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Original Article

Measuring Technostress Among Tunisian Remote and Hybrid Engineers: A Descriptive Study and Preliminary Psychometric Assessment in the Age of Generative Artificial Intelligence

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Abstract

Remote and hybrid work are now common in software engineering, although their prevalence varies across countries and firms. They expose engineers to a form of psychological strain known as technostress, which the spread of generative AI tools in development practices has renewed. To our knowledge, no study to date has measured technostress among Tunisian engineers. This study offers a first descriptive mapping of technostress in this population, along with a preliminary psychometric assessment of the scales used to measure it. A cross-sectional quantitative survey was conducted among 85 Tunisian engineers working fully remote or hybrid, recruited through Facebook groups and pages for Tunisian IT professionals between March and May 2026. The questionnaire, administered via Google Forms, measured techno-overload, techno-complexity, AI-related techno-insecurity, techno-isolation, well-being, and work-couple conflict among respondents in a relationship (n = 53). The structure of the instrument was examined through an exploratory factor analysis of the 17 technostress items, and its relationship to well-being was explored through linear and logistic regression and an interaction analysis. Techno-complexity (M = 3.70) and techno-overload (M = 3.12) were the highest-scoring dimensions, ahead of AI-related techno-insecurity (M = 2.79) and techno-isolation (M = 2.37). The scales showed satisfactory to good internal consistency (alpha between 0.74 and 0.91). The factor analysis supported four factors, with every item loading on its intended scale. The four scores were almost uncorrelated with one another, a pattern that is unusual in this literature and needs testing on a larger sample. AI-related techno-insecurity was negatively associated with well-being in every analysis, but the significance of this association depended on how well-being was measured. The relationship between techno-isolation and well-being appeared to differ by telework arrangement. It was negative among hybrid respondents and reversed, without reaching significance, among the 12 fully remote respondents. This study offers a first measurement of technostress among Tunisian remote and hybrid engineers, with preliminary evidence of scale reliability and structure, for future larger-scale research. It also points to two exploratory leads, AI-related techno-insecurity, and telework arrangement. Limitations include the small sample size (n = 85), non-probability sampling limited to a single recruitment channel, newly written scales without external validation, and the cross-sectional design.

Categories: Strategic Human Resource Management, Digital business, Organisational Behavior

Keywords: technostress, remote work, engineers, generative ai, well-being, tunisia, preliminary psychometric assessment, exploratory factor analysis

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Introduction

Remote and hybrid work are now widespread in software engineering. In a 2024 international survey of nearly 55,000 developers, 38% worked fully remote, 42% worked hybrid, and 20% worked in person (Stack Overflow, 2024). These shares differ from one country and firm to another, and many developers, given the choice, still prefer remote or hybrid arrangements (Duong and Chang, 2026) (Sampson, 2025). This shift belongs to a broader transformation of the workplace, one in which cloud computing, collaboration platforms, and, more recently, generative AI are changing both where engineers work and the content of their work.

Both changes also bring strain. Remote work answers a real and legitimate desire for a better balance between professional and personal life, but it also increases exposure to a form of psychological strain that the information systems literature has studied for decades under the name technostress (Tarafdar et al., 2007). The concept long rested on a small set of dimensions. This has recently changed with the spread of remote work and the rapid adoption of generative AI tools in software development practice (Sapkota et al., 2025).

Most of the empirical work available on this topic comes out of India, China, Switzerland, or South Korea, leaving the case of North African countries largely unexplored. In Tunisia, the Information and Communication Technology sector, telecommunications included, accounted for about 4.3% of Gross Domestic Product in 2019 and employed close to 100,000 people in some 2,120 private firms (Direction générale du Trésor, 2026). Remote and hybrid work are present in this workforce, yet no empirical study has measured how it experiences technostress.

Faced with this gap, the present study takes a descriptive approach, with a preliminary psychometric assessment, rather than a confirmatory one. Its aim is not to test a set of pre-established causal relationships, but to answer a more basic question that has so far gone unanswered: how is technostress experienced by Tunisian remote and hybrid engineers, and can a questionnaire built for the occasion capture it reliably and coherently in this context? Once this mapping is established, the study examines, through exploratory multivariate methods, how these dimensions relate to one another and to respondents' well-being, in order to generate leads for future confirmatory research rather than statistically validating them.

The remainder of this article proceeds as follows. The next part of this Introduction presents the conceptual framework used to build the measurement instrument and outlines the analytic strategy adopted. The Research Method section details the study's design, sample, measurement instrument, and data collection procedure. The Results and Discussion section presents the study's findings, first descriptive and psychometric, then exploratory, alongside their interpretation, the instrument's performance relative to other contexts, and the study's limitations. The Conclusions section summarizes the study's contribution and the research avenues it opens.

Conceptual framework

Technostress under Pressure from Generative AI

Tarafdar and colleagues gave technostress its most enduring conceptualization, identifying five constitutive dimensions: techno-overload, techno-invasion, techno-complexity, techno-insecurity, and techno-uncertainty, of which two, techno-overload and techno-complexity, are retained in this study's instrument (see Measurement Instrument section) (Tarafdar et al., 2007). For a long time, this model was enough to describe the tensions employees felt as digitalization advanced around them.

This foundational model was subsequently validated empirically (Ragu-Nathan et al., 2008) and extended through a person-environment fit lens identifying the technology characteristics of usability, intrusiveness, and dynamism that give rise to these stressors (Ayyagari et al., 2011).

The arrival of generative AI tools has reshuffled the picture. Sapkota and colleagues show that the classic technostressors no longer capture the full reality, and propose a complementary taxonomy built around loss of decisional autonomy, technological unpredictability, ethical conflict, and career disruption (Sapkota et al., 2025). It is this broader framework, combining classic and emerging dimensions, that the present study adopts to build its measurement instrument.

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Technostress also differs from the general work stress long studied in occupational psychology, whose classic sources, role ambiguity, role conflict, and general workload, differ from those identified by Tarafdar and colleagues, which are specifically tied to the use of digital technologies (Tarafdar et al., 2007). The two forms of stress remain related at the level of underlying mechanisms nonetheless, since the job demands-resources model of Bakker and Demerouti, drawn on further in this framework, applies equally well to either (Bakker and Demerouti, 2007). It is this specificity of sources, rather than a difference in psychological nature, that justifies relying on a dedicated technostress instrument rather than a general work-stress scale. Because this study did not measure general work stress alongside technostress, it cannot empirically establish this distinction within its own sample, only draw on it as a theoretical justification for the methodological choice made.

Techno-Overload and Techno-Complexity

Duong and Chang, surveying 446 employees including IT professionals, found perceived technological complexity to be a significant antecedent of technostress (Duong and Chang, 2026). A convergent picture emerges from Xie and Yang, who studied 972 IT professionals in China (Xie and Yang, 2025). Within software development specifically, Sampson reports that technological acceleration, combined with pressures specific to hybrid arrangements, weighs directly on practitioners' daily experience (Sampson, 2025). These two dimensions occupy a central place in the instrument built for this study, as the best-documented components of technostress in the existing literature.

AI-Related Techno-Insecurity

Sharma and colleagues, in a phenomenological study of Indian IT professionals, document several psychological themes tied to the perceived threat of AI-driven job displacement, among them chronic anxiety and erosion of professional identity (Sharma et al., 2025). A similar picture emerges from the work of Kwon and colleagues in South Korea and of Jeyam and colleagues in Switzerland (Kwon et al., 2026) (Jeyam et al., 2026). These studies informed the construction of a dedicated AI-related techno-insecurity scale for this study, a dimension the literature suggests may play a particular role in professionals' well-being.

Techno-Isolation

Mirowska and Bakici proposed the concept of techno-isolation, defined as the distress resulting from heavy reliance on communication technologies for professional interaction (Mirowska and Bakici, 2024). Zacharias and colleagues observe that the speed with which generative AI delivers technical answers tends to reduce communication between developers (Zacharias et al., 2026). These studies informed the techno-isolation scale used here. The scale therefore takes a broader view than Mirowska and Bakici and covers two sources of isolation (Mirowska and Bakici, 2024). Q23 and Q24 refer to the distance created by remote work, Q22 to fewer exchanges with colleagues since using generative AI, and Q25 can reflect either.

Well-Being and Couple Life

The job demands-resources model of Bakker and Demerouti offers a frame for linking the dimensions of technostress to engineers' well-being (Bakker and Demerouti, 2007). The work-family conflict literature, initiated by Netemeyer and colleagues, further suggests that exhaustion accumulated at work can spill into personal life, a dynamic this study explores for the first time among remote engineers, through a section dedicated to couple life (Netemeyer et al., 1996).

Analytic Strategy

Rather than formulating causal hypotheses to confirm, this study draws on the conceptual framework above to build a measurement instrument covering four dimensions of technostress along with well-being and work-couple conflict, then to explore, once these dimensions are measured, their internal structure and their relationship to well-being.

This exploration unfolds in two stages. The first stage assesses the reliability of each scale and examines whether these dimensions, as measured in this sample, behave as distinct constructs or collapse into a broader factor, using an exploratory factor analysis of the items. The second stage examines, on an exploratory basis, how these dimensions relate to respondents' well-being, through linear and logistic regression and an interaction analysis testing whether this

relationship varies by telework arrangement. This exploratory strategy reflects the unprecedented nature of the terrain studied: in the absence of any prior data on technostress among Tunisian engineers, a confirmatory approach would have assumed theoretical expectations that nothing yet allowed to be firmly grounded in this specific context.

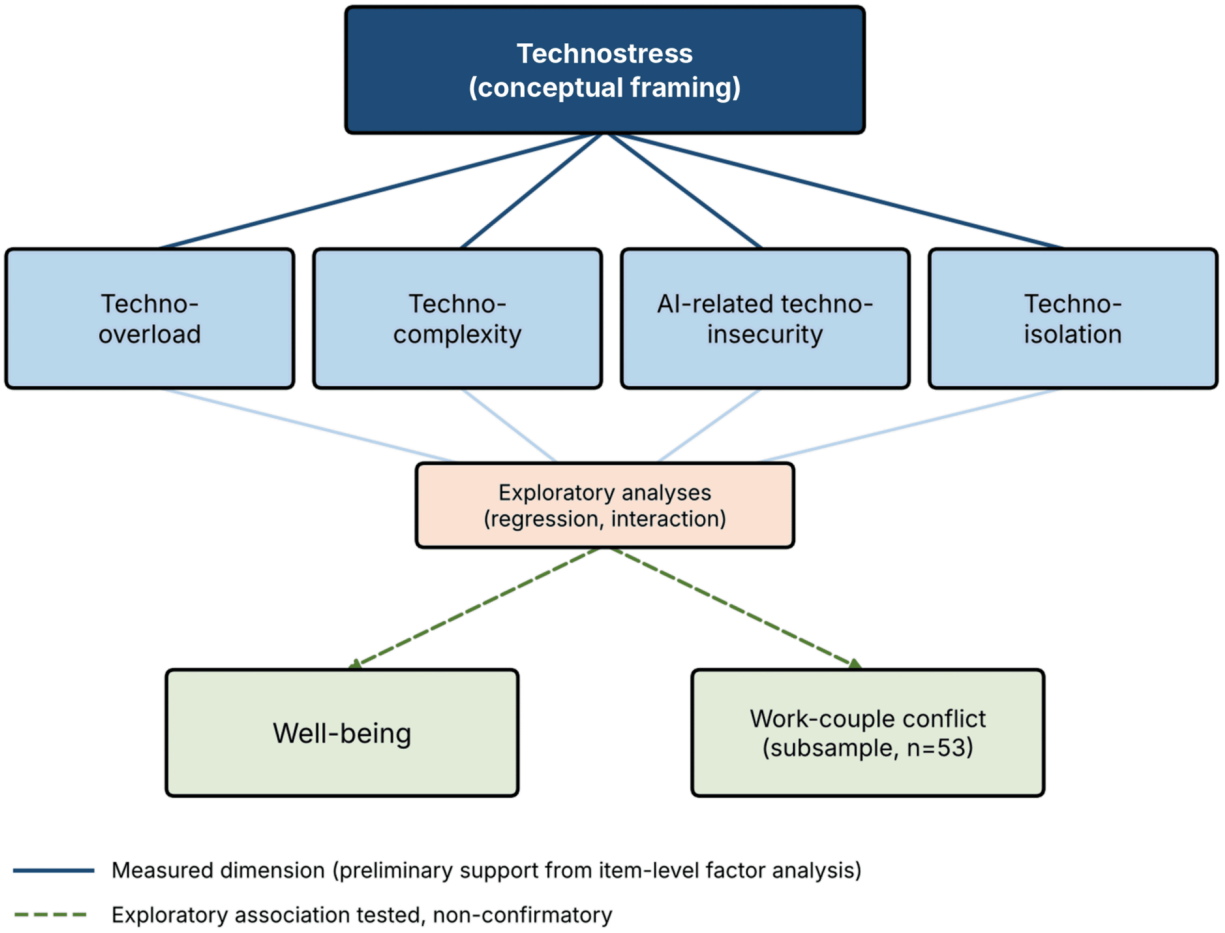

FIGURE 1: Conceptual framework of the measured dimensions.

This figure summarizes the conceptual framework underlying the study's measurement instrument. The four technostress dimensions, techno-overload, techno-complexity, Artificial Intelligence-related techno-insecurity, and techno-isolation, were measured as four separate scales, with preliminary support from an item-level factor analysis (solid lines). The top box shows the conceptual framing of the study and does not stand for an overall score, which the factor analysis did not support. Their exploratory relationship to well-being and work-couple conflict was then examined through linear and logistic regression and an interaction analysis (dashed lines), presented here as non-confirmatory associations rather than tested hypotheses.
Source: Developed by the authors, based on the conceptual framework presented above; figure generated using Python (matplotlib).

Research Method

Study design

This study adopts a cross-sectional quantitative approach aimed at description and preliminary psychometric assessment. It sets out to measure, for the first time, the dimensions of technostress among Tunisian remote and hybrid engineers, to assess the reliability and structure of the scales used to do so, and then to explore, through complementary

methods, how these dimensions relate to one another and to respondents' well-being.

Population and sample

The target population comprises engineers and IT professionals working in Tunisia under a fully remote or hybrid arrangement. An initial eligibility filter, placed at the start of the questionnaire, screened out respondents who did not meet this criterion.

Sampling was non-probabilistic. The survey link was posted by the authors in Facebook groups and pages likely to reach Tunisian developers and IT professionals. The number of groups and pages was not recorded. No respondent was asked to share the link, although some may have done so. The form received 128 responses. Forty-three were removed, most of them because the questionnaire was incomplete and the others because the respondent did not meet the eligibility criterion. The remaining 85 were retained for analysis. This sample suits a first exploratory measurement and does not allow generalization to the whole population.

Measurement instrument

The questionnaire, administered in French, is organized into eight sections totaling thirty-seven items. It opens with the eligibility filter described above, followed by a block of sociodemographic and professional questions covering seniority, industry sector, and frequency of generative AI tool use.

The core of the questionnaire adapts, in modified form, two dimensions from the model of Tarafdar and colleagues: techno-overload (for example, "I am forced to work faster because of the digital tools I use") and techno-complexity (for example, "I find that most of the new tools used in my work are hard to understand"), chosen for having the strongest empirical grounding in the literature (Tarafdar et al., 2007). Two scales built specifically for this study round out these classic dimensions: AI-related techno-insecurity (for example, "I fear that generative AI tools will make some of my skills obsolete"), drawing on the work of Sharma and colleagues (Sharma et al., 2025) and of Sapkota and colleagues (Sapkota et al., 2025), and techno-isolation (for example, "I feel professionally isolated in my remote work environment"), drawing on Mirowska and Bakici for isolation linked to remote work and on Zacharias and colleagues for reduced exchanges linked to generative AI (Mirowska and Bakici, 2024) (Zacharias et al., 2026). A short well-being scale rounds out the instrument (for example, "I feel efficient and energized in carrying out my professional tasks"), followed by a final, optional section on work-couple conflict (for example, "The time I spend on my professional digital tools eats into the time I spend with my partner"), reserved for married or partnered respondents and introduced through an explicit skip logic. All closed-ended scales use a five-point Likert format.

The well-being scale was developed for this study, drawing conceptually on the exhaustion-vigor structure central to the job demands-resources model already used to frame the study's outcome variable, rather than adapting a single pre-existing validated instrument (Bakker and Demerouti, 2007). The work-couple conflict scale was likewise developed for this study, drawing conceptually on the work-family conflict literature, narrowing its broader scope to couple life specifically, rather than adapting Netemeyer and colleagues' validated scale item by item (Netemeyer et al., 1996). The work-couple conflict score is the mean of Q31 to Q34. Q35, on overall satisfaction with the relationship, was asked as a separate question and is not part of this score or of the analyses reported here. All items measuring AI-related techno-insecurity, techno-isolation, well-being, and work-couple conflict were newly written for this study rather than adapted item by item from existing validated instruments, reflecting the absence of established quantitative scales for these emerging constructs in the literature to date. Items were written directly in French by the authors, who based the content of each scale on the studies cited in the conceptual framework [(Sharma et al., 2025) (Sapkota et al., 2025) for AI-related techno-insecurity; (Mirowska and Bakici, 2024) (Zacharias et al., 2026) for techno-isolation; (Bakker and Demerouti, 2007) for well-being; (Netemeyer et al., 1996) for work-couple conflict]. Before distribution, one engineer from the target population completed the questionnaire to check that the questions were clear. No content validation, expert review, formal pretest or pilot test was carried out, and no cognitive interviews were conducted. The two exhaustion items (Q26 and Q27) were reverse scored before analysis, so that higher scores on all four items indicate better well-being. The complete questionnaire is provided in English translation in the Appendices.

Data collection procedure

Data collection ran over three months, from March to May 2026, exclusively through Facebook groups and pages for Tunisian developers and IT professionals. The questionnaire, hosted on Google Forms, guaranteed complete respondent anonymity, with no directly identifying data collected. Participation was entirely voluntary, and an introductory message stated the study's purpose, its estimated duration, and the optional status of the section on couple life.

Analysis plan

The analysis unfolds in two stages, consistent with the study's descriptive and preliminary psychometric positioning rather than a set of hypotheses to confirm.

The first stage, central to the study, provides a detailed description of the sample and measures the six scales using descriptive statistics (mean, standard deviation) and Cronbach's alpha for each scale. An exploratory factor analysis (minimum residual extraction, oblimin rotation) is then run on the 17 technostress items to examine whether they group into the four intended scales. The number of factors is checked with parallel analysis.

The second stage, exploratory, examines how these dimensions relate to respondents' well-being, using linear regression on the continuous well-being score, a logistic regression estimating the likelihood of reporting high well-being, and an interaction analysis testing whether the relationship between technostress and well-being varies by telework arrangement. These analyses are presented as exploratory and indicative, meant to guide future confirmatory research rather than to establish causal relationships.

Well-being was operationalized as a continuous score (the mean of its four items) in the linear regressions and the interaction analysis, and dichotomized for the logistic regression (strictly above the sample median of 3.50 versus at or below it). As a check that does not depend on reverse scoring, the linear regression was repeated with the two positively worded items only (Q28 and Q29). No correction for multiple testing was applied. The interaction was also checked with robust standard errors (HC3) and by removing each fully remote respondent in turn.

Ethical considerations

Respondent anonymity was preserved at every stage of data collection, with no email address or personal identifier requested at any point. Participation rested on informed consent, presented at the start of the questionnaire, and the section on couple life remained entirely optional, with a "prefer not to answer" option offered for every sensitive item.

Results And Discussion

Results

Sample Characteristics

The final sample includes 85 Tunisian engineers working fully remote or hybrid, who completed the entire questionnaire between March and May 2026. Table *1* presents the details of its composition.

Variable	Category	n	%
Gender	Male	48	56.5
	Female	37	43.5
Age	Under 25	3	3.5
	25–34	22	25.9

	35–44	52	61.2
	45 and over	8	9.4
Marital status	Single	35	41.2
	Partnered, unmarried	18	21.2
	Married	31	36.5
	Other	1	1.2
Seniority	Under 2 years	11	12.9
	2–5 years	43	50.6
	6–10 years	29	34.1
	Over 10 years	2	2.4
Sector	IT service company	4	4.7
	Offshoring	7	8.2
	Startup	19	22.4
	Product company	5	5.9
	Freelance	28	32.9
	Other	22	25.9
Telework arrangement	Fully remote	12	14.1
	Hybrid	73	85.9
Generative AI use	Daily	53	62.4
	Several times a week	31	36.5
	Occasional	1	1.2
Total		85	100

TABLE 1: Sociodemographic and professional characteristics of the sample (n = 85).

Source: Survey data collected by the authors (n = 85).

As Table *1* shows, the sample skews male, sits mostly between 35 and 44 years old, works predominantly hybrid, and reports daily generative AI use for nearly two-thirds of respondents.

Measuring Technostress: Levels and Scale Reliability

This section forms the core of the study's results: the first documented measurement of technostress among Tunisian remote and hybrid engineers, together with a preliminary psychometric assessment of the scales. Table *2* reports, for each dimension, the mean, standard deviation, reliability, and the intensity ranking of the four technostress dimensions proper.

Rank	Dimension	Items	Mean	SD	Cronbach's alpha
1	Techno-complexity	4	3.7	0.86	0.909*
2	Techno-overload	4	3.12	0.73	0.738
3	AI-related techno-insecurity	5	2.79	0.87	0.806
4	Techno-isolation	4	2.37	0.73	0.78
—	Well-being	4	3.42	0.65	0.754
—	Work-couple conflict (n=53)	4	3.7	0.75	0.751

TABLE 2: Descriptive statistics, reliability, and ranking of the scales (n = 85).

*Seventeen respondents (20%) gave the same answer to all four techno-complexity items (straight-lining). Without them, alpha is 0.853 (n = 68). The ranking (Rank column) applies only to the four technostress dimensions proper; well-being and work-couple conflict, being outcome variables rather than stressors, are not ranked. Well-being scores were computed after reverse scoring the two exhaustion items (Q26 and Q27).
Source: Authors' calculations, based on survey data (n = 85)

Table *2* shows, moreover, that difficulty keeping up with the pace of tool and technology change (techno-complexity) is, on average, the most intensely felt stressor among the Tunisian engineers in this sample, followed by workload and pace pressure (techno-overload). The dimensions more directly tied to generative AI, AI-related techno-insecurity and techno-isolation, score lower, suggesting that the more classic tensions of technostress still dominate this population's experience at this stage.

All scales reach a satisfactory to good level of internal consistency (alpha ≥ 0.74). The high alpha for techno-complexity is partly due to straight-lining, but it remains good once these respondents are removed. No respondent gave identical answers across all 17 technostress items. The work-couple conflict scale was analyzed for the 53 respondents who answered yes to Q30. This number differs from the marital status counts in Table *1* because five single respondents reported being in a relationship and two married respondents answered no.

Dimensional Structure of Technostress

An exploratory factor analysis was run on the 17 technostress items. Sampling adequacy was acceptable (KMO = 0.742) and Bartlett's test was significant ($\chi^2(136) = 580.7$, $p < 0.001$). Four eigenvalues exceeded 1 (3.27, 3.04, 2.52 and 2.18, the fifth being 0.86) and parallel analysis also retained four factors, which together explained 54.6% of the variance. As Table *3* shows, every item loaded on its intended factor (0.45 to 0.90) with no cross-loading above 0.20. The four factors were almost uncorrelated (−0.06 to 0.12), as were the four scale scores (−0.07 to 0.12).

Item	Techno-overload	Techno-complexity	AI-related techno-insecurity	Techno-isolation
Q9 Work faster	0.64	0.02	0.12	−0.13
Q10 Work longer hours	0.70	0.00	0.12	−0.05
Q11 Many tools at once	0.82	−0.01	−0.09	0.10
Q12 Volume of information	0.45	0.07	−0.18	−0.11
Q13 No time to improve skills	0.05	0.85	−0.05	0.02
Q14 Tools hard to understand	0.06	0.90	0.03	0.03
Q15 Regularly learn new tools	0.00	0.76	0.05	−0.02
Q16 Pace of change	−0.10	0.87	0.01	−0.04
Q17 Skills obsolete	−0.01	0.09	0.65	−0.02
Q18 Pressure to keep training	−0.03	−0.06	0.75	−0.20
Q19 Expertise losing value	−0.06	0.08	0.70	0.05
Q20 Job security	0.11	−0.05	0.60	0.07
Q21 Reduced autonomy	0.07	0.00	0.70	0.19
Q22 Ask colleagues less	0.05	0.06	−0.10	0.76
Q23 Lack of informal exchanges	0.03	−0.01	0.08	0.65
Q24 Professionally isolated	−0.15	0.12	−0.11	0.58
Q25 Learn less from seniors	−0.02	−0.10	0.10	0.79
Variance explained	10.8%	17.3%	14.3%	12.2%

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TABLE 3: Factor loadings from the exploratory factor analysis of the 17 technostress items.

Minimum residual extraction, oblimin rotation. Loadings on the intended factor are in bold. Item labels are shortened; full wording is given in Appendix A.
Source: Authors' calculations, based on survey data (n = 85).

This gives preliminary support for the four scales as separate measures. It does not support an overall technostress score, and the absence of correlation between factors is unusual in this literature, where moderate correlations are the rule. With 85 respondents and no second sample, the structure remains to be confirmed.

Exploratory Associations

The following associations are presented on an exploratory, non-confirmatory basis.

Regarding AI-related techno-insecurity by professional seniority, engineers with 5 years of seniority or less (n = 54) report a mean score of 2.88, compared with 2.63 among those with more than 5 years (n = 31), a gap that runs in the direction the literature would predict but does not reach statistical significance ($t = 1.244$, $p = 0.219$).

As for the relationship between techno-isolation and frequency of generative AI use, the Spearman correlation is weak and non-significant ($\rho = -0.083$, $p = 0.450$). Likewise, for the relationship between overall technostress and work-couple conflict (n=53), the Pearson correlation is also weak and non-significant ($r = -0.219$, $p = 0.115$). The negative direction runs counter to theoretical expectations, which anticipated a positive association between higher technostress and greater work-couple conflict; combined with its non-significance, this result offers no support for the expected relationship. The overall score is the mean of four almost uncorrelated scales, so this result should be read with that reservation.

Technostress Dimensions and Well-Being

Mean scores by dimension, already presented in Table *2*, are shown visually in Figure *2*.

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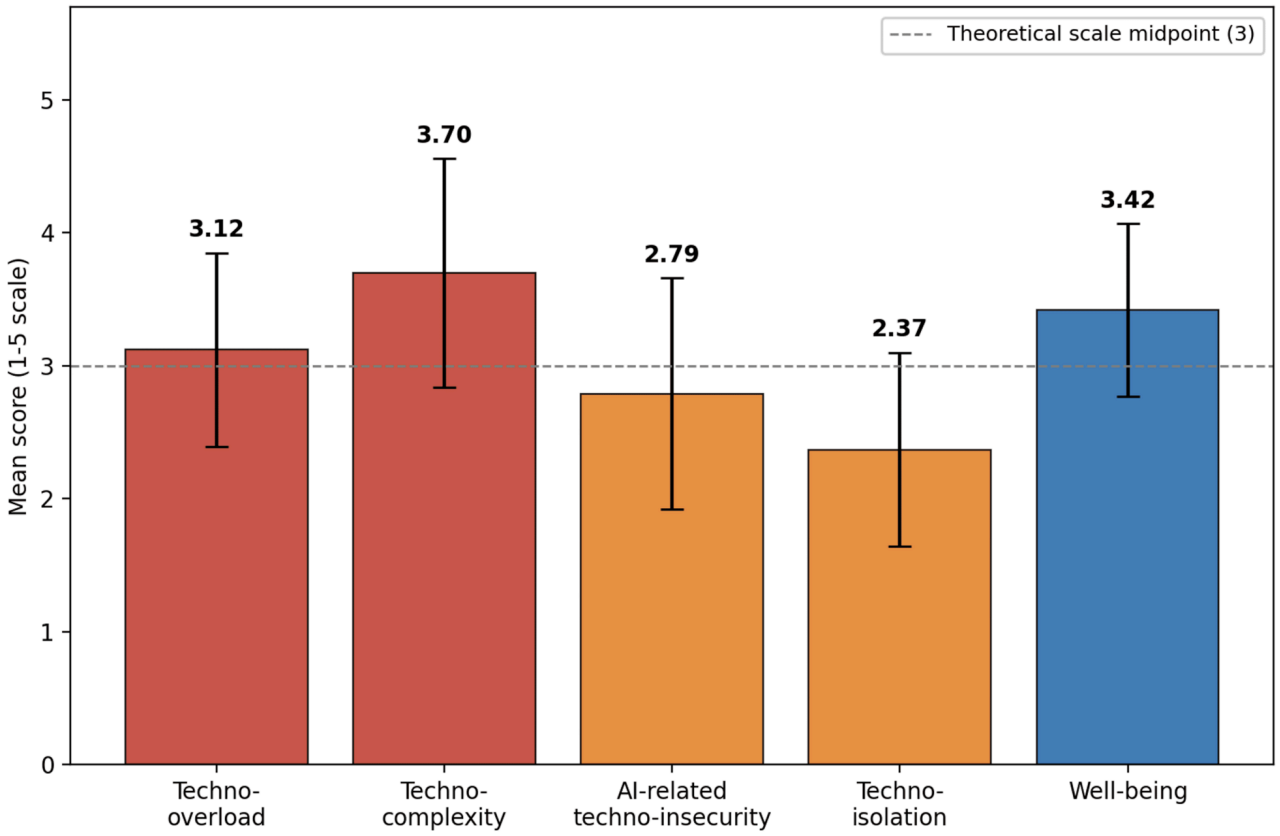

FIGURE 2: Mean scores of the technostress dimensions and well-being.

Mean score for each of the four technostress dimensions and for well-being on a five-point scale. Error bars show one standard deviation, and the dashed line marks the scale midpoint (3).
Source: Developed by the authors, based on the results presented in Table 2; figure generated using Python (matplotlib).

A logistic regression examined the likelihood of reporting high well-being (above the sample median) as a function of the four technostress dimensions and control variables (gender, telework arrangement). Table *4* presents the detailed results, illustrated in Figure *3*.

Predictor	Odds ratio	95% CI	p
Techno-overload	1.14	[0.57, 2.26]	0.710
Techno-complexity	1.08	[0.62, 1.90]	0.780
AI-related techno-insecurity	0.42	[0.22, 0.80]	0.008
Techno-isolation	0.56	[0.28, 1.14]	0.110
Gender (female)	0.95	[0.35, 2.63]	0.925
Fully remote	0.36	[0.07, 1.98]	0.240

TABLE 4: Logistic regression: predictors of high well-being.

Overall model significant (p = 0.048), McFadden's pseudo-R^2 = 0.116. High well-being is defined as a score strictly above the sample median (3.50) (29 respondents). The reference group (56 respondents) includes the 15 respondents scoring exactly at the median.
Source: Authors' calculations, based on survey data (n = 85); results from the logistic regression estimating the likelihood of high well-being.

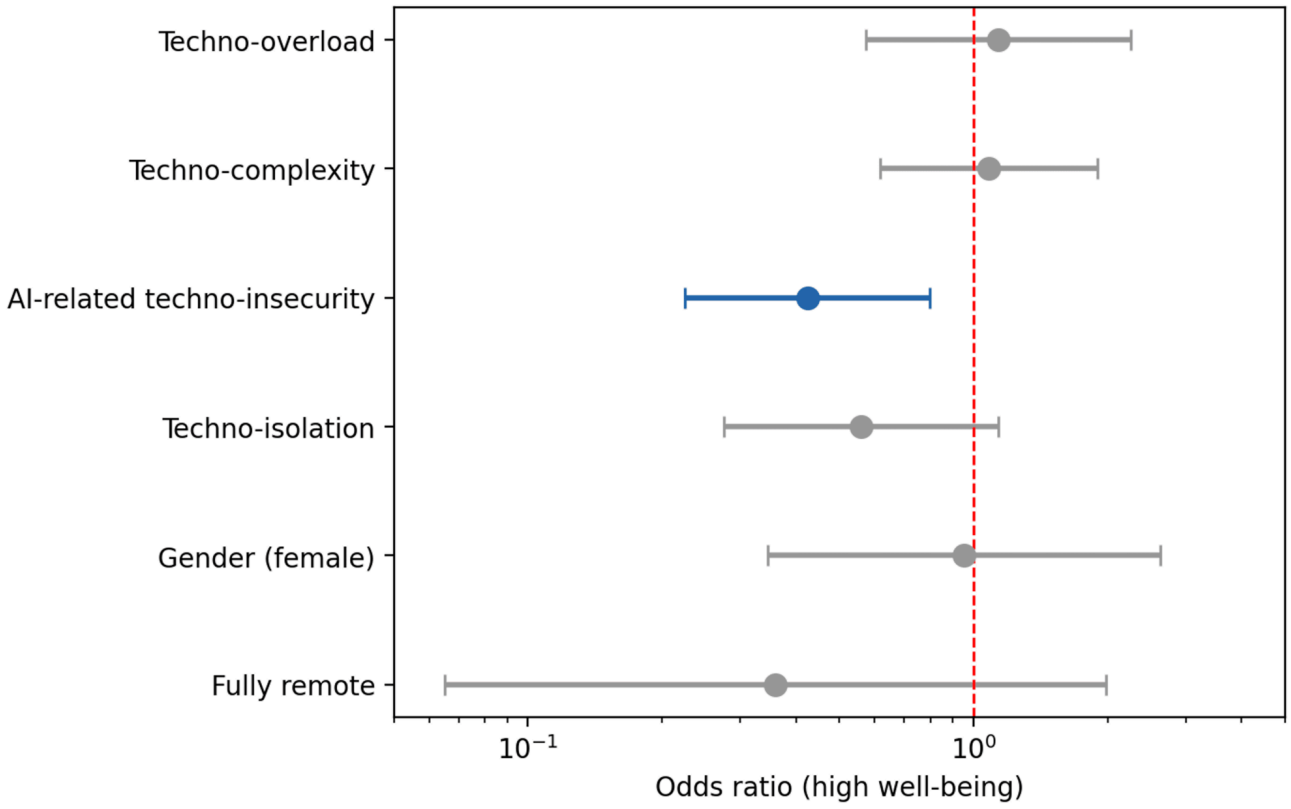

FIGURE 3: Odds ratios from the logistic regression of well-being.

Odds ratios and 95% confidence intervals for each predictor in the logistic regression of high well-being (score above the sample median). The dashed vertical line marks an odds ratio of 1 (no association). Only the interval for AI-related techno-insecurity (in blue) excludes 1. This result depends on the median cutoff (see Table 5).
Source: Developed by the authors, based on the results presented in Table 4; figure generated using Python (matplotlib).

As Table *4* and Figure *3* show, AI-related techno-insecurity is the only predictor associated with the odds of above-median well-being (OR = 0.42). This result is not robust. It disappears when the cutoff is set at the scale midpoint (p = 0.275). Table *5* reports linear regressions on the continuous score. With the four-item score, the coefficient for AI-related techno-insecurity is negative and just short of significance (b = −0.157, p = 0.055), and techno-overload and techno-complexity show no association with well-being. With the two positively worded items only, the association with AI-related techno-insecurity is significant (b = −0.251, p = 0.007). The direction is the same in all three analyses, but the size and significance of the association vary with how well-being is measured.

Predictor	Four-item score: b [95% CI]	p	Two-item score (Q28, Q29): b [95% CI]	p

Techno-overload	0.052 [−0.139, 0.243]	0.588	0.020 [−0.196, 0.236]	0.854
Techno-complexity	0.015 [−0.145, 0.176]	0.850	−0.064 [−0.245, 0.118]	0.487
AI-related techno-insecurity	−0.157 [−0.318, 0.004]	0.055	−0.251 [−0.433, −0.069]	0.007
Techno-isolation	−0.166 [−0.356, 0.024]	0.086	−0.145 [−0.360, 0.070]	0.182
R^2	0.079		0.107	

TABLE 5: Linear regressions of well-being on the four technostress dimensions.

Unstandardized coefficients. Overall model: F(4, 80) = 1.70, p = 0.157 for the four-item score; F(4, 80) = 2.41, p = 0.056 for the two-item score.
Source: Authors' calculations, based on survey data (n = 85).

Exploratory Interaction: Isolation, Telework Arrangement, and Well-Being

A final exploratory analysis tested whether telework arrangement (fully remote versus hybrid) moderates the relationship between techno-isolation and well-being. The interaction term is significant (coefficient = 0.636, p = 0.024), but this result is fragile. With robust standard errors (HC3) it falls short of significance (p = 0.065), and removing any one of the 12 fully remote respondents in turn leaves the coefficient positive (0.45 to 0.86) but not always significant (p up to 0.162). It was the only one of the four dimensions to show such an interaction, and the result would not hold after correction for four tests. Among hybrid respondents (n = 73), isolation is negatively associated with well-being, consistent with theoretical expectations (r = −0.282, p=0.016). Among fully remote respondents (n = 12), the relationship appears to reverse, though it does not reach significance within this small subgroup (r = 0.507, p = 0.093). The interaction was virtually unchanged when the item on AI use (Q22) was removed from the isolation score (coefficient = 0.643, p = 0.023).

This result calls for particular caution: the fully remote subgroup is very small, and the reversed trend it shows rests on a handful of respondents. One possible explanation, which these data cannot test, is that some fully remote engineers chose this arrangement and experience isolation less as distress.

Discussion

What this First Measurement Reveals, Viewed Against Other Contexts

This study offers, to our knowledge, the first empirical measurement of technostress among Tunisian remote and hybrid engineers. The overall level reported here, with techno-complexity well above the scale midpoint and techno-overload slightly above it (Table *2*), is close to what Kasemy and colleagues observed among Egyptian healthcare staff working remotely during the pandemic: a technostress level they themselves describe as moderate to high (Kasemy et al., 2022). The comparison deserves some nuance given the different sector and country, but it suggests that this level of intensity may not be specific to any one occupation or organizational culture in the region.

A more direct comparison comes from work conducted in South Africa by Harunavamwe and Ward, who likewise document substantial technostress among remote employees, with a measurable association on what they call workplace flourishing (Harunavamwe and Ward, 2022). This comparison remains indicative, given the differences in country, sample and scales used.

Instrument Psychometric Performance, a Useful Comparison

The reliability obtained here for the scales (Table *2*, alpha between 0.74 and 0.91) falls within a range comparable to that reported for instruments already validated on larger samples. Colledani and colleagues, developing a technostress scale for everyday life tested on 602 Italian respondents, report solid psychometric properties for a four-factor structure close to the one adopted here, which is consistent with an organization into distinct technostress dimensions, although our own evidence for this structure comes from a single small sample (Colledani et al., 2025). Comotti and colleagues, validating a technostress scale for the aging workforce on 470 Italian respondents, report reliability coefficients above 0.75 across all their subscales, a threshold the present study reaches for five of its six scales despite a considerably smaller sample (Comotti et al., 2025).

These comparisons concern internal consistency only. The scales used here are new and their validity against external criteria has not been tested. The lack of correlation between the four scores also sets this sample apart from earlier studies, where moderate correlations are usual.

A Contribution Rooted in Measurement, Qualified by Two Exploratory Leads

Most of the associations tested here were not significant. Techno-overload and techno-complexity, the two highest scores, showed no relationship with well-being. AI-related techno-insecurity did not differ by seniority, techno-isolation was unrelated to the frequency of AI use, and the link between technostress and work-couple conflict was weak and in the opposite direction to what we expected. The most likely reasons are the small sample, which gives little statistical power, and the use of newly written scales whose validity is not established. These null results should not be read as evidence that the relationships do not exist. A recent systematic review of 201 empirical studies also reports unstable findings across contexts (Mansuroğlu and Smith, 2026).

Two results nonetheless deserve attention. The first is the association between AI-related techno-insecurity and well-being. Its direction is negative in every analysis, but it is significant only in the logistic model with a median cutoff and in the regression on the two positively worded items. It is a lead, not an established effect. The second concerns telework arrangement. Suh and Lee already noted that vulnerability to technostress varies considerably with telework intensity. In this sample, isolation is negatively associated with well-being among hybrid respondents but not among those working fully remote (Suh and Lee, 2017). With only 12 fully remote respondents, and a result that does not hold with robust standard errors, this difference is indicative at most, and it makes telework arrangement a variable worth examining in future studies.

Practical Implications

Independently of the statistical associations, the high levels of techno-complexity and techno-overload in this sample (Table *2*) are relevant for Tunisian technology organizations. This echoes the recommendations made by Harunavamwe and Ward in the South African context, where insufficient perceived organizational support was associated with higher technostress in remote work, a lead worth testing directly in a future Tunisian replication (Harunavamwe and Ward, 2022).

If confirmed, the interaction observed above would suggest that telework policies should not treat isolation as a uniform risk, since its association with well-being may differ by work arrangement.

Limitations

This study relies on a small sample (n = 85, n = 53 for the couple subgroup, n = 12 for the fully remote subgroup) and non-probability recruitment limited to a single channel, which limits how far its descriptive findings can be generalized to the broader population of Tunisian remote and hybrid engineers. Unlike the larger-scale validation studies cited above (602 respondents for Colledani et al., 470 for Comotti et al.), this study makes no claim to a definitive psychometric validation of the instrument, only a first assessment of its performance in a context never before explored.

The cross-sectional design also rules out any causal claim, and the especially small fully remote subgroup (n = 12) calls for a cautious reading of the interaction reported above, which will need confirming on a sample more evenly split across telework arrangements. Additionally, the sample's telework composition is highly unbalanced (85.9% hybrid, 14.1% fully

remote); descriptive findings and mean-level comparisons should therefore be read as primarily reflecting the experience of hybrid engineers, the interaction reported above notwithstanding, rather than as equally representative of fully remote engineers.

Several limits concern measurement. The scales are new and have evidence of internal consistency and of factor structure in this sample only, with no test against external criteria. The techno-isolation scale combines isolation linked to remote work and isolation linked to AI use. The four items loaded on a single factor, but with four items these two sources cannot be separated. One respondent in five gave identical answers to all four techno-complexity items. The near-zero correlations between the four technostress scores are unusual in this literature and may signal measurement problems. The questionnaire was checked by a single engineer before distribution. About one third of the responses received were incomplete and could not be used, and we have no information on whether these respondents differed from those retained. The number of Facebook groups and pages used was not recorded, so no response rate can be calculated. Recruitment through Facebook also reaches only engineers who use these groups, and people who chose to answer may be those most concerned by the topic. The levels of technostress reported here may therefore be higher or lower than in the wider population, and this bias cannot be estimated with the available data. Several tests were run without correction for multiple comparisons, so isolated significant results may be due to chance. Finally, we found no official statistics on telework in Tunisia and no earlier Tunisian study on technostress to compare our results with.

Directions for Future Research

A larger-scale replication, allowing for confirmatory factor validation comparable to that conducted by Colledani and colleagues or by Comotti and colleagues, would be the natural extension of this work (Colledani et al., 2025) (Comotti et al., 2025). Such a replication would benefit from including measures of perceived organizational support, in line with Harunavamwe and Ward, and from recruiting a sufficient number of fully remote workers to formally test, with adequate statistical power, the interaction observed above (Harunavamwe and Ward, 2022).

Conclusions

This study offers a first measurement of technostress among Tunisian remote and hybrid engineers, a population absent until now from the empirical literature on the topic. It shows that techno-complexity and techno-overload dominate this population's experience, while the dimensions more directly tied to generative AI, AI-related techno-insecurity and techno-isolation, remain more moderate for now. The instrument built for this study shows satisfactory to good internal consistency across most of its scales, and an item-level factor analysis gives preliminary support for four separate scales. Their scores were almost uncorrelated, a result that remains to be explained.

While most of the associations tested between these dimensions and well-being, seniority, AI use, or couple life did not prove statistically robust, two results deserve further attention. The first is the negative association between AI-related techno-insecurity and well-being, consistent in direction but dependent on how well-being is measured. The second is the difference by telework arrangement in the relationship between isolation and well-being, which rests on 12 fully remote respondents. This work does not claim to fully explain technostress among Tunisian engineers; it offers a first measurement with preliminary evidence of reliability and two concrete leads on which future, larger-scale research can build. In the Tunisian technology sector, where remote work and generative AI are changing engineering work, having such an instrument, tested here primarily among hybrid engineers, is a necessary starting point both for research and for the organizations concerned alike.

Appendices

Appendix A - complete questionnaire

The questionnaire was administered in French, the main working language of Tunisian engineers, and is reproduced here in English translation. Data collection and analysis were conducted on the original French items. Unless stated otherwise, items in Sections 2 to 7 were answered on a five-point scale (1 = strongly disagree, 5 = strongly agree). Items marked (R)

were reverse scored.

Section 0 - Eligibility Filter

Q0. Do you currently work fully remote or in a hybrid arrangement (partial telework)? (Yes, fully remote / Yes, hybrid / No)

Section 1 - Sociodemographic and Professional Profile

Q1. Gender: Male / Female / Prefer not to answer
Q2. Age range: Under 25 / 25-34 / 35-44 / 45 and over
Q3. Marital status: Single / Partnered, unmarried / Married / Other
Q4. Professional seniority: Under 2 years / 2-5 years / 6-10 years / Over 10 years
Q5. Industry sector: IT service company / Offshoring / Startup / Product company / Freelance / Other
Q6. Role: Developer / DevOps engineer / Technical project lead / Software architect / Other
Q7. Share of working time spent remote: 100% / 75-99% / 50-74% / Under 50%
Q8. Frequency of generative AI tool use at work: Daily / Several times a week / Occasionally / Never

Section 2 - Techno-Overload

Q9. I am forced to work faster because of the digital tools I use.
Q10. I am forced to work longer hours because of the digital tools I use.
Q11. I have to manage a large number of tools and digital platforms simultaneously to do my work.
Q12. The volume of information I have to process daily (messages, notifications, tickets) exceeds my capacity to manage it.

Section 3 - Techno-Complexity

Q13. I do not have enough time to improve my technical skills.
Q14. I find that most of the new tools used in my work are hard to understand.
Q15. I have to regularly learn new tools or technologies to stay effective at work.
Q16. I find the pace of technological change difficult to keep up with.

Section 4 - AI-Related Techno-Insecurity

Q17. I fear that generative AI tools will make some of my skills obsolete.
Q18. I feel pressure to keep training continuously so as not to be outpaced by generative AI.
Q19. I feel that my professional expertise is losing value compared to what generative AI can produce.
Q20. I worry about my long-term job security because of the progress of generative AI.
Q21. The growing use of generative AI in my work reduces my technical decision-making autonomy.

Section 5 - Techno-Isolation

Q22. I ask my colleagues for help with technical problems less often since I started using generative AI tools.
Q23. I feel a lack of informal exchanges with my colleagues since I started working remotely.
Q24. I feel professionally isolated in my remote work environment.
Q25. I feel that I learn less from more experienced colleagues than I used to.

Section 6 - Well-Being

Q26. I feel emotionally exhausted by my work. (R)
Q27. I feel physically and mentally drained by the end of a workday. (R)
Q28. I feel efficient and energized in carrying out my professional tasks.
Q29. Overall, I would say my level of well-being at work is good.

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Section 7 - Work-Couple Conflict (Optional, Married or Partnered Respondents Only)

Q30. Are you currently married or in a relationship? (Yes / No)
Q31. The time I spend on my professional digital tools eats into the time I spend with my partner.
Q32. I feel too exhausted by work to be fully present in my relationship.
Q33. My partner makes comments about my reduced availability because of work.
Q34. I feel tension in my relationship linked to my extended or irregular working hours.
Q35. Overall, how would you rate your current satisfaction in your relationship? (1 = Very dissatisfied - 5 = Very satisfied) (separate question, not included in the work-couple conflict score)

Section 8 - Open Question

Q36. Would you like to add any comment about your experience of technostress while working remotely? (optional) (not analyzed in this article)

Additional Information

Author Contributions

All authors have reviewed the final version to be published and agreed to be accountable for all aspects of the work.

Concept and design: Zyed Achour, Salma Achour

Acquisition, analysis, or interpretation of data: Zyed Achour

Drafting of the manuscript: Zyed Achour

Critical review of the manuscript for important intellectual content: Zyed Achour, Salma Achour

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Conflicts of interest: In compliance with the ICMJE uniform disclosure form, all authors declare the following:

- **Payment/services info:** All authors have declared that no financial support was received from any organization for the submitted work.
- **Financial relationships:** All authors have declared that they have no financial relationships at present or within the previous three years with any organizations that might have an interest in the submitted work.
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Data Availability Statements

The datasets (and/or code) supporting this study are available from the corresponding author upon reasonable request.

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