaping the relationships among usability, institutional learning, and public value.

From this perspective, usability ceases to be a static attribute assessed through isolated metrics and becomes an emergent phenomenon resulting from dynamic interactions. Each iteration of design, evaluation, and feedback reorganizes the ecosystem, generating new patterns of coordination and understanding. This interpretation aligns with the emerging field of *Ecosystemic HCI*, which regards sociotechnical systems as evolving, interdependent networks rather than as discrete artifacts.

Table 2 synthesizes this conceptual transition, contrasting the linear logic of traditional service design with the adaptive, relational dynamics of ecosystemic public services. This ecosystemic perspective introduces three theoretical implications. First, usability can be reframed as a form of dynamic equilibrium within complex institutional environments, where improvements in one area produce cascading effects across the ecosystem. Second, learning and reflexivity emerge as essential conditions for sustaining innovation in digital government. Third, participatory practices such as co-design and iterative evaluation act as adaptive mechanisms that maintain systemic balance amid environmental and policy change.

In sum, by incorporating principles of complexity and adaptation into the PSE model, usability evaluation transcends its traditional diagnostic role and becomes a mechanism for institutional learning and organizational adaptation, fostering the continuous evolution of digital public services toward more responsive, inclusive, and legitimate governance.

Table 2. Comparative Perspective: From Linear Service Models to Complex Adaptive Ecosystems			
Analytical Dimension	Traditional View of Digital Services	Ecosystemic and Adaptive View	
Nature of System	Static and hierarchical, defined by pre-established processes and control structures.	Dynamic and adaptive, composed of interdependent agents and evolving relationships.	
Source of Value	Efficiency and compliance with procedural norms.	Emergent value generated through continuous interaction, learning, and feedback.	
Role of Users	Passive recipients or evaluators of service quality.	Active co-creators who influence system adaptation through participation and feedback.	
Usability Approach	Evaluated through isolated metrics of interface performance.	Emergent property reflecting systemic equilibrium across human, technological, and institutional levels.	
Design Logic	Focused on standardization and control.	Focused on flexibility, iteration, and contextual responsiveness.	

3 Materials and Methods

The methodological design of this study follows an iterative multi-method qualitative approach, combining primarily qualitative techniques complemented by descriptive quantitative indicators commonly used in usability research with an interpretive analysis grounded in the Public Service Ecosystem (PSE) model. The goal was to capture not only the interface-level interaction patterns but also the organizational and systemic implications of usability phenomena within the context of digital public services. The methodological strategy thus operates across multiple levels of observation (*submicro*, *micro*, *meso*, and *macro*) reflecting the adaptive and relational character of the system under study.

3.1 Case Context: The SplitGov Platform

The empirical setting of this research is the *SplitGov* platform, developed by the Ministry of Management and Innovation in Public Services (MGI) to support the coordination and monitoring of shared service agreements across federal institutions. Conceived as an instrument for transparency and collaborative management, *SplitGov* integrates information on service demand, delivery, and performance, offering both managerial dashboards and user interfaces for operational teams.

The *SplitGov* platform was selected as a case study due to its hybrid nature, simultaneously technological and organizational, and its potential to illustrate how usability issues can reflect deeper systemic dynamics. Its evaluation thus served as an opportunity to explore how micro-level interaction experiences relate to meso-level governance practices and macro-level policy objectives.

Figure 1 presents a representative view of the SplitGov platform interface used during the evaluation sessions. The figure illustrates the organizational structure of the system and the interaction environment analyzed throughout the usability evaluation procedures.

3.2 Methodological Strategy

The usability evaluation of the *SplitGov* system was conducted using a methodological triangulation approach, as illustrated in Figure 2. Each of these techniques contributes distinct perspectives on the user experience, enabling a more robust and comprehensive analysis:

- 1. Guided navigation with experienced users: sessions

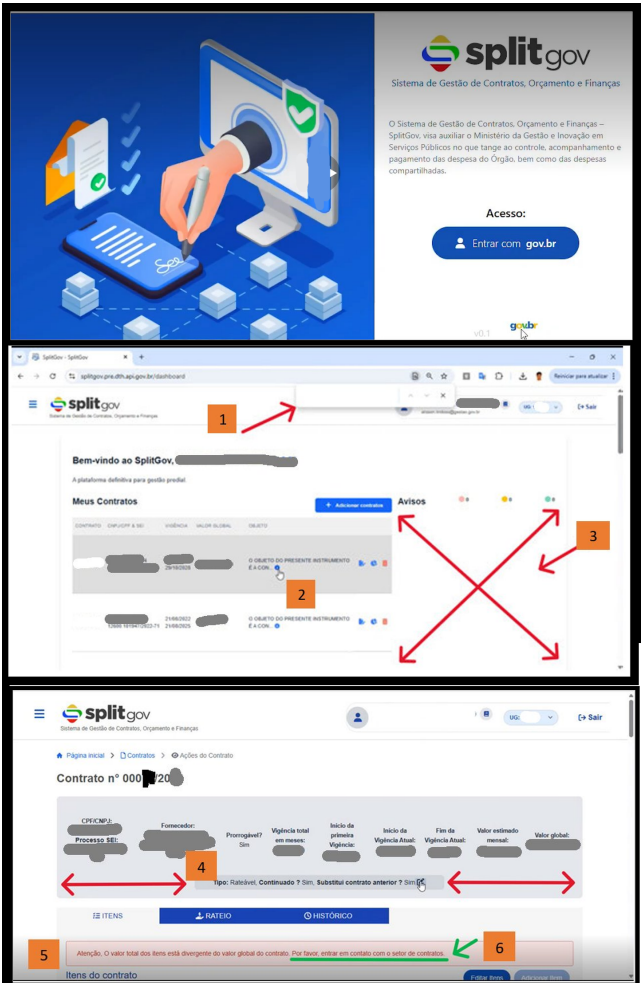


Figure 1. Representative interface of the SplitGov platform used during the usability evaluation sessions, highlighting some of the interface improvement opportunities identified throughout the study.

were conducted with nine participants associated with the SplitGov ecosystem, including experienced and first-time users with different organizational roles and interaction profiles. The sessions took place in real usage contexts and were monitored by UX analysts who recorded user interactions, obstacles encountered, and spontaneous strategies adopted. Participants were asked to execute predefined operational tasks while researchers observed navigation behavior, interaction difficulties, task completion patterns, and

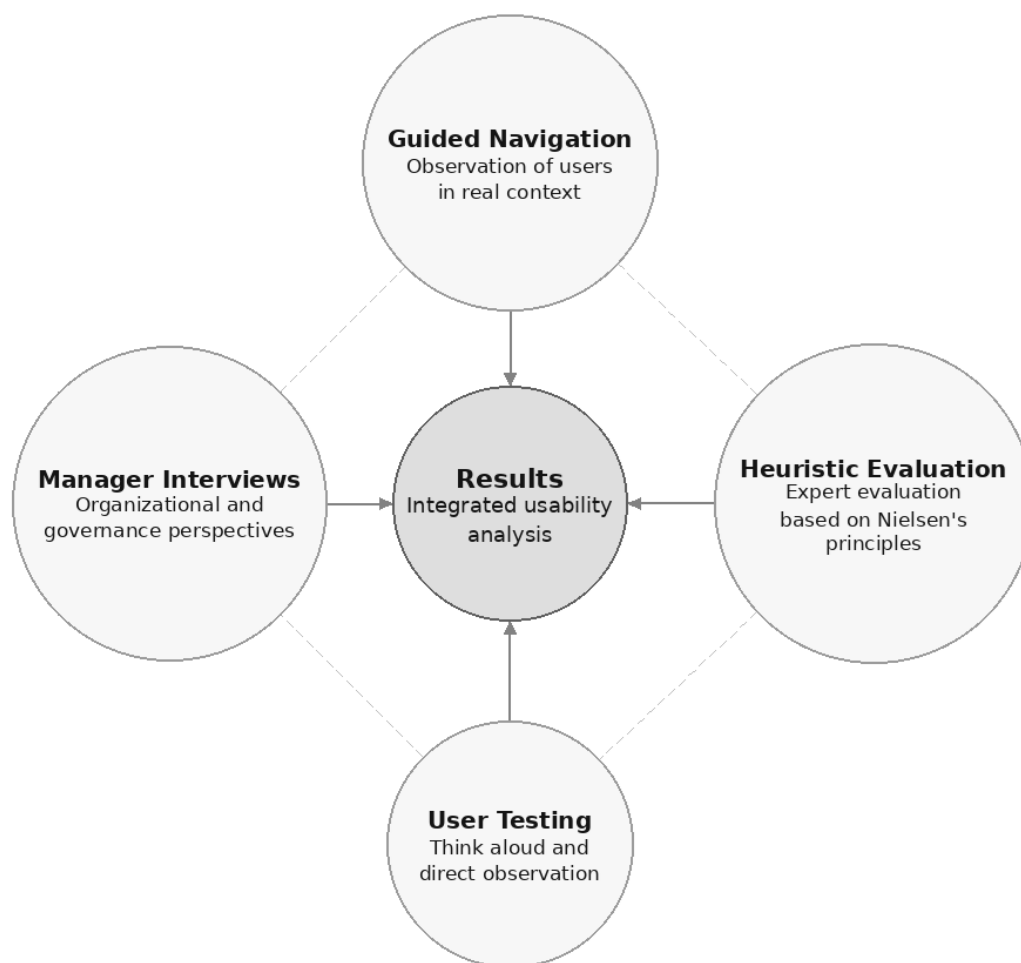


Figure 2. Multi-method evaluation strategy adopted for the SplitGov assessment.

verbalized perceptions during workflow execution.

The guided navigation sessions were informed by adapted Contextual Inquiry principles [Beyer and Holtzblatt, 1995], combining task observation, interaction monitoring, and contextual questioning during workflow execution. Most participants were experienced SplitGov users familiar with organizational workflows. However, three first-time users were intentionally included to capture onboarding difficulties, learnability issues, and differences in interaction behavior between experienced and novice users.

2. **Usability testing with direct observation and think aloud:** five public servants participated, selected for convenience. During the sessions, users performed typical tasks in the system while verbalizing their actions, questions, and perceptions following a think-aloud protocol [Nielsen, 1994]. Other civil servants and researchers observed the sessions, enabling triangulation of observations and collaborative interpretation of usability issues.
3. **Expert heuristic evaluation:** three evaluators with prior experience in Human-Computer Interaction and usability evaluation of digital systems applied Nielsen's usability heuristics. The evaluators explored the system functionalities through representative operational workflows, examining navigation structures, terminology consistency, visibility of system status, interaction feedback, accessi-

bility aspects, and error prevention mechanisms based on Nielsen's heuristics. The heuristic evaluation combined free exploration and task-oriented interaction with the platform, allowing the evaluators to identify usability issues associated with both general interface consistency and specific operational workflows. The heuristics were applied across all platform functionalities, supported by functional documentation provided by MGI.

In addition to the usability-oriented procedures, semi-structured interviews with managers were conducted after the evaluation activities to investigate how usability findings were interpreted and incorporated into organizational routines and system improvement processes. The interviews with platform managers focused on organizational routines and decision-making processes associated with system use, highlighting how usability feedback is (or is not) incorporated into continuous improvement cycles.

A summary of participant characteristics is presented in Table 3, including institutional contexts, experience with *SplitGov*, and roles in the federal administration. Tables 4, 5, and 6 present the profiles and roles associated with each evaluation technique. This information helps contextualize the usability patterns identified during the evaluation.

Each technique was analyzed separately and then integrated through a cross-level synthesis guided by the PSE dimensions. To clarify this integration alignment, Table 7

Table 3. Profile of Participants in the Guided Navigation Sessions

ID	Position	Experience with SplitGov	Role or Function
P1	Coordinator	Frequent user	Oversees stakeholder relationships and coordinates shared technological services; key decision-maker for cross-department interactions.
P2	Coordinator	Occasional user	Leads initiatives to improve employee digital experience; focuses on usability, engagement, and workflow optimization.
P3	Coordinator	Frequent user	Drives innovation strategies and planning processes; evaluates technological adoption and alignment with budget priorities.
P4	Software Engineering Student – UnB	First-time user	Represents the novice user perspective, supporting usability tests, onboarding evaluation, and clarity of information architecture.
P5	Coordinator	First-time user	Monitors IT and operational contracts; evaluates adherence to regulations, performance indicators, and audit requirements.
P6	Senior Technical Advisor	Frequent user	Provides technical assessments, supports process improvements, and ensures alignment of workflows with system capabilities.
P7	Project management / requirements analyst	Occasional user	Provides technical assessments, supports process improvements, and ensures alignment of workflows with system capabilities.
P8	Coordinator of IT Contract Compliance and Analysis	Occasional user	Ensures compliance in IT contracting processes; evaluates legal, technical, and operational conformity within the platform.
P9	IT Contract Compliance and Analysis Support	First-time user	Ensures compliance in IT contracting processes; evaluates legal, technical, and operational conformity within the platform.

Table 4. Profile of Participants in the Usability Testing Sessions

Participant	Experience with SplitGov
U1	Frequent user
U2	Occasional user
U3	First-time user
U4	Frequent user
U5	Occasional user

Table 5. Profile of Heuristic Evaluation Inspectors

Inspector	Background Area
H1	Human-Computer Interaction
H2	UX and Service Design
H3	Software Engineering

presents the correspondence between PSE levels, evaluation techniques, and observed outcomes. This new framework connects methodological layers with systemic interpretation, extending the analytical contribution of the original study [Figueiredo *et al.*, 2025]. This integration allowed the identification of systemic interdependencies that would remain invisible in a single-method approach.

Throughout the evaluation process, the study employed supporting research artifacts, including informed consent procedures, observation records produced during usability sessions, heuristic evaluation protocols, interview support scripts, and researcher field notes used during data collection and analysis.

3.3 Data Analysis

Data analysis combined descriptive and interpretive procedures. First, all qualitative material (transcripts, field notes, and researcher memos) was coded using open and axial coding to identify patterns of interaction and perception. Quantitative data from the heuristic evaluation (frequency and severity of

Table 6. Profile of Interviewed Managers

Manager	Relationship to SplitGov
M1	Platform management activities
M2	Technical and operational activities
M3	Digital transformation activities

violations) were used to corroborate and contextualize qualitative findings.

The integration of these datasets followed an abductive reasoning strategy, iterating between empirical evidence and theoretical constructs of the PSE model and complexity theory. Through this process, usability issues were not treated as isolated defects but as expressions of adaptation challenges within the ecosystem.

The triangulation of methods followed a systemic logic designed to uncover how the different PSE levels adapt to one another. Usability barriers identified in the heuristic evaluation (micro level) often reflected organizational bottlenecks in the incorporation of user feedback (meso level) or revealed policy misalignments that influenced design priorities (macro level). Conversely, positive usability results, such as faster task completion and fewer errors, tended to be linked to institutional practices that supported iterative learning and collaboration across departments.

This integrative interpretation made it possible to identify emerging patterns in which usability functions simultaneously as an indicator and a driver of adaptation. Instead of treating the findings as static observations, the analysis sought to understand how each level of the ecosystem responds, compensates, and evolves in the face of user experience challenges. This dynamic perspective sets the stage for the next section, which examines how usability-driven feedback loops strengthen the resilience and learning capacity of digital public services.

Table 7. Analytical Correspondence Between PSE Levels and Evaluation Techniques

PSE Level	Evaluation Technique	Analytical Focus and Example of Insights
Submicro	Guided navigation with end users	Individual perceptions, mental models, interaction perceptions and cognitive reactions during task execution.
Micro	Heuristic evaluation	Interaction-level patterns, feedback timing, visibility of system status, and task efficiency; e.g., delays in response or absence of error prevention cues.
Meso	Manager interviews	Organizational routines, communication flows, and the role of UX feedback in managerial decision-making; e.g., how error reports circulate and influence design iterations.
Macro	Cross-level synthesis	Institutional norms, governance structures, and strategic orientation of digital transformation policies; e.g., alignment of usability metrics with the Federal Digital Government Strategy.

Together, these complementary techniques enabled a multi-level interpretation of usability phenomena, connecting individual interaction experiences to organizational routines and broader governance structures.

4 Results and Discussion

The integration of findings across the evaluation procedures revealed a set of interdependent usability phenomena that operate simultaneously at different levels of the Public Service Ecosystem (PSE). Consistent with the theoretical perspective of complex adaptive systems, these phenomena do not occur in isolation: each local improvement or deficiency propagates through feedback loops that influence broader organizational routines and institutional decisions. This section discusses the most salient patterns identified in the analysis, emphasizing how usability acts as both a diagnostic lens and a driver of systemic adaptation within digital public services.

4.1 Micro-Level Patterns

The heuristic evaluation identified 32 usability issues grouped into 9 violated heuristics. The most frequent problems related to the lack of visibility of system status, inconsistency of terminology, and inadequate feedback after task completion. Although these findings echo traditional usability concerns, their recurrence in high-complexity workflows reveals deeper systemic causes.

This finding differs from traditional usability studies focused primarily on citizen-facing services, where interaction problems are often analyzed mainly in terms of efficiency, accessibility, and user satisfaction. In the SplitGov case, usability issues also revealed dependencies between interface design, organizational routines, and institutional coordination.

Guided navigation sessions corroborated these observations, showing that users often needed to rely on tacit organizational knowledge to interpret interface messages or navigate between modules. In other words, the system presupposed an internalized understanding of bureaucratic procedures that new users did not possess. This mismatch between interface logic and cognitive models generated frustration, hesitancy, and occasional task abandonment, phenomena typical of cognitive overload in multi-actor systems.

To provide additional clarity to the micro-level findings, this subsection incorporates concrete examples from the guided navigation sessions. Participants frequently reported uncertainty when navigating between modules or interpreting

system messages. One participant stated:

“I often need to guess which option will take me to the information I need because the labels are not clear.”

These observations illustrate how the absence of clear status indicators and inconsistent terminology contributes to cognitive overload, especially for first-time or occasional users.

The heuristic evaluation corroborated these difficulties. For example, the lack of confirmation messages after completing certain actions led to repeated submissions by users attempting to verify whether the system had registered their input. During the sessions, one user commented:

“I clicked save twice because nothing happened the first time. Then I realized the page had updated without showing any confirmation.”

This pattern reflects a critical gap in the system’s feedback mechanisms and demonstrates how local interaction issues can accumulate into larger operational inefficiencies.

4.2 Meso-Level Patterns

At the meso level, interviews with managers revealed that usability problems are frequently mediated through informal communication channels. Instead of systematic feedback cycles, most corrections depend on interpersonal negotiation between departments, generating time lags and inconsistencies in system evolution.

To illustrate how usability issues evolve into organizational challenges, this subsection incorporates specific examples from the interviews with platform managers. Several managers reported that interface problems often generate additional coordination tasks among teams. One interviewee explained:

“When users cannot identify where a task ends or begins, they call our team directly, and we try to guide them step by step. This creates extra demand that should not exist if the system provided clearer feedback.”

These comments reveal how micro-level friction increases the volume of informal support and redirects organizational resources to compensate for deficiencies in the user interface.

The interviews also showed that different units respond to usability issues in distinct ways. Some teams organize periodic review meetings where feedback from users is consolidated and translated into improvement requests. One manager stated:

“We meet every month to look at what users struggled with and decide which adjustments can be implemented in the next development cycle.”

Other units, however, rely almost entirely on ad hoc communication and do not maintain structured mechanisms for feedback integration. This variation demonstrates that organizational learning occurs unevenly across the ecosystem and explains why certain usability issues persist despite their recurrence.

Together, these examples show that the system’s usability is directly linked to organizational workload, communication patterns, and the capacity to incorporate feedback. They also reinforce the interpretation that digital platforms operate as interconnected components of a broader institutional environment in which small interaction problems can escalate into significant operational bottlenecks.

Nonetheless, several adaptive mechanisms were observed. Teams that institutionalized periodic usability reviews, often led by multidisciplinary groups, were able to convert micro-level feedback into actionable improvements. These practices demonstrate that organizational learning, even when emergent, can re-stabilize the ecosystem by translating local experiences into collective norms. This supports the interpretation that usability evaluation functions as an organizational feedback mechanism, enhancing reflexivity within the public service structure.

This observation aligns with recent discussions on agile digital transformation and adaptive governance in the public sector, which emphasize the importance of iterative learning, feedback incorporation, and cross-functional collaboration for sustaining institutional adaptation [Choi and Cucciniello, 2026; Mergel et al., 2020].

4.3 Macro-Level Patterns

At the macro level, the analysis identified tensions between the strategic goals of digital transformation and the operational realities of system design. Policy documents such as the Federal and National Digital Government Strategies emphasize citizen centrality, yet performance indicators remain predominantly procedural and quantitative. This misalignment constrains the capacity of agencies to incorporate experiential data, such as usability findings—into policy assessment.

However, the *SplitGov* case also revealed signs of adaptation. The Secretariat for Digital Government (SGD) has begun integrating qualitative evidence from UX evaluations into its monitoring framework, treating user satisfaction as a proxy for institutional responsiveness. Such initiatives illustrate how usability insights can influence macro-level governance structures, reinforcing the idea that adaptation in digital ecosystems occurs through nested cycles of feedback across institutional boundaries.

4.4 Emergent Cross-Level Patterns

Synthesizing these observations across PSE levels revealed four dominant adaptive patterns: *friction feedback*, *distributed workaround*, *reflexive iteration*, and *policy translation*. Each represents a recurring configuration through which the ecosystem responds to usability stimuli. Table 8 summarizes these patterns, linking empirical evidence to theoretical interpretation.

These adaptive patterns indicate that usability is not merely a set of interface attributes but a dynamic process that mediates the relationship between individual action and institutional change. When considered through the complexity lens, usability evaluation emerges as a diagnostic of systemic health, its anomalies revealing where coordination, learning, or alignment fail within the ecosystem.

The cross-level analysis shows that usability operates as a dynamic mechanism that influences learning, coordination, and adaptation within the public service ecosystem. The findings indicate that interaction challenges identified at the micro level do not remain localized. Instead, they generate ripple effects that affect organizational routines and policy interpretation. This observation aligns with research on digital transformation and public value, which highlights the interdependence between technological design, institutional capacity, and governance structures [Mergel et al., 2019; Vial, 2019].

The results also demonstrate that the ability of an institution to respond to usability issues is a more relevant indicator of maturity than the presence or absence of interface problems. Some teams were able to convert user feedback into concrete improvements, which suggests the existence of learning practices that support adaptation. Other teams relied on informal workarounds, which indicates that unresolved friction at the interface level can create additional cognitive and operational workload for users. This divergence highlights the uneven development of organizational capabilities across the ecosystem.

Another important insight is the role of feedback loops in maintaining or disrupting system stability. When usability findings are systematically incorporated into design decisions, the ecosystem tends to evolve toward higher levels of coherence and predictability. When feedback is fragmented or ignored, users compensate by modifying their own behavior, often at the cost of increased complexity or reduced efficiency. This pattern supports the interpretation of public service ecosystems as complex systems in which small perturbations can produce broader structural effects.

From a sociotechnical perspective, these findings reinforce that usability problems should not be interpreted as isolated interface defects, but rather as manifestations of interdependencies between technological structures, organizational routines, and institutional contexts [Baxter and Sommerville, 2011].

Overall, the discussion reinforces the idea that usability functions both as an evaluative dimension and as a mechanism that influences institutional adaptation. By linking micro-level experience to meso-level routines and macro-level policy environments, the study provides empirical support for the integration of the PSE model with complexity theory. This perspective contributes to a more comprehensive understanding of how digital government systems evolve and why continuous learning processes are essential for sustaining public value creation.

5 Practical Recommendations

This section translates the theoretical and empirical findings of the *SplitGov* usability evaluation into concrete, actionable

Table 8. Emergent Adaptive Patterns in the SplitGov Ecosystem

Adaptive Pattern	Empirical Manifestation	Interpretive Meaning (PSE/Complexity Lens)
Friction Feedback	Recurrent user errors and delays trigger informal communication between teams.	Micro-level disruptions operate as feedback signals that mobilize organizational adaptation and redesign.
Distributed Workaround	Users develop alternative procedures to compensate for interface limitations.	Illustrates self-organization: agents locally adjust behavior to maintain system functioning despite structural rigidity.
Reflexive Iteration	Repeated usability reviews lead to gradual interface improvement and learning.	Demonstrates adaptive cycles where experiential knowledge stabilizes new norms and design conventions.
Policy Translation	Aggregated UX data incorporated into digital-strategy monitoring.	Represents top-down adaptation: policy frameworks evolve to include experiential dimensions of public value.

recommendations for public sector practice. Moving beyond isolated interface fixes, we propose a strategic, multi-level framework for digital governance based on the Adaptive Patterns observed in the public service ecosystem.

5.1 Interface-Level Adaptations Emerging from UX Evaluation

Although this study emphasizes the ecosystemic and organizational implications of usability, the evaluation also generated concrete interface-level redesign recommendations directly derived from the usability testing sessions, guided navigation activities, and heuristic evaluation.

The usability testing sessions revealed recurrent interaction breakdowns associated with unclear navigation flows, inconsistent terminology, insufficient feedback mechanisms, and inefficient search operations. These issues were particularly evident among first-time and occasional users, who frequently relied on trial-and-error strategies or external support to complete operational tasks.

One of the most recurrent problems involved the absence of explicit confirmation feedback after critical operations. Several participants reported uncertainty regarding whether actions had been successfully completed, often leading to repeated submissions or duplicated interactions. To mitigate this issue, the evaluation recommended the implementation of immediate visual feedback mechanisms, including confirmation messages, progress indicators, and clearer system-status notifications.

The evaluation also identified substantial difficulties related to information retrieval. Users frequently reported challenges locating contracts, reports, and operational records due to the absence of advanced filtering and unified search capabilities. In response, the redesign recommendations included:

- implementation of advanced filtering options;
- unified cross-module search functionality;
- contextual autocomplete suggestions;
- personalized and persistent search views.

Another recurring issue concerned inconsistencies in terminology and interaction patterns across modules. Different labels were used to describe similar actions, increasing cognitive load and reducing predictability during navigation. The heuristic evaluation corroborated these findings and motivated recommendations focused on terminology standardization,

interface consistency, and harmonization of interaction elements.

The usability sessions additionally revealed that some participants depended on tacit organizational knowledge to interpret system workflows and complete tasks. This finding motivated recommendations for contextual help mechanisms, including tooltips, onboarding guidance, and embedded interaction support aimed at reducing onboarding friction and improving learnability.

These interface-level adaptations reinforce the interpretation that usability operates simultaneously as a local interaction phenomenon and as a trigger for broader organizational adaptation. In this sense, the redesign recommendations complement the adaptive patterns discussed in the previous section by illustrating how micro-level usability findings can initiate reflexive iteration and institutional learning processes within the broader Public Service Ecosystem.

5.2 Adaptive Mechanisms and Multi-Level Recommendations

The results discussed in the previous section indicate that usability in digital public services operates as an adaptive mechanism through which the ecosystem learns and reorganizes itself. Consequently, recommendations for improving user experience should not be limited to interface adjustments; they must also strengthen the institutional conditions that allow feedback to circulate and generate collective learning. Building upon the patterns identified in the *SplitGov* evaluation and the PSE model, this section presents a set of practical recommendations aimed at enhancing adaptability, resilience, and value co-creation in public digital services.

Table 9 consolidates these recommendations by linking each to a specific level of the PSE model and clarifying its expected adaptive function within the broader digital ecosystem. Together, they underscore that improving usability in public services is not merely a matter of optimizing interface design but of enabling systemic learning that aligns human experience, institutional processes, and policy frameworks.

Implementing these recommendations requires a cultural shift toward reflexive design and governance practices. This shift involves recognizing usability evaluation as an ongoing process of sensemaking rather than as a discrete project phase. In adaptive ecosystems, each usability insight contributes to the co-evolution of technologies and institutions, ensuring that public digital services remain inclusive, resilient, and capable

Table 9. Recommendations for Adaptive and Resilient Digital Service Design

Ecosystem Level	Recommendation	Intended Adaptive Effect
Submicro (User)	Promote participatory testing and longitudinal usability tracking to capture evolving user expectations.	Enables continuous calibration of interface logic and vocabulary to users' cognitive models, reducing overload and alienation.
Micro (Interface)	Implement modular interface components and responsive feedback mechanisms.	Facilitates rapid adjustment and learning through local modifications without disrupting system integrity.
Meso (Organization)	Establish permanent UX governance committees involving designers, managers, and service operators.	Institutionalizes feedback loops and distributes accountability for usability improvement.
Meso (Processes)	Integrate usability indicators into performance dashboards and project evaluation routines.	Creates traceable connections between experience-level data and managerial decision-making.
Macro (Policy)	Include UX and accessibility metrics in national digital government monitoring frameworks.	Encourages policy adaptation through experiential evidence, reinforcing citizen-centric accountability.
Cross-level (Learning)	Adopt adaptive documentation practices that capture design decisions and lessons learned across iterations.	Supports institutional memory and accelerates collective learning in future service development cycles.

of evolving alongside societal needs. These reflections set the stage for the final section, which synthesizes the theoretical and practical contributions of this study and outlines future directions for research on ecosystemic approaches to digital government.

5.3 Governance Implications for G2G System Evolution

The findings of this study yield significant practical implications for public managers, development teams, and policymakers involved in digital governance. Our analysis demonstrates that usability evaluation, rather than being a superficial interface review, can support governance improvements across different levels of the Public Service Ecosystem (PSE). The documented process from friction (usability defects), to learning (evaluation report) and reconfiguration (implementation), introduces the practical notion of Adaptive Patterns for the evolution of Government-to-Government (G2G) systems.

We offer the following recommendations, mapped to the respective levels of impact within the PSE:

- **Institutionalize Continuous UX Feedback (Meso Level):** Government agencies must transition from ad-hoc testing to the formal integration of UX evaluation cycles into their continuous development roadmaps. The experience of the SSC team, which used the findings to establish a development roadmap for 2026, exemplifies the necessity of treating public servant feedback as crucial governance data, institutionalizing learning and strengthening organizational capacity (Meso Level).
- **Elevate UX Findings to Data Integrity Audits (Micro/Meso Link):** The critical finding of value divergence in *SplitGov*, which was revealed by usability testing but required fixing the system's API, underscores the link between user friction and data reliability. Managers should use failures in user experience as diagnostic entry points for potential backend integrity issues. Addressing these issues transforms a usability correction into a fundamen-

tal step toward improving auditability and accountability.

- **Establish a G2G Design Language (Micro Level):** To overcome interface inconsistencies, lack of system status visibility, and complex task flows, agencies must invest in developing a unified Design System tailored for G2G environments. This system should incorporate clearer navigation flows, consistent terminology, explicit feedback messages after task completion, and accessibility-oriented interface standardization identified during the usability evaluation sessions. This system must standardize navigation elements (e.g., breadcrumbs), clarify technical terminology (tooltips), and ensure compliance with accessibility standards, reducing training time and cognitive load for federal employees.
- **Policy Alignment Through Adaptability (Macro Level):** The demonstrated commitment to enhancing system reliability and user experience ensures alignment with national policies such as the National Digital Government Strategy (ENGDD). Policymakers should recognize that investing in internal system usability is a cost-effective method for ensuring regulatory compliance and reinforcing the long-term Public Value generated by the digital government strategy.

By systematically adopting these Adaptive Patterns, public organizations ensure their digital services evolve iteratively, transforming daily user friction into strategic organizational improvements and robust state efficiency.

6 Threats to Validity

Although this study followed a rigorous and triangulated methodological design, several threats to validity must be acknowledged. These limitations do not undermine the relevance of the findings but indicate boundaries for their generalization and guide opportunities for future research.

First, the qualitative nature of the study introduces inherent risks to internal validity. Guided navigation, heuristic evaluation, and interviews may be influenced by the interac-

tion between researchers and participants, especially because the presence of observers can encourage users to alter their behavior or verbalize concerns differently from their routine practice. In addition, the researchers' familiarity with the platform and institutional environment may shape interpretation during coding and synthesis. To mitigate these risks, multiple researchers documented observations independently and engaged in iterative discussions to reconcile divergent interpretations.

A second threat concerns construct validity. The analysis relies on the PSE model as an interpretive framework to connect micro-level usability issues to organizational and policy dynamics. Although the model offers a robust conceptual structure, the process of mapping empirical phenomena to theoretical constructs involves a degree of abstraction and subjective judgment. This also applies to the adaptation of Nielsen's heuristics to the context of government systems, which may influence how specific usability issues are categorized or interpreted.

External validity is also limited. The findings are drawn from a single case within the Brazilian federal administration. Although *SplitGov* is representative of complex G2G platforms, the institutional culture, governance maturity, and digital transformation strategies surrounding it may differ from those in other agencies, states, or countries. The sample of nine participants, despite including diverse profiles, is non-probabilistic and may not reflect the full range of user experiences present across the federal ecosystem.

To mitigate these threats, the study employed methodological triangulation, independent note-taking, reflexive analysis, and documentation of analytic decisions. Still, future research should expand the empirical basis through longitudinal designs, comparative analysis with other platforms, and the inclusion of quantitative indicators to complement the interpretive findings.

7 Conclusion

The core objective of this article was to develop and validate an in-depth interpretation of usability as an adaptive and systemic phenomenon within the Public Service Ecosystem (PSE). This research builds upon and significantly expands the theoretical and empirical foundations established in [Figueiredo et al., 2025]. The analysis moved beyond the traditional view of usability as a static attribute of digital interfaces, conceptualizing it instead as a dynamic process of institutional learning and reconfiguration. To achieve this, the study integrated heuristic evaluation, guided user navigation, and interviews with platform managers. The results demonstrated how micro-level interaction challenges, meso-level organizational routines, and macro-level policy frameworks interact and co-evolve, ultimately shaping the trajectory of public digital service development.

The theoretical contribution of this study lies in the synthesis between the PSE model and complexity theory, offering a new lens through which to understand usability as a driver of adaptation in sociotechnical ecosystems. This perspective repositions usability from a diagnostic tool to a mechanism of systemic feedback, enabling organizations to perceive, interpret, and respond to changes in their operational and political

environments. By introducing the notion of *adaptive patterns*, the study contributes to a more nuanced understanding of how digital government systems evolve through cycles of friction, learning, and reconfiguration.

The practical contribution of this work consists of a set of recommendations that align usability evaluation with institutional resilience. These recommendations emphasize the creation of feedback-rich environments in which user experience data inform both design and policy decisions. When implemented at scale, such practices can transform digital government initiatives into living systems capable of continuous adaptation, balancing operational efficiency with inclusive and user-oriented service design.

From a methodological standpoint, the integration of qualitative and quantitative techniques under the PSE model provides a replicable structure for studying multi-level interactions in digital ecosystems. Future research may build upon this foundation by incorporating computational models, network analysis, or longitudinal evaluation methods to observe how usability-driven adaptations propagate over time and influence the sustainability of digital transformation policies.

In sum, this work reinforces that usability is not the endpoint of digital design but its important driver of continuous improvement. By interpreting digital government as a complex adaptive ecosystem, public institutions can move beyond compliance-based evaluation toward a model of continuous learning and co-evolution. This shift reinforces the role of usability as a relevant organizational capability, one that improves interaction quality, supports organizational learning at the meso level, and contributes to alignment with national digital policies at the macro level, thereby supporting the sustainable creation of Public Value across the entire service ecosystem.

Future investigations could build upon the contributions of this study by addressing its methodological and contextual constraints. First, longitudinal research would make it possible to observe how adaptive patterns evolve over time and how usability-driven changes propagate across organizational routines and policy cycles. Second, comparative studies involving other federal platforms or state-level G2G systems could strengthen external validity and reveal whether similar ecosystemic dynamics emerge in different institutional environments. Third, international comparative analyses, particularly in Global South contexts, could illuminate how sociotechnical complexity, governance models, and digital maturity influence the interplay between usability, institutional learning, and public value creation. Finally, future work may incorporate computational or network-based models to simulate cross-level feedback loops, providing additional analytical depth to the ecosystemic interpretation adopted in this study.

Declarations

Acknowledgements

This research is part of a cooperation agreement between the Information Technology Research and Application Center (ITRAC) at the University of Brasilia (UnB) and the Ministry of Management and Innovation in Public Services (MGI), Shared Services Secretariat (SSC), Information Technology Directorate (DTI).

Authors' Contributions

Rejane M. da C. Figueiredo contributed to Conceptualization, defining the research question and the theoretical framework (PSE model). She also contributed to Supervision and Writing – Original Draft. Marcelo O. Judice contributed to Conceptualization and provided Supervision for the overall project. Andrea C. B. Judice contributed to Conceptualization and supported the definition of the theoretical framework. Glauco V. Pedrosa contributed to Investigation and Data Curation (Heuristic Analysis and Usability Testing). He is the main contributor to Writing – Original Draft and led the Writing – Review & Editing process. Flavio F. Costa contributed to Investigation and Data Curation, supporting usability testing and heuristic analysis. John L. C. Gardenghi contributed to Investigation and Data Curation, participating in the usability evaluation procedures. Stefani P. Ferreira contributed to Investigation and Data Curation during usability testing and heuristic analysis. Bruna de O. Guedes contributed to Formal Analysis, examining the organizational response and post-assessment actions (Institutional Change analysis).

All authors read and approved the final manuscript.

Competing interests

The authors declare that they have no competing interests.

Availability of data and materials

The research materials that are not subject to institutional restrictions have been made publicly available in the Zenodo repository (DOI: <https://doi.org/10.5281/zenodo.21263958>), including the interview protocols, heuristic evaluation instruments, methodological procedures, and other research artifacts used in the study. The data generated within the collaboration with the Information Technology Directorate (DTI) of the Shared Services Secretariat (SSC) of the Ministry of Management and Innovation in Public Services (MGI) cannot be made publicly available due to institutional restrictions formally established by the partner institution.

Further relevant information

Ethical Approval: This study followed institutional ethical procedures applicable to observational and interview-based research involving public servants in organizational contexts. Participation was voluntary, and all participants were informed about the research objectives, confidentiality procedures, and their right to withdraw at any time. All data were anonymized prior to analysis and reporting.

The study is aligned with an ongoing umbrella research project on Service Design and Agile Governance in Digital Government, later approved by the Research Ethics Committee of the University of Brasília (CEP/UnB), under CAAE 94501325.3.0000.5540 and Opinion No. 8.126.365.

Use of Generative AI Tools: Parts of the manuscript, including language refinement and LaTeX formatting, were prepared with the assistance of OpenAI's ChatGPT language model. All conceptual design, data interpretation, and analytical content were entirely developed by the authors. The authors reviewed and validated all AI-assisted outputs before inclusion in the final text.

Citation Diversity Statement: The authors are aware of the potential for bias in citation practices and have made a conscious effort to include references representing a diversity of authors, geographic regions, and perspectives, including works by women, underrepresented groups, and scholars from the Global South.

References

Baxter, G. and Sommerville, I. (2011). Socio-technical systems: From design methods to systems engineering. *Interacting with Computers*, 23(1):4–17. DOI: <https://doi.org/10.1016/j.intcom.2010.07.003>.

Beyer, H. R. and Holtzblatt, K. (1995). Apprenticing with the customer. *Communications of the ACM*, 38(5):45–52. DOI: <https://doi.org/10.1145/203356.203365>.

Brasil (2016a). Decreto n. 8.638: Institui a Política de Governança Digital no âmbito dos órgãos e das entidades da administração pública federal direta, autárquica e fundacional. https://www.planalto.gov.br/ccivil_03/_Ato2015-2018/2016/Decreto/D8638.htm. Accessed on: 13 July 2026.

Brasil (2016b). Decreto n. 8.936: Institui a Plataforma de Cidadania Digital e dispõe sobre a oferta dos serviços públicos digitais, no âmbito dos órgãos e das entidades da administração pública federal direta, autárquica e fundacional. https://www.planalto.gov.br/ccivil_03/_Ato2015-2018/2016/Decreto/D8936.htm. Accessed on: 13 July 2026.

Brasil (2018). Decreto n. 9.319: Institui o Sistema Nacional para a Transformação Digital e estabelece a estrutura de governança para a implantação da Estratégia Brasileira para a Transformação Digital. https://www.planalto.gov.br/ccivil_03/_ato2015-2018/2018/decreto/d9319.htm. Accessed on: 13 July 2026.

Brasil (2020). Decreto n. 10.332: Institui a Estratégia de Governo Digital para o período de 2020 a 2022, no âmbito dos órgãos e das entidades da administração pública federal direta, autárquica e fundacional. https://www.planalto.gov.br/ccivil_03/_ato2019-2022/2020/decreto/d10332.htm. Accessed on: 13 July 2026.

Brasil (2024a). Decreto n. 12.069: Dispõe sobre a Estratégia Nacional de Governo Digital e a Rede Nacional de Governo Digital – Rede Gov.br e institui a Estratégia Nacional de Governo Digital para o período de 2024 a 2027. https://www.planalto.gov.br/ccivil_03/_ato2015-2018/2018/decreto/d9319.htm. Accessed on: 13 July 2026.

Brasil (2024b). Decreto n. 12.198: Institui a Estratégia Federal de Governo Digital. https://www.planalto.gov.br/ccivil_03/_ato2023-2026/2024/decreto/d12198.htm. Accessed on: 13 July 2026.

Choi, H. and Cucciniello, M. (2026). Citizen-centered public service design in agile digital transformation: Insights from public mobility services. *Public Administration*. DOI: <https://doi.org/10.1111/padm.70059>.

Figueiredo, R., Judice, A., Judice, M., Pedrosa, G., Costa, F., Gardenghi, J., Ferreira, S., and Guedes, B. (2025). Beyond the interface: Usability and value creation in the public services ecosystem. In *Anais do XXIV Simpósio Brasileiro sobre Fatores Humanos em Sistemas Computacionais*, pages 18–37, Porto Alegre, RS, Brasil. SBC. DOI: <https://doi.org/10.5753/ihc.2025.10813>.

Figueiredo, R., Pedrosa, G., Gardenghi, J., Venson, E., Judice, M., Judice, A., Costa, F., Silva, W., and Marsicano, G. (2024a). Co-design and co-creation in digital public services: A service design approach. In *Anais do XII Workshop de Computação Aplicada em Governo Eletrônico*, pages 87–98, Porto Alegre, RS, Brasil. SBC. DOI: <https://doi.org/10.5753/wcge.2024.2505>.

- Figueiredo, R., Venson, E., Pedrosa, G., Gardenghi, J., Judice, M., Judice, A., and Costa, F. (2024b). Stakeholder interaction in the redesign and creation of digital public services: a service design approach. In *Proceedings of the XXIII Brazilian Symposium on Human Factors in Computing Systems, IHC '24*, New York, NY, USA. Association for Computing Machinery. DOI: <https://doi.org/10.1145/3702038.3702107>.
- Lindgren, I. and van Veenstra, A. F. (2018). Digital government transformation: A case illustrating public sector innovation. *Government Information Quarterly*, 35(4):657–667. DOI: <https://doi.org/10.1016/j.giq.2018.09.002>.
- Mergel, I., Edelman, N., and Haug, N. (2019). Defining digital transformation: Results from expert interviews. *Government Information Quarterly*, 36(4):101385. DOI: <https://doi.org/10.1016/j.giq.2019.06.002>.
- Mergel, I., Ganapati, S., and Whitford, A. B. (2020). Agile: A new way of governing. *Public Administration Review*, 81(1):161–165. DOI: <https://doi.org/10.1111/puar.13202>.
- Nielsen, J. (1994). Enhancing the explanatory power of usability heuristics. In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems, CHI '94*, pages 152–158, Boston, Massachusetts, USA. ACM. DOI: <https://doi.org/10.1145/191666.191729>.
- OECD (2023). Global trends in government innovation 2023. Technical report, OECD Publishing, Paris.
- OECD (2024). 2023 OECD digital government index: Results and key findings. Technical Report No. 44, OECD Publishing, Paris.
- Osborne, S. P., Powell, M., Cui, T., and Strokosch, K. (2022). Value Creation in the Public Service Ecosystem: An Integrative Framework. *Public Administration Review*, 82(4):634–645. DOI: <https://doi.org/10.1111/puar.13474>.
- Pereira, J. R., Barros, J. F. d. A., Freire, R. d. S., and Vieira França, V. (2021). A qualidade da usabilidade dos portais de transparência das universidades federais do nordeste do brasil. *Revista do Serviço Público*, 72(4):803–823. DOI: <https://doi.org/10.21874/rsp.v72.i4.4795>.
- Pereira, R., Darin, T., and Silveira, M. S. (2024). GrandIHC-BR: Grand Research Challenges in Human-Computer Interaction in Brazil for 2025-2035. In *Proceedings of the XXIII Brazilian Symposium on Human Factors in Computing Systems, IHC '24*, New York, NY, USA. Association for Computing Machinery. DOI: <https://doi.org/10.1145/3702038.3702061>.
- Savveli, I., Rigou, M., and Balaskas, S. (2025). From e-government to ai e-government: A systematic review of citizen attitudes. *Informatics*, 12(3). DOI: <https://doi.org/10.3390/informatics12030098>.
- Vial, G. (2019). Understanding digital transformation: A review and a research agenda. *The Journal of Strategic Information Systems*, 28(2):118–144. DOI: <https://doi.org/10.1016/j.jsis.2019.01.003>.
- Viana, R. R., Sandim, T. L., and Knop, M., editors (2024). *Guia diversidade no setor público: a construção cotidiana de uma gestão inclusiva*. Escola Nacional de Administração Pública (Enap), Brasília.
- Wirtz, B. W. and Birkmeyer, S. (2015). Open government: Origin, development, and conceptual perspectives. *International Journal of Public Administration*, 38(5):381–396. DOI: <https://doi.org/10.1080/01900692.2014.942736>.