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TELEWORK IN PUBLIC UNIVERSITIES: PROPOSAL FOR A MANAGERIAL SOCIOTECHNICAL ASSESSMENT TOOL

TELETRABALHO NA UNIVERSIDADE PÚBLICA: PROPOSTA DE UMA FERRAMENTA GERENCIAL DE AVALIAÇÃO SOCIOTÉCNICA

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ABSTRACT

Purpose: To propose a tool for assessing the technical, personnel, and organizational conditions that affect telework management in Brazilian public universities.

Method/approach: The study was conducted in two stages. The first consisted of a Systematic Literature Review (SLR), which supported the development of a tool for assessing telework conditions, grounded in the sociotechnical approach and structured into three dimensions: technical, personnel, and organizational subsystems. In the second stage, the tool was applied at a public university, and semi-structured interviews were conducted to validate its semantics. Quantitative and qualitative data were triangulated through semantic convergence analysis.

Main findings: The tool validation stage revealed social desirability bias among participants, indicating that public servants value telework and seek to preserve it. This finding prompted reflections on the individual and collective motivations of university public servants, which helped identify the adjustments required to increase the assessment tool's effectiveness in

terms of statement wording, response formats, and expansion of its thematic scope. As a result, the tool became more sensitive to participants' lived realities, enhancing its practical utility and alignment with the context under study.

Theoretical, practical/social contributions: The research contributes to knowledge of telework management in the public sector by integrating the sociotechnical approach as a theoretical basis for assessing its effectiveness. In practical terms, it presents a tool for assessing the sociotechnical conditions of telework, grounded in the literature and empirically validated. The tool enables the diagnosis of situations that affect telework and can guide managers in planning more strategic and human-centered actions. It is a replicable resource with the potential to improve telework programs in the public sector.

Originality/relevance: The study connects theory and practice by proposing a tool grounded in the sociotechnical approach, thereby promoting a more integrated and realistic assessment of telework conditions in the public sector.

Keywords: Telework. Public administration. Managerial tool. Sociotechnical approach. Organizational assessment.

1 INTRODUCTION

Since the early 1990s, telework in the public sector has been the subject of academic research. In recent decades, this work modality has been discussed in the literature as a solution to promote work-life balance, stimulate innovation, and increase efficiency in public organizations (Mele et al., 2023). However, studies have focused more on analyzing the outcomes and effects of telework than on understanding the organizational conditions that support its implementation and sustainability. In this context, there is a gap in the availability of tools that enable an integrated assessment of telework by jointly addressing the technical, personnel, and organizational dimensions involved in its management.

The onset of the Coronavirus pandemic in 2019 made telework a widespread practice worldwide, including in public organizations, which needed to ensure the continuity of service delivery while complying with biosafety and social distancing measures (ILO, 2021). Public universities were no exception and were compelled to adapt their administrative and academic processes. As occurred in many public agencies, educational institutions found telework to be a solution that enabled them to continue performing their core and support activities (Lopes e Lunardi, 2022).

In Brazil, even after the pandemic period, telework became consolidated and formalized within the public sector, including through guidelines issued by the Brazilian Federal Government, which enacted regulations such as Normative Instruction No. 65 of 2020 (Instrução Normativa nº 65 de 2020), Normative Instruction No. 89 of 2022 (Instrução Normativa nº 89 de 2022), and Decree No. 11,072 of 2022 (Decreto nº 11.072 de 2022), which govern the Management and Performance Program (Programa de Gestão e Desempenho—PGD). The PGD further expanded the adoption of telework in the Brazilian public sector and enabled its implementation across ministries, autonomous government agencies, foundations, institutes, and universities. Data for May 2026, made available through the Dashboard of Personnel Participating in the PGD within the Federal Public Administration (Painel de Pessoas em PGD na Administração Pública Federal), indicate that 107,800 federal public servants were working under a telework arrangement, equivalent to 24% of the public

servants eligible for this arrangement and approximately 20% of all active public servants (MGI, 2026).

The consolidation of this model depends, among other factors, on understanding the conditions experienced by public servants participating in telework programs, given the range of factors that shape their experiences. Elements such as the available technological infrastructure, organizational support, and work–life balance directly affect telework-related outcomes. From this perspective, the sociotechnical approach provides an integrative framework for analyzing these dynamics because it considers the interdependence among the technical, organizational, and personnel subsystems (Bélanger et al., 2013). This approach enables a more comprehensive and realistic assessment, thereby contributing to the effectiveness of telework.

Adequate working conditions and relationships grounded in autonomy and transparency are strongly associated with well-being and quality of working life (Nunes & Silva, 2024). Based on an appropriate diagnosis of sociotechnical conditions, public universities can plan more effective actions to improve their telework management policies and practices.

At the same time, the challenges faced by public universities have increased the pressure to adopt management practices that contribute to financial and economic sustainability and to the quality of services provided to society (Siqueira & Fritz Filho, 2023). In this context, the adoption of telework must be aligned with institutional strategies that promote administrative efficiency without neglecting public servants' well-being, which requires tools capable of assessing their working conditions systematically and contextually. This need highlights a gap that remains underexplored in both the literature and the practice of university management.

Accordingly, this research sought to answer the following question: How can a tool be proposed that provides managers with the means to assess the technical, personnel, and organizational dimensions of telework in Brazilian public universities?

To this end, a tool for assessing the sociotechnical conditions of telework was developed and validated for the context of public universities. Its purpose is to support managerial decisions based on data that are sensitive to public servants' realities and to contribute to advancing research on telework management in the public sector.

2 LITERATURE REVIEW

Telework in public administration has been increasingly examined in recent literature. This section first discusses the benefits of this work arrangement and the factors that condition its consolidation in the public sector. It then presents the sociotechnical approach as the theoretical basis for understanding the conditions that influence telework management.

2.1 TELEWORK IN PUBLIC ADMINISTRATION

The emergence of the democratic state in the twentieth century expanded governmental duties and functions, requiring changes in the public management model to achieve greater effectiveness in the services provided to the population (Matias-Pereira, 2018; Secchi, 2009). From this perspective, the transition toward results-oriented management is considered a fundamental step in administrative modernization (Bresser-Pereira, 1997), combining efficiency, accountability, and public service quality.

It is within this context that telework has been viewed as an opportunity to reorganize work in the public service. Given budgetary constraints, which require innovative approaches to maintaining the quality of services provided to the population, telework may offer a solution for increasing operational efficiency (Souza et al., 2021; Lima & Neto, 2020).

Moreover, telework has provided public servants with several benefits. Scheduling flexibility and autonomy in organizing tasks are identified as factors that enable a better work-life balance and improved family interaction, while also fostering a more motivating work environment (Filardi et al., 2020). Conversely, this work arrangement may encounter challenges such as adaptation difficulties, communication failures, weakened institutional ties, and inadequate infrastructure (Santos et al., 2022; Filardi et al., 2020).

These effects tend to manifest unevenly among workers. The literature indicates that, in the absence of supportive organizational and social policies, telework may deepen gender inequalities by reinforcing the overlap between paid work and domestic and caregiving responsibilities (Lu & Zhuang, 2023; Tomei, 2021).

Although telework may, in certain contexts, facilitate the reconciliation of work and family life, empirical research demonstrates that women continue to assume a disproportionate share of domestic demands and responsibilities for caring for children and family members (Tomei, 2021). This suggests that telework alone does not promote shared gender responsibility or the development of more equitable work environments unless accompanied by deliberate institutional decisions to that effect.

Thus, although telework is recognized as a long-term trend, its consolidation in the public sector depends on several factors, including the implementation of robust policies, investment in technological infrastructure, the provision of training, and, above all, the adoption of new leadership practices grounded in trust and team autonomy (Thiago & Gonçalves, 2024).

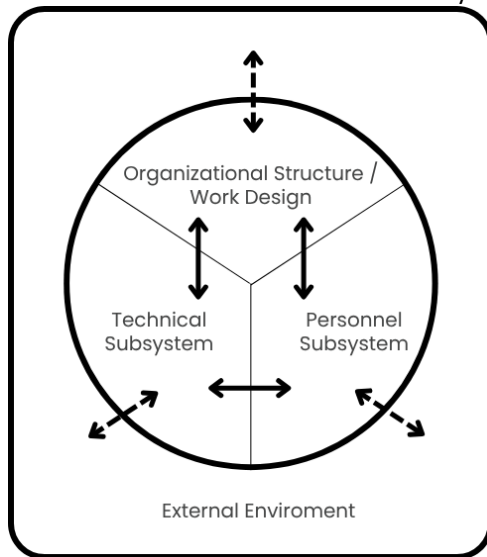
However, the literature on this topic tends to focus on aspects such as satisfaction, well-being, and the meaning of telework for workers, while rarely examining telework management in the public sector (Leite & Lemos, 2021). Therefore, studies of telework in public organizations are needed to inform policies and practices suited to the specific context of these organizations (Mele et al., 2023).

2.2 SOCIOTECHNICAL APPROACH TO TELEWORK MANAGEMENT

Sociotechnical systems theory holds that every organization consists of a combination of technologies and people that are continuously interrelated (Trist & Bamforth, 1951). Unlike approaches that focus exclusively on technological or task-related aspects, sociotechnical theory emphasizes the role of human and organizational factors in the design and implementation of work systems (Gohoungodji et al., 2023).

From this perspective, organizations comprise three internal subsystems—the technical, personnel, and organizational subsystems—and an external environment that continuously influences their functioning (Bélanger et al., 2013). When properly integrated, these subsystems strengthen the fit among teleworkers, their tasks, and the organizational environment, promoting positive outcomes for both individuals and the organization as a whole (Bentley et al., 2016).

Figure 1
Basic Model of the Sociotechnical Work System



Source: Bélanger et al. (2013, p. 1.259)

When applied to telework, the sociotechnical approach provides an integrated perspective on the conditions that influence its effectiveness by considering not only the available technical resources but also the organizational and personnel-related factors that shape workers' experiences. In the model proposed by Bélanger et al. (2013), the technical, personnel, and organizational subsystems represent the internal dimensions of a work system that, through their interaction with the external environment, determine the outcomes achieved through the adoption of telework. Figure 1 illustrates the understanding of work from a sociotechnical perspective.

The technical subsystem encompasses the technologies, equipment, tools, and procedures required to perform the work (Trist & Bamforth, 1951). The infrastructure supporting telework includes information and communication technologies (ICTs), access to secure networks, appropriate equipment, and the ergonomic conditions of the home workspace, ensuring that duties are performed efficiently and safely, even outside the office (Bélanger et al., 2013).

The personnel subsystem, in turn, encompasses the human aspects that directly affect how activities are performed. It includes individual factors, such as motivations, expectations, health, well-being, and skills, as well as collective aspects, such as values, organizational culture, and patterns of social interaction (Trist & Bamforth, 1951; Katz & Kahn, 1966). In the context of telework, the personnel subsystem comprises elements such as attitudes toward work, perceptions of organizational support, preferences regarding social interaction, and the ability to manage simultaneous work and caregiving demands (Bélanger et al., 2013; Lu & Zhuang, 2023).

At a higher level than the technical and personal subsystems, the organizational subsystem is responsible for managing the organization as a whole by defining the objectives, structures, and policies that guide administrative practices. Through this subsystem, the degree of process formalization, the level of centralization or decentralization in decision-making, and the degree of complexity are established, both in the differentiation among units and functions and in the integration required among these components (Bélanger et al., 2013).

Perceived organizational support across the technical, personnel, and organizational subsystems is associated with higher levels of well-being, lower psychological strain, less social isolation, and greater job satisfaction in telework contexts (Beckel & Fisher, 2022). Therefore, work system performance is achieved not through improvements to isolated elements but through the appropriate integration of technical, personnel, and organizational aspects, while also considering the demands of the external environment.

3 METHODOLOGICAL ASPECTS

3.1 SYSTEMATIC LITERATURE REVIEW

This research is applied, descriptive, and qualitative in nature. The study was divided into stages. The first consisted of a Systematic Literature Review (SLR), which provided the basis for developing the constructs of the tool for assessing the sociotechnical conditions of telework.

The SLR was conducted according to the procedures described by Roever (2020), including protocol definition—research question, inclusion and exclusion criteria, and study selection—and critical analysis of the studies. Only articles presenting empirical data on the challenges of telework in Brazilian public administration and published between 2014 and 2024 were selected.

The resulting corpus made it possible to map recurring problems and classify them according to the three subsystems proposed by the sociotechnical approach: technical, personnel, and organizational. Based on the results, an assessment tool was developed in the form of a closed-ended questionnaire using a five-point Likert scale. The statements were developed in accordance with the criterion of theoretical representativeness (Goulart et al., 2012), ensuring that all items corresponded to the constructs identified in the literature.

3.2 EMPIRICAL VALIDATION

The empirical validation of the tool involved its administration to 12 technical-administrative public servants at a federal public university who were engaged in either part-time or full-time telework. Semi-structured interviews were subsequently conducted with the same participants. The research was approved by the Research Ethics Committee of UTFPR-MD under Protocol No. 85323124.0.0000.0165, and the ethical procedures established in the research project were followed during data collection.

The selection of a purposive sample was based on the need to recruit participants with direct experience of telework who could contribute both quantitative and qualitative data, an essential requirement for the methodological triangulation proposed in the study (Denzin, 2017). The study also sought to ensure diversity in terms of gender, age group, organizational unit, and the performance of managerial and nonmanagerial roles to capture different perspectives and experiences of telework.

The number of participants was determined based on methodological and analytical feasibility criteria, considering the decision to conduct an in-depth qualitative analysis manually performed by the researcher. Interviews were conducted until participants' accounts reached a level of analytical saturation sufficient for the semantic validation of the tool. Data collection continued until all sections and themes included in the tool could be assessed in terms of clarity, coherence, and alignment with participants' perceptions. This process made it possible to identify convergences, ambiguities, and divergences relevant to the study objectives.

The preliminary version of the tool contained sociodemographic questions and 23 statements organized into three sections corresponding to the sociotechnical subsystems. The questions addressed aspects such as technical infrastructure and ergonomics, well-being and motivation, guidelines, managerial support, and goal planning, among other issues that shape the telework experience.

Empirical data collection occurred in two phases. The tool was administered through a questionnaire in Google Forms. Semi-structured interviews were then conducted with the same 12 participants. The use of a purposive sample comprising participants who contributed both quantitative and qualitative data enabled methodological triangulation (Denzin, 2017).

This triangulation made it possible to examine the semantic validity of the tool—that is, to deepen the analysis according to the criteria of clarity, coherence, applicability, and thematic coverage. The quantitative data obtained through the administration of the tool were analyzed using descriptive statistics, while the qualitative interview data were analyzed using content analysis (Bardin, 2011).

Semantic convergence analysis is an important stage in validating research instruments because it makes it possible to examine the alignment between the meanings attributed by respondents and the theoretical constructs intended to be measured (Pasquali, 2010). To conduct this analysis, an Excel spreadsheet containing participants' individual questionnaire responses was used. Based on this material, the perceptions expressed in the interviews were compared with the responses provided in the questionnaire for each participant, item, and corresponding theme to assess the consistency of participants' perceptions within the research context.

For each participant and item analyzed, the comparison between the two data sources was qualitatively classified into four categories: convergent, when a participant's statement corroborated the response provided in the questionnaire; divergent, when there was an explicit contradiction between the two sources; neutral, when the account was ambiguous or insufficient to indicate convergence or divergence; and not assessable, when the topic was not addressed during the interview. Each category was assigned a score: 1 for convergent, -1 for divergent, and 0 for neutral or not assessable. Based on these scores, a convergence index was calculated and expressed as a percentage. The index was obtained by dividing the number of convergent responses by the total number of assessable responses, considering only cases classified as convergent or divergent.

4 RESULTS ANALYSIS

4.1 SAMPLE CHARACTERISTICS

The study sample consisted of 12 technical-administrative public servants from the Federal University of Southern Bahia (Universidade Federal do Sul da Bahia) who had joined the Management and Performance Program (PGD), including five men and seven women. Three participants held managerial positions, each supervising between one and five people.

Only one participant was engaged in full-time telework, whereas the others were engaged in part-time telework. Within this group, on-site attendance patterns varied: some public servants performed their activities on the University premises every day for half of the day and worked from home during the other half, whereas others traveled to the institution two or more times per week and worked both daily shifts on on-site workdays.

Regarding the length of participation in telework, seven public servants reported having between one and two years of experience in the Management and Performance

Program (PGD). Three participants reported having engaged in telework for more than two years, while two stated that they had joined the program less than one year earlier.

4.2 QUANTITATIVE RESULTS BY SUBSYSTEM

In the tool, participants rated the statements corresponding to the subsystems using a five-point agreement scale (“1 – Strongly disagree” to “5 – Strongly agree”). To calculate the mean response for each statement, the sum of the scores was divided by the number of valid respondents. The mean score for each subsystem was then calculated as the arithmetic mean of the scores for the statements comprising each section.

The Personnel subsystem received the highest score, with a mean of 4.14, indicating a positive assessment of well-being, routine, and self-management in telework. The Technical Subsystem had an intermediate mean of 3.78, a moderately favorable result that pointed to certain difficulties, such as ergonomics at home and the system used to record institutional activities.

The Organizational Subsystem had the lowest mean, at 3.47, indicating less favorable perceptions regarding the clarity of guidelines, organizational support, goal setting, and communication in telework management.

The analysis of the quantitative data revealed behavioral patterns reflecting the regulatory and institutional context governing telework in Brazilian public universities. The statements with the highest mean scores concerned conditions for which responsibility is assigned to the public servant participating in the PGD, indicating a possible tendency among respondents to assess these aspects positively. Particularly noteworthy were items concerning adequate internet access, equipment availability, and autonomy in performing activities, all of which had mean scores above 4.4.

These results are consistent with the regulations governing the Management and Performance Program (PGD) in Brazilian public administration, which assign the workforce responsibility for funding and ensuring the infrastructure required to perform tasks during telework, while also requiring public servants to self-manage their deliverables. Thus, the high proportion of positive responses to questions concerning personal infrastructure and autonomy appears to reflect, to a considerable extent, an understanding that these conditions are mandatory for joining and remaining in telework.

Conversely, the statements with the lowest mean scores concerned institutional responsibilities, such as guidance on ergonomics, organizational support, management feedback, and telework guidelines, with mean scores ranging from 2.25 to 2.83.

This discrepancy highlights, on the one hand, individual responsibility for self-management in telework and, on the other, weaknesses in the institutional practices that should provide clearer and more structured conditions for its operation. Furthermore, the data support the inference that participants may feel more comfortable and secure providing negative assessments when these concern aspects perceived as falling outside their direct sphere of responsibility—that is, aspects under the institution’s responsibility. Conversely, participants may exercise greater caution or display a positive bias when assessing statements perceived as concerning the public servants’ own responsibilities.

The qualitative data obtained from the interviews made it possible to deepen this analysis by examining participants’ accounts to determine the extent to which they confirmed or contradicted the quantitative assessments.

4.3 CONVERGENCE ANALYSIS OF QUANTITATIVE AND QUALITATIVE RESPONSES

The data convergence analysis involved comparing the perceptions expressed in the interviews with the responses provided in the questionnaire, considering each participant, item, and corresponding theme. Through interpretive judgment, each case was analyzed to determine whether the verbal accounts confirmed, contradicted, or did not directly correspond to the quantitative responses.

The items were classified as convergent, divergent, neutral, or “not assessable.” Based on these classifications, a convergence index was calculated for each item and each subsystem.

The Technical Subsystem had the lowest convergence rate, at 88.78%, whereas the Personnel and Organizational Subsystems both reached 92.75%. Some divergences were identified between participants’ quantitative responses to the tool and the perceptions they expressed during the interviews, as discussed below.

The semantic triangulation results showed that, overall, items related to institutional responsibility exhibited a high level of convergence between the data sources, whereas items related to elements under the direct responsibility of public servants showed greater response divergence. These results appear to reflect a previously identified interpretive pattern in which participants may feel more comfortable providing critical assessments when these concern aspects under institutional responsibility rather than their own performance in telework.

The findings revealed limitations in the wording of certain items and in the preliminary version of the tool’s ability to capture nuances related to comfort, health, and technical challenges without triggering a logic of individual responsibility. These results informed the refinement of the tool, as discussed in the following subsections.

5 DISCUSSION OF RESULTS

5.1 TECHNICAL SUBSYSTEM RESULTS

The Technical Subsystem exhibited the lowest level of convergence (88.78%) between the quantitative and qualitative data compared with the other subsystems, indicating that perceptions of the technical conditions of telework were characterized by greater variation in participants’ interpretations.

During the interviews, some public servants reported having invested their own resources to ensure adequate telework conditions, which, on the one hand, explains the tendency toward positive assessments of issues related to home infrastructure. On the other hand, other participants acknowledged that they lacked adequate conditions, even though they had provided favorable ratings in the tool. In these cases, their statements contradicted their questionnaire responses and included references to the absence of ergonomic furniture, internet connection difficulties, or the inadequacy of the equipment available in the home environment.

The inconsistencies between verbal accounts and quantitative assessments indicate that responses to the tool may have been influenced by discursive strategies aimed at legitimizing telework or protecting oneself in the face of a possible performance assessment. A possible attempt to legitimize telework was also observed, as participants emphasized that limitations in their workstations at home did not interfere with their performance, even when acknowledging those limitations.

These findings suggest the existence of a dynamic of individual responsibility for the technical conditions of work, in which public servants tend to downplay discomfort and material limitations by comparing them with perceived benefits, such as eliminating commuting time and gaining greater flexibility in their routines. This tendency may render factors that affect occupational health and long-term productivity less visible.

Furthermore, within the context of public administration, this implicit transfer of responsibility creates tension with the notion of quality-oriented innovation. When the ability to maintain performance in telework comes to depend on personal resources invested in the home environment, there is a risk of compromising process standardization and weakening the sustainability of telework.

Accordingly, the observed phenomena were interpreted as relevant evidence for improving the assessment tool. The findings demonstrated the need to reformulate the questionnaire items so that they can capture perceptions of comfort, challenges, limitations, and health impacts without triggering a logic of individual responsibility on the part of public servants. This adjustment strengthens the tool's usefulness in supporting managerial decisions oriented toward institutional innovation and public service quality, while preventing individual responsibility for structural shortcomings from becoming normalized.

5.2 PERSONNEL SUBSYSTEM RESULTS

The Personnel subsystem exhibited a high level of convergence between the quantitative and qualitative data (92.75%). This result may suggest that participants felt more comfortable expressing perceptions related to aspects such as health, work-life balance, and well-being in the context of telework. These themes concerned experiences directly lived by the public servants themselves, which may have made it easier for them to perceive, reflect on, and report these conditions consistently.

The results indicate that, overall, the conditions of the Personnel Subsystem were consistently assessed positively, with tangible gains in participants' quality of life, including greater proximity to family, opportunities to attend to their health, healthy eating habits, and the ability to incorporate physical activities into their routines. These factors are associated with individual well-being and, consequently, foster motivation and productivity in performing work activities. These results are consistent with recent literature identifying flexibility and autonomy as relevant factors in public servants' motivation and well-being in telework contexts (Filardi et al., 2020; Beckel & Fisher, 2022).

All but one of the Personnel subsystem questions achieved a convergence rate of 100%, indicating alignment between the questionnaire responses and verbal accounts. However, the analysis revealed a critical issue concerning the statement addressing a telework routine based on defined schedules and planned activities, which had a lower convergence rate (67%). Although some participants assigned high scores to this item, the qualitative accounts revealed work dynamics characterized by flexibility, adaptation to deadlines, and frequent rearrangements between professional and personal demands rather than rigid, standardized schedules.

This result indicates that the wording of the statement did not adequately capture the more autonomous nature of telework and may have led respondents to associate "defined schedules" with a normative expectation of commitment and discipline. Thus, the observed divergence was interpreted as a semantic limitation of the item rather than an inconsistency in participants' perceptions.

Routines that can be adjusted to personal needs were frequently mentioned in participants' accounts and regarded as a positive aspect of telework. However, the wording of Statement 12 suggested that "following defined schedules" was an ideal or desirable practice. Therefore, the lower convergence rate associated with this statement was interpreted as a limitation in the wording of the item, which did not adequately reflect the more flexible and autonomous nature of public servants' telework routines.

5.3 ORGANIZATIONAL SUBSYSTEM RESULTS

The Organizational Subsystem exhibited a convergence rate of 92.75% between the quantitative and qualitative data. When compared with the mean quantitative score assigned by participants to this section (3.47), this rate appears to confirm that participants may feel more comfortable providing critical assessments when these concern aspects under institutional responsibility rather than their own performance in telework.

In contrast to the Technical Subsystem assessment, when responsibility for the condition under evaluation was attributed to the institution, public servants showed less reluctance to express negative perceptions in both questionnaire responses and interviews. In this regard, the quantitative data, corroborated by the qualitative accounts, point to institutional problems concerning the support and management of telework. The absence of clear guidelines, inadequate support and guidance initiatives, and lack of feedback were repeatedly identified as shortcomings in institutional management.

From an accountability perspective, the findings reveal key challenges for telework management. The adoption of results-oriented models requires clear criteria for defining, monitoring, and validating deliverables. The absence of clearly defined parameters tends to create uncertainty, weaken institutional accountability, and hinder the demonstration of telework effectiveness to oversight bodies and society.

Assessments directed at the institution do not appear to activate the same mechanisms of self-protection or mitigation of criticism among respondents as those observed in items more directly associated with their individual responsibilities in telework. Nevertheless, isolated cases of divergence between questionnaire responses and interview statements were identified.

These divergences appear to arise from ambiguity regarding the organizational level to which the items referred—the individual, immediate supervisor, organizational unit, or institution—leading respondents to select intermediate ratings as a strategy for dealing with uncertainty.

These situations demonstrate the need to formulate the tool's items more precisely and contextually by clearly specifying the organizational level to which they refer. Overly general items may generate this type of interpretive ambiguity, leading respondents to select neutral or partial responses as a means of dealing with uncertainty in the question.

5.4 CLARITY OF THE TOOL ITEMS

The analysis of item clarity revealed that, overall, participants understood the statements well. However, comments were identified that suggest the need to revise the wording of certain items, particularly to adapt them to the organizational realities of telework in public universities.

Some participants noted that certain statements presupposed institutional practices that did not correspond to their actual experiences, such as the provision of equipment by the organization or the establishment of goals by management.

In addition to these specific wording issues, a cross-cutting difficulty emerged regarding the response scale itself. Some participants expressed uncertainty about the distinction between the options “Partially disagree” and “Partially agree,” which they perceived as semantically similar, creating uncertainty when selecting the most appropriate response. Although this difficulty did not compromise their understanding of the items, it indicates a relevant semantic limitation of the scale that may affect the accuracy and quality of the responses.

5.5 APPLICABILITY AND THEMATIC COVERAGE

Regarding the tool’s applicability and thematic coverage, the qualitative data indicated that, overall, the topics addressed by the tool reflected key elements of the telework experience, encompassing factors associated with technical conditions, organizational support, communication, well-being, and productivity. However, new topics emerged during the interviews, revealing important thematic gaps that must be addressed to achieve a broader understanding of the sociotechnical conditions of telework.

One such gap was the absence of items addressing the impact of caregiving responsibilities for children, older adults, or family members with special needs and how these responsibilities could affect public servants’ telework experiences. The interviews showed that these responsibilities directly affect public servants’ routines, productivity, and mental health.

The need to incorporate questions concerning gender inequalities was also identified, as women more frequently reported experiencing an excessive burden resulting from the need to reconcile work with domestic demands or family responsibilities. The absence of specific items addressing this topic prevented these nuances from being systematically captured during the quantitative stage.

Tools for assessing telework in the public sector should recognize inequalities in public servants’ experiences, including gender inequalities, particularly when caregiving and work demands overlap in the home environment (Tomei, 2021; Lu & Zhuang, 2023). Accordingly, the tool was refined to capture more sensitively the inequalities in social and organizational conditions that shape the experience of telework.

The findings also demonstrated the importance of incorporating public servants’ perceptions of the institution’s concern for their mental health into the tool. Some participants expressed frustration with the absence of preventive monitoring policies and reported that isolated initiatives, such as lectures, have not been sufficient to effectively promote well-being.

The accounts suggest that the Covid-19 pandemic had lasting effects on public servants’ emotional health and social interaction, reinforcing the need for telework to be accompanied by more structured support strategies.

Another theme that emerged during the interviews was the perception that how the institution understands and communicates its position on telework directly affects public servants’ experiences. Participants reported uncertainty regarding the legitimacy of this work arrangement and the absence of feedback or performance indicators from management. Therefore, the findings demonstrated the need to include items assessing public servants’ perceptions of the institution’s stance toward telework.

Participants also criticized the quality of interdepartmental communication, particularly difficulties in obtaining prompt responses or contacting geographically distant units. This finding indicates the need to broaden the scope of the tool by incorporating items that assess communication at broader organizational levels.

5.6 REVISIONS TO THE TOOL

The application and validation of the tool made it possible to identify several aspects requiring improvement. One of the main phenomena identified during the study was the presence of social desirability bias in participants' responses. This bias occurs when respondents tend to provide socially desirable responses by downplaying problems or exaggerating characteristics perceived as positive (Costa & Hauck Filho, 2017).

Figures 2, 3, and 4 below present the revised sections of the questionnaire.

Figure 2
Questionnaire Section on the Conditions of the Technical Subsystem

Questions	
How would you rate the quality of the internet connection at the location where you perform telework? ☐ Very good (fast and stable, with no connection outages) ☐ Good (usually stable, with rare connection outages) ☐ Fair (some instability and/or slowness) ☐ Poor (frequent connection outages and/or slowness)	To enable telework, did you have to invest your own resources in equipment, furniture, peripherals, or improvements to your internet connection? ☐ Yes ☐ No
Which of the following peripherals do you have and use for telework? (Select all that apply) ☐ Keyboard ☐ Mouse ☐ External monitor ☐ Webcam ☐ Headset (headphones with a microphone) ☐ Printer ☐ No peripherals ☐ Other: _____	Do you find that certain activities are easier to perform during on-site work because of the infrastructure available, such as equipment, internet access, or furniture? ☐ Yes, frequently ☐ Yes, sometimes ☐ Rarely ☐ Never
When teleworking, do you experience any of the following infrastructure-related problems? (Select all that apply) ☐ Connection outages or unstable internet ☐ Slow equipment, system freezes, or insufficient performance ☐ Lack of peripherals that provide comfort (monitor, keyboard, mouse, etc.) ☐ Difficulty accessing all institutional systems, software, or files ☐ Uncomfortable physical environment (furniture, noise, temperature, etc.) ☐ None of the above	At the location where you perform telework, which of the following are available? (Select all that apply) ☐ An ergonomic chair or a comfortable chair suitable for prolonged use ☐ An appropriate desk or work surface ☐ Adequate lighting for work activities ☐ An environment free from excessive noise or other disturbances ☐ An appropriate temperature most of the time ☐ None of the above is available
Does using the infrastructure available to you during telework require greater physical or mental effort than working in the on-site environment? ☐ Yes, frequently ☐ Yes, sometimes ☐ Rarely ☐ Never	Has the organization provided any guidance, training, or materials on how to arrange your work environment ergonomically for telework? ☐ Yes, fully ☐ Yes, to a large extent ☐ Partially ☐ To a limited extent ☐ I received no guidance

Is the system used by the organization to record and monitor telework activities functional and easy to use? ☐ Yes, fully ☐ Yes, to a large extent ☐ Partially ☐ To a limited extent ☐ It is not functional	Does the system allow you to record and organize your deliverables efficiently? ☐ Yes, fully ☐ Yes, to a large extent ☐ Partially ☐ To a limited extent ☐ No, it does not
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Accordingly, the qualitative analysis and its triangulation with the quantitative data revealed the need to modify items whose interpretation may have triggered a logic of individual responsibility. The statements were therefore reformulated to avoid potential biases.

Figure 3
Questionnaire Section on the Conditions of the Personnel Subsystem

Questions	
Under your current telework arrangement, do you perceive that your physical health has remained: ☐ Better than during the period of fully on-site work ☐ The same as during the period of fully on-site work ☐ Worse than during the period of fully on-site work	How has telework affected your mental health and emotional well-being? ☐ Positively—I feel more balanced and experience a better quality of life ☐ In a mixed way—I perceive both benefits and some adverse effects ☐ Negatively—I feel more overwhelmed, isolated, or stressed ☐ I do not perceive any significant impact ☐ I am unable to assess
In your perception, does the institution provide sufficient support to promote the mental health of public servants engaged in telework? ☐ Yes, effective support and care initiatives are available ☐ Partially, but more initiatives could be provided ☐ No, I am not aware of any initiatives addressing this issue ☐ I am unable to assess	Overall, does telework contribute to your work-life balance? ☐ Yes ☐ No
When teleworking, do you perceive that your workload is: ☐ Appropriate and compatible with the time available ☐ High but manageable ☐ Excessive and frequently overwhelming	Do you feel able to organize your work routine in a way that also accommodates your personal and family needs? ☐ Yes, fully ☐ Yes, partially ☐ No ☐ I am unable to assess
Do you usually rearrange or extend your working hours to accommodate family or household activities? ☐ Yes, frequently ☐ Sometimes ☐ Rarely ☐ Never	How do you feel about balancing work and household tasks during telework? ☐ I am able to balance both effectively ☐ I am generally able to balance them, but sometimes experience overload or difficulties ☐ I have difficulty balancing the two sets of demands ☐ This does not apply to my routine
Do you currently have regular caregiving responsibilities for other people, either within or outside your household? ☐ Yes, I care for one or more children ☐ Yes, I care for one or more older adults ☐ Yes, I care for one or more persons with disabilities or health conditions requiring assistance ☐ Yes, I care for people in more than one of these groups ☐ I do not have regular caregiving responsibilities	How do you perceive the impact of caregiving responsibilities on your telework experience? ☐ These responsibilities are easier to manage during telework ☐ They remain similar to the period of on-site work ☐ They are more difficult to manage during telework ☐ Other: _____

In your household, are caregiving responsibilities for other people shared equitably among household members? ☐ Yes, they are shared equitably ☐ Partially, but I assume most of the responsibility ☐ No, I am the primary caregiver ☐ I live alone or do not have these responsibilities ☐ I prefer not to answer	Do you feel that the organization's institutional telework practices and policies accommodate the realities of people with caregiving responsibilities? ☐ Yes, fully ☐ Partially ☐ No, I do not believe they provide adequate accommodation ☐ I am unable to assess
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Items addressing sensitive topics were revised using a supportive and nonjudgmental approach to prevent participants from interpreting them as assessments of public servants' performance or behavior. The language was also revised to redirect the focus toward evaluating institutional practices and the resources provided by the organization. The same approach was applied to the section concerning the Personnel Subsystem.

Figure 4
Questionnaire Section on the Conditions of the Organizational Subsystem

Questions	
Did you receive clear and sufficient guidance from the organization on how telework operates, including its rules, procedures, expectations, and monitoring methods? ☐ Yes, fully ☐ Yes, to a large extent ☐ Partially ☐ To a limited extent ☐ I received no guidance	Does the institution provide sufficient institutional support for telework, such as the following? (Select all that apply) ☐ Guidance on rules, procedures, and the use of systems ☐ Technical support for problems involving systems, VPN access, or remote access ☐ Materials or training on telework, ergonomics, or routine organization ☐ None of these forms of support was provided
In your perception, how are the criteria for participating in telework at the University applied? ☐ Equitably, clearly, and transparently ☐ With some equity, but with limited clarity ☐ They are unclear, and I perceive a lack of equity ☐ I am unable to assess	The work goals agreed upon under telework are: ☐ Clear, well-defined, and compatible with the workload ☐ Unclear or disproportionate to the workload ☐ No formal telework goals have been established ☐ I am unable to assess
Do you feel that you have sufficient autonomy to perform your activities during telework? ☐ Yes, fully ☐ Yes, to a large extent ☐ Partially ☐ To a limited extent ☐ I have no autonomy	During telework, how often do you receive feedback from your immediate supervisor regarding your performance? ☐ Never ☐ Rarely ☐ Sometimes ☐ Frequently ☐ Always
Do you find it easy to communicate with public servants from other organizational units, departments, or institutional locations during telework? ☐ Always—communication is efficient and free of barriers ☐ Frequently—there are minor difficulties, but I am able to communicate effectively ☐ Sometimes—I encounter difficulties that affect the progress of activities ☐ Rarely—communication is usually inefficient	Do you find it easy to communicate with your team (colleagues from your organizational unit) during telework? ☐ Always—communication is efficient and free of barriers ☐ Frequently—there are minor difficulties, but I am able to communicate effectively ☐ Sometimes—I encounter difficulties that affect the progress of activities ☐ Rarely—communication is usually inefficient

☐ Never—I experience considerable difficulty communicating with other organizational units ☐ I prefer not to answer	☐ Never—I experience considerable difficulty communicating with colleagues in my organizational unit ☐ I prefer not to answer
During telework, do you perceive that: ☐ You maintain the same sense of belonging to your team and the organization ☐ Your sense of belonging has decreased compared with on-site work ☐ Your sense of belonging has increased during telework	Does the institution communicate its objectives, expectations, and perceptions regarding telework? ☐ Yes, clearly and consistently ☐ Yes, but only partially or in a poorly structured manner ☐ It rarely communicates about the topic ☐ It does not communicate about the topic

The thematic scope of the tool was expanded to include items assessing, among other issues, gender inequality in telework, caregiving responsibilities, and perceptions of institutional support for public servants' physical and mental health.

In the questions addressing organizational conditions, the organizational levels to which the constructs referred (such as the immediate supervisor, organizational unit, and institution) were specified where appropriate to improve clarity and reduce potential interpretive ambiguities.

In addition to the modifications mentioned above, the initial sociodemographic questions were revised to include questions concerning family composition and caregiving responsibilities within the household routine. Furthermore, rather than relying exclusively on a Likert scale, different response formats were adopted to reduce potential difficulties for respondents.

These changes, grounded in the research findings, were intended to refine the tool as an instrument for meaningfully capturing public servants' perspectives. The empirical application and validation of the tool made it possible to critically assess its alignment with the study's initial objective, which was to propose a tool for assessing the technical, personnel, and organizational conditions that affect telework management in Brazilian public universities.

Guided by an integrated sociotechnical perspective that is sensitive to actual working conditions and the institutional challenges associated with telework implementation and management, the revisions arose directly from the research findings and were intended to strengthen both the tool's diagnostic capacity and its usefulness for public management.

6 FINAL CONSIDERATIONS

The main objective of this study was to propose a tool for assessing the technical, personnel, and organizational conditions that affect telework management in Brazilian public universities. The tool was developed based on a Systematic Literature Review and the sociotechnical approach and was subsequently validated and revised based on its application at a federal university.

The methodology employed successfully achieved the proposed objectives. The results of the validation stage were important and contributed to both practical and theoretical aspects. During the study, public servants exhibited behaviors suggesting concern about ensuring the continuity of telework, a work arrangement they valued, which may have activated a social desirability mechanism in their responses. This phenomenon prompted reflections on the nature of social and political relationships within the university context, the organizational culture of these institutions, and how safe people feel when responding to surveys in their work environment.

However, these behaviors should not be regarded as a limitation of the study. On the contrary, they were essential to deepening the understanding of the individual and collective motivations of university public servants and, consequently, helped identify the adjustments required to increase the effectiveness of the assessment tool in terms of statement wording, response format, and thematic coverage.

Regarding the study's limitations, the empirical validation was conducted at a single federal university, which may limit the generalizability of the results. Specific characteristics of the organization under analysis and the research participants may have influenced the perceptions captured. Furthermore, the possibility that responses were influenced by social desirability reinforces the need for caution when interpreting some of the results.

Nevertheless, by proposing a theoretically grounded and empirically tested assessment tool, this study provides a conceptual basis that can be adapted and further developed in future research. Replicating the tool in other institutional contexts may help assess its alignment with those contexts, identify necessary adjustments, and broaden its potential contribution.

As an agenda for future research, the tool should be applied in different public organizations to investigate its suitability for other contexts and realities. In addition, studies evaluating the use of the tool to support decision-making may contribute to consolidating its practical applicability.

Through the integrated perspective provided by the sociotechnical approach, the tool can support more strategic and human-centered management decisions and practices. Its application makes it possible to diagnose situations that hinder telework and may facilitate the planning of improvement initiatives. The resulting product is therefore a replicable resource with the potential to improve telework programs and foster environments that are more responsive to workers' needs.

It is concluded that research on telework in public universities should consider the complexity of the political and social nuances permeating this context. In this regard, the proposed tool, combined with participatory and human-centered management, may foster practices that are more effective and responsive to public servants' needs.

DECLARATION ON THE USE OF GENERATIVE ARTIFICIAL INTELLIGENCE

The authors used Grammarly and ChatGPT (OpenAI) as language support tools to assist with the translation of the article from Portuguese into English and to provide suggestions for textual revisions. The resulting content was reviewed and edited by the authors, who assume full responsibility for the accuracy, integrity, and content of the article.

AUTHORS' CONTRIBUTIONS

Author 1: Conceituação; Metodologia; Análise formal; Investigação; Curadoria de dados; Redação.

Author 2: Supervisão; Administração do projeto; Validação; Redação (revisão e edição).

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