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The Impact of Information and Communication Technologies on Job Demands and Job Control

The Moderating Role of Perceived Usability

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Abstract: *Introduction:* Using the job demands control support (JDCS) model, we examined the impact of introducing information and communication technologies (ICTs) on the working conditions of civil servants in a major public institution in Gabon. We hypothesized that perceived ICT usability moderates the temporal beneficial/detrimental (dis)continuity of job demands and job control before and after their introduction. For exploratory and complementary purposes, we also investigated changes in social support. *Methods:* To this end, we conducted a quantitative two-wave longitudinal study of 162 civil servants, with measures before and after the introduction of ICTs for one subsample, and compared them to another subsample for which ICTs had not already been introduced (control group). *Results:* At baseline (T1), the two subsamples were similar regarding JDCS variables; at follow-up (T2), civil servants without ICTs reported, on average, a slight increase in job demand and a strong decrease in job control, whereas civil servants with newly introduced ICTs reported unchanged levels of job demand and job control. Similar observations, albeit of a lesser magnitude, occurred for social support. The analyses revealed that perceived usability marginally moderated the temporal stability of job control, whereas high job control at T1 favored similarly high job control at T2 only when ICTs were perceived as very highly usable. *Discussion and Conclusion:* The discussion addresses the possible existence of a downward social comparison effect for civil servants without ICTs, suggests the likely role of coping strategies to explain the mixed results, examines the study contributions and limitations, and delineates practical implications.

Keywords: technological changes, job demands control support (JDCS) model, civil servants, African public administration, perceived usability

Introduction

In organizational contexts, information and communication technologies (ICTs) are electronic work management modes, which include collaborative work tools that make it possible to produce, process, and transform information and communication to increase the effectiveness of employees and work teams. Mediated collaborative work refers to how the organization seeks to optimize or promote collective activity through technical devices that increase cooperation and coordination between employees and departments (Chan & Cho, 2022). In advanced countries, the emergence of ICTs in the work world stems from a search for excellence in how companies operate to make decision-making circuits more fluid, to bring (intra- and intercompany) actors closer together, and to create a more flexible, responsive, and agile organization to meet the new

challenges of constantly evolving work demands (Gaudart et al., 2019; Nudalo-Gonzaga et al., 2022).

Among countries in the Global South, most African states are engaged in administrative reform programs following the path traced by the more industrialized countries. For its part, Gabon has moved toward improving state services by opting to ICTs, in particular the internet, wi-fi, and groupware technologies. These technologies enable civil servants to provide high-quality work at a lower cost (Giritli Nygren, 2012) and to do high-quality work in real-time, all while sharing information as they carry out their activities according to the objectives set by the authorities. However, there is little evidence on the factors that would facilitate developing country employees in their work roles, premised on the use of ICT. Moreover, developing country employees may be less well prepared for the ICT revolution at the workplace because of the digital divide between developed and

developing countries (Boubakary & Moussa, 2017; Fambeu, 2017). As a result, developing countries would experience challenges with ICT-based work practices; they would require various types of resources for this.

This study analyzes the links between ICTs and job demands, job control, and social support, on the one hand, while also, on the other hand, determining whether perceived usability moderates the effects of ICTs on the job demands and job control of public servants in a large African ministerial institution. If the purpose of technological tools is to accompany or trigger the implementation of a new organization characterized by its flexibility in terms of place, space, and time and to improve work procedures and their efficacy (Valenduc & Vendramin, 2016), then, on the contrary, these ICTs were often used to standardize and formalize activities and relations between employees, to control and evaluate them more efficiently, and thus induce a centralization of decisions (Terssac et al., 2007). This often has irreversible repercussions on the psychological health of employees. Thus, ICTs can positively or negatively affect employees, and identifying moderators appears necessary.

Economies in emerging countries, such as Gabon, which are rapidly adopting ICT managerial practices, provide great opportunities for studying the boundary conditions for employees' resources to cope with ICT demands and thereby improve their psychological well-being. Therefore, this study investigates the moderating role of perceived usability in the relationship between ICTs, job demands, job control, and social support. To our knowledge, no previous study has considered this issue.

Impact of ICTs in Organizations

The use of ICT promotes collaborative work practices and hence organizational efficiency (Wang & Zatzick, 2019) through improved work procedures (Haliday & Naudin, 2019). The implementation of ICTs breaks organizational silos (Greenan & Guellec, 1998), giving way to a more flexible organization, favoring transversal relationships and the emergence of networking (Reix, 2000; Ughetto, 2007). ICTs also enable organizations to reconfigure work teams and develop employee polyvalency (Medzo-M'engone et al., 2019). Beyond the production process, one can also measure their effects in terms of employee activity. Indeed, ICTs encourage employee autonomy in managing their activities, enabling them to enrich their knowledge at work (Assadi, & Denis, 2005). ICTs are intended to accompany – or trigger – the implementation of a new work organization characterized by flexibility in terms of place, space, and time (Valenduc & Vendramin, 2016). Thus, thanks to information systems (e.g., the internet and its derivatives, instant messaging services), employees can connect to and be

reached by the company at any time and place. The immediate benefits of this time- and space-saving measure are greater efficiency in individual and collective actions, lower coordination costs, and, above all, the optimization of communication and knowledge exchange (Chan & Cho, 2022). ICTs also lead to the emergence of a horizontal type of work organization (Andersen, 2018).

These innovations are sometimes considered paradoxical (Mick & Fournier, 1998), since advantages and disadvantages simultaneously accompany them. Indeed, ICTs have brought innovations to the organizational world as well as raising concerns about their negative effects on the lives of individuals and organizations (Bohnsack et al., 2022). This damage to workers' health is reflected most often in forms of work intensification, which refers both to the acceleration of the pace of work (intensity), the amplification, as well as the simultaneity of the tasks to be performed (density) and the reduction of room for maneuver (Volkoff, & Delgoulet, 2019). All of which results in quantitative overload (number of things to do relative to the time available) because of the excess of information to be processed and the multiple interruptions (Dupuis et al., 2019). Employees may also experience qualitative overload (diversity, complexity, and interference between activities), especially when technologies impose work procedures contrary to the quality criteria of the profession (Sauvezon et al., 2019). Some authors (Kim et al., 2022; Tarafdar et al., 2019) have shown that the strong dependence on using new technologies in the organizational world is a probable source of technostress.

The Job Demand Control Support Model (JDACS)

Given the effects of ICTs mentioned above, assessing the impact of introducing professional technologies in terms of work stress seems necessary. This is especially the case in African countries, given the scarcity of studies from this continent. The JDACS model (Karasek & Theorell, 1990) is the reference point for this research, because of its international use, relevance, and psychometric reliability – and because it allows comparisons with other studies carried out in other countries/continents. In addition, endorsing a sociological and historical perspective, Kristensen (1996, pp. 253–254) considered that “job strain should be seen as a phenomenon related to the structural and technological development in the production process,” and that the JDACS must be considered “as a model of work organization and technological changes.” The central assumption of the Job Demand Control Support Model (JDACS) is that tension is higher in jobs characterized by high demand and low control over work (Karasek, 1979). This model highlights two key factors of work-related stress: psychological demands

and decision-making flexibility (Bakker & Demerouti, 2007; Karasek & Theorell, 1990). It measures difficulties at work that are often responsible for work-related stress. This model views the consequences of the nature of work as twofold: work demands and job control, also known as decision-making flexibility. This model views work demands as work overload in terms of the physical and cognitive quantity of work and the time and/or deadline demands when performing the work. The demand-control model has been extended to a third factor: the beneficial effects of work support. Several studies (e.g., Johnson & Hall, 1988) showed the value of social support within an organization. Most of these studies attribute different roles to social support, such as informational support, work assistance during work overload, or emotional support. Social support thus appears to be a “shock absorber” of organizational pressure. A job strain situation accompanied by a lack of social support amplifies the deterioration of employees' psychological health (Hammar et al., 1998; Tuckey & Hayward, 2011).

On the one hand, ICTs can be perceived as increasing job control because they provide opportunities for employees to enhance their learning capacity (e.g., training and learning technologies), to develop their professional skills, and thus their capacity for action. Furthermore, ICTs can foster employees' adaptiveness because the systems are themselves clear and flexible (Béguin & Clot, 2004), in the sense that they can leave sufficient leeway for the activity to be performed efficiently, both in terms of productivity and in terms of health management (Chatterjee et al., 2017). Thus, ICTs can alleviate certain organizational constraints (shortening decision-making circuits, decentralizing and democratizing access to knowledge, making the transmission of information more fluid) by significantly increasing employees' autonomy (Van der Doef & Maes, 1999). This results in an evolution from a passive work situation (where the employee is a mere performer of mechanistic externally-designed tasks) to an active work situation (the employee becomes more the architect of their own activity, using and developing capacities for action and innovation). ICTs can also help enrich the activity's content (more varied tasks with higher added value) while developing a sense of personal effectiveness during the computerized activity (Andersen, 2018).

On the other hand, one may question the constructive nature of ICTs for employees' activities regarding the JDCS model, as they can have detrimental effects. Users can perceive these technologies as much too prescriptive and as closing off opportunities for mobilizing intelligence (Bobillier Chaumon, 2018). Indeed, organizations can use ICTs (e.g., ERP, workflow systems) to accentuate job demands (e.g., work-pace acceleration, diversity and volume of information to be processed, multiplication of software to

be mastered, multiple and often remote collaborations, etc.), while at the same time reducing employees' room for manoeuvre and initiatives. Thus, the introduction of ICTs in organizations can have a “double-edged sword” effect: They can either increase or decrease job demands and control, depending on the extent to which they are used to enrich job content and to empower employees or to intensify work and to prescribe a unique mechanistic standardized way of working (Day et al., 2010; Kristensen, 1996).

Purpose of the Present Study

Two questions guided the following empirical study: First, what impact does introducing ICTs in the workplace have on the variables of the JDCS model in an African country like Gabon? And are these impacts mostly positive or negative, and what factor is likely to moderate these effects? The first issue is important because of the lack of studies conducted in sub-Saharan African countries. Indeed, in this part of the African continent, to our knowledge, there are no studies on the uses and impacts of ICTs in the public sector since these countries have accumulated a considerable technological backlog in this sector of activity. Thus, we know of no previous study investigating the impact of technological changes in Gabon, especially in the public sector.

The Gabonese administration, such as the Ministry of Digital Economy, Communications and Postal Services, has not previously used such technologies in managing administrative activity, except for typewriters with desktop computers and printers. Wi-fi and groupware technologies complement the internet previously introduced in this Ministry in 2002. Thus, the results of our study make it possible – with the JDCS model – to identify the impact of ICTs in Africa, particularly in a Gabonese public administrative body, with a different cultural and socioeconomic context from that of the West.

The second guiding question refers to the fact (illustrated above) that the introduction of ICTs in organizations can have a “double-edged sword” effect on JDCS variables (Day et al., 2010). This leads to the need to identify moderators that may explain constructive or adverse effects. In this context, the success of an ICT in terms of the JDCS (i.e., the perceived balance between demands and control) probably depends on how employees perceive its usability regarding their skills, habits, and job tasks. Studies addressing the determinants of technology acceptance/acceptability showed that the attitudes of potential users moderate the relationships between technology availability (i.e., the fact of having the possibility of using the technology) and its actual use by individuals (i.e., frequency and generalization to the whole activity) (Porter & Donthu, 2006; Venkatesh &

Bala, 2008; Venkatesh et al., 2012). Accordingly, these attitudes shape how individuals anticipate and interpret their experiences with technology. The formation of these attitudes depends on the extent to which the characteristics of technology (e.g., number and types of functionalities, design, response time, reliability) match both the characteristics of the tasks to be performed (e.g., timeframe, complexity, information needed, structured/unstructured, collaborative-interdependent/solitary-independent nature) and the characteristics of users (e.g., individual differences in terms of knowledge, skills and preferences) (Dishaw & Strong, 1999; Goodhue et al., 2002; Liu et al., 2011). The present research extends the position of these studies by considering the usability of technology as a moderator of the workload and the employee's ability to better control the management of his activity.

Thus, ICTs with low objective usability (i.e., actually little matching employees' job tasks and characteristics) likely generate interferences (and imbalance) between task-related demands and employees' abilities/working habits. These experienced interferences can be interpreted as additional demands caused by unusable ICTs and as threats to job control (i.e., disqualification, loss of mastery). Therefore, working with new technologies can be experienced as a source of discontinuity in job demands and job control or as a source of continuity, depending on their perceived usability and the initial perceived levels of job demands and control. For instance, according to the JDCS (Karasek & Theorell, 1990; Kristensen, 1996), technological change can be perceived by employees as reconfiguring, for instance, an initial "active job" or "qualified work" situation – fostering motivation and learning – to a "job strain" or "tempo work" situation (with its deleterious effects on health) and vice-versa (i.e., favoring the transition from a "job strain/tempo work" situation to an "active job/qualified work" situation). In line with this rationale, we thus consider that the perceived usability of ICTs moderates the temporal (dis)continuity of job demands and job control before and after their introduction. More precisely, we expect that:

Hypothesis 1 (H1): The perceived usability of ICTs moderates the continuity of job demands before (T1) and after (T2) their introduction; the higher the perceived usability, the more job demands decrease across time (T1 > T2).

Hypothesis 2 (H2): The perceived usability of ICTs moderates the continuity of job control before (T1) and after (T2) their introduction; the higher the perceived usability, the more job control increases across time (T1 < T2).

Hypothesis 3 (H3): The perceived usability of ICTs moderates the continuity of social support before (T1) and after (T2) their introduction; the higher the

perceived usability is, the more social support increases across time (T1 < T2).

Method

Technologies Introduced and Participants

Among these technologies, there is an internet network (administrative Wimax) entirely wifi-based, whose purpose is to allow civil servants, via its applications (instant messaging, messages, email), to enrich the content of individual and collective activities, and to share and disseminate information to the management, other officials of the department and various partners. In addition to the internet, the Ministry has also been equipped with groupware (remote groupware) thanks to videoconferencing, webcam, and cloud folder-sharing software. The groupware allows staff members to collaborate and exchange information while processing an administrative file.

A statistical power-based required sample size calculation (using G*power 3.1.9.4, Faul et al., 2009) revealed that a sample of at least 144 participants is sufficient for detecting a significant within-between interaction in a repeated measures analysis of variance (with parameters $\alpha = 0.05$, power $1-\beta = 0.80$ and $f^2 = 0.15$, three groups compared, two measurements, and a correlation of .50 between repeated measures). Likewise, to detect a significant increase in explained variance (ΔR^2) in multiple regression, a sample size of at least 73 participants is enough (with parameters $\alpha = 0.05$, power $1-\beta = 0.80$, and $f^2 = 0.15$, 1 predictor tested and four other predictors). The sample included civil servants employed in several public institutions in Gabon: the Ministry of the Digital Economy, Communications and Postal Services, and its parent institutions. In total, we distributed 200 questionnaires, 191 of which were returned; 162 were usable. The sample comprised more men (61.7%) than women (38.3%). Participants ranged in age from 25 to 42 and over ($M = 1.93$, $SD = .80$), and 33.7% had more than 10 years seniority in their institution ($M = 2.53$, $SD = 1.05$). The respondents held various positions, of whom 31.5% were research officers, 30.9% were inspectors, 22.2% were heads of departments, 13.6% were general managers and deputy managers, 1.2% were secretaries-general, and 0.6% were chairpersons of director boards.

Procedure and Design

After we made initial contact and explained the purpose of our research, the management of each department consented to participate in a questionnaire survey. Given the very high number of our survey population, we chose the

so-called “selective” sampling technique, which allowed us to target administrations and participants. The study was approved by the Ethics Committee at the Department of Psychology, University of Lumiere Lyon2, and was conducted in accordance with the 1964 Helsinki Declaration. We collected the data anonymously via a paper-and-pencil questionnaire, and public civil servants received no benefits or incentives for participating in the study. To avoid the loss of the questionnaires, the department delegated couriers to collect the questionnaires from participants and deliver them to us in person once completed. In line with the American Psychological Association’s ethical guidelines, on the first page, we provided information regarding the purpose of the research, its approximate duration, the chosen data collection method (self-administered questionnaire), participants’ right to decline this invitation and withdraw at any time from the study without any consequences, the guarantee that no identifying information would be requested, the use of the collected data (sample-level statistical analyses and publication of the results), and the contact details (of the first author of this article) for asking questions about the research and regarding their rights as a participant. The participants had to explicitly accept or decline our invitation to participate under the conditions described before starting the survey.

We used a two-wave longitudinal study design. We collected data from the same group of public civil servants before (T1) and after (T2) the implementation of ICTs in departments (2-year follow-up). At T2, 44 civil servants in the sample had not yet received ICTs. Therefore, we considered them a control group, while the public civil servants who had received ICTs (118) were considered an experimental group.

Instrument

The participants completed a questionnaire consisting of demographic information, a job strain scale, and a perceived usability scale. We assessed job strain with the SUMER revised version (Niedhammer, 2002) of Karasek’s questionnaire, which asks employees to rate on a 4-point Likert-type scale (1 = *strongly disagree*, 4 = *strongly agree*) three stress-related factors: Job Demands (9 items, T1, $\alpha = .88$ and T2, $\alpha = .94$, e.g., “My work requires long periods of concentration”; “My task is often interrupted before I finish it, needing to pick them up later”), Job Control (9 items, T1, $\alpha = .87$ and T2, $\alpha = .94$, e.g., “In my work, I have the opportunity to do different things . . .”; “In my work, I have the opportunity to develop my professional qualifications”; and Social Support (8 items, T1, $\alpha = .85$, T2, $\alpha = .91$, e.g. “My supervisor makes it easy to get the job done”; “The colleagues I work with help me get the job done”). At T2, civil servants for whom ICTs had been introduced also

completed the System Usability Scale short version (4 items, $\alpha = .98$) developed by Finstad (2010) to measure their attitudes toward the implemented technologies. They rated on a scale ranging from 1 (= *strongly disagree*) to 7 (= *strongly agree*) whether they perceived ICTs as matching their expectations, as easy to use, and as not the cause of frustration (“These ICT capabilities meet my requirements”; “Using these ICTs is a frustrating experience [reversed]”; “These ICTs are easy to use”; “I have to spend too much time correcting things with these ICTs [reversed]”).

Statistical Analyses

Statistically, H1 implies a significant interaction between T1 job demands and perceived usability in the determination of T2 job demands, with positive correlations between job demands before (T1) and after (T2) the introduction of ICTs in cases of high T1 job demands and low perceived usability; or in cases of low T1 job demands and high perceived usability. Conversely, in cases of high T1 job demands and high perceived usability, the mean score of job demands was expected to decrease between the two measurements, while in cases of low T1 job demands and low perceived usability, the mean score of job demands was expected to increase (with no T1–T2 correlation). H2 implies a significant interaction between T1 job control and perceived usability in determining T2 job control, with expected patterns of results opposite to those expected for job demands. For exploratory and complementary purposes, we also investigated changes in social support across times and groups.

Because the complete test of these hypotheses requires distributions of independent variable scores to cover the full spectrum of values (from very low to very high), we preliminarily examined the box plots displayed in Figure 1. This inspection revealed that the large majority of civil servants reported moderate-to-high levels of job control at T1 (Figure 1a), low-to-moderate levels of job demands at T1 (Figure 1b), moderate-to-high levels of social support at T1 (Figure 1c), and moderate-to-high levels of perceived usability at T2 (Figure 1d). Therefore, given the actual distributions of these variables, the results reported below only address the subhypotheses H1b (i.e., cases of low T1 job demands) and H2b (i.e., cases of high T1 job control).

In addition, the distribution of perceived usability was essentially bimodal, with 59 participants having a mean score of 4 and 48 participants a mean score of 5, while the remaining 11 participants obtained scores of 3.00 ($n = 5$), of 3.75 ($n = 1$), and of 4.25 ($n = 5$). Therefore, this variable was dichotomized and then treated as nominal with a subgroup having a moderate to high perceived usability ($3 \leq x \leq 4.25$; $n = 70$) and a subgroup with a very high perceived usability ($x = 5$, $n = 48$). Thus, no civil servants in this

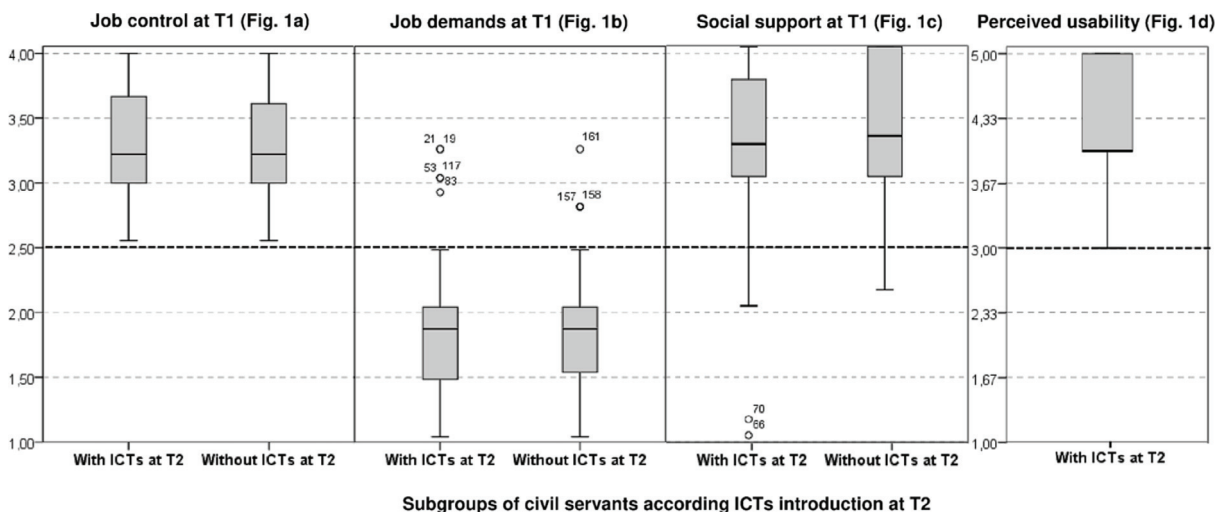


Figure 1. Descriptive characterization of the sample (box plots) regarding perceived job demands, job control, social support at T1 and perceived usability of ICTs at T2.

sample judged the deployed technologies as really unusable (Figure 1d). Accordingly, we expected that, for civil servants with a very high perceived usability (VHU) ($n = 48$), the results would be consistent with the hypothesized beneficial continuity pattern: stability of initially low levels of job demands and stability of initially high levels of job control (i.e., nonsignificant changes in means and significant positive correlations of T1-T2 measures). For civil servants with moderate-to-high perceived usability (MHU) ($n = 70$), we expected – compared to the other group – that the results would be more similar to the hypothesized detrimental discontinuity pattern with an increase in initially low levels of job demands and a decrease in initially high levels of job control (i.e., significant changes in means and nonsignificant correlations of T1-T2 measures). For civil servants with no introduction of ICTs, we expected no changes across time for both job demands and job control.

We tested these expectations with repeated measures ANCOVAs, with job demands, job control, and social support as dependent variables, T1 and T2 measurements (i.e., before and after the introduction of ICTs) as within-subject independent variables and the three subgroups of civil servants (i.e., without ICTs, with ICTs at T2, and moderate-to-high perceived usability, with ICTs at T2 and very high perceived usability) as between-subject independent variables. In addition, to estimate the main and interaction effects of the independent variables, we controlled the main effects of demographics, such as age and gender (covariates), because of their correlation with at least one dependent variable at T2. The data complied with the sphericity assumption, given that Mauchly's test was always nonsignificant. However, because Levene's test of equality of variance across groups of the repeated measures was significant for T2 measures of job demands, job control,

and social support, we transformed them within each group to set the standard deviation equal to 1. Finally, to estimate whether perceived usability moderated the effect of the introduction of ICTs, we used Model 1 of the PROCESS macro v3.3 for SPSS (Hayes, 2018) with the same covariates. We used the bootstrap technique to resample 5,000 times the data with the bias-corrected percentile method to create a 95% CI.

Results

Correlations Between Variables

Table 1 displays the correlations. The values reported above the diagonal correspond to the subgroup of public servants who received the implemented technologies, whereas the values reported below the diagonal correspond to participants working without technologies at T2.

At T1 and T2, and for the two groups of civil servants, job demands were negatively correlated with job control and social support ($-.241 \leq r \leq -.772$). For the subgroup with ICTs at T2, there was a positive and significant T1-T2 correlation of job demands ($r = .572, p < .01$), a positive but nonsignificant T1-T2 correlation of job control ($r = .109, p > .05$), and a positive and significant correlation of the social support variable in T2 ($r = .669, p < .01$). For the subgroup of civil servants without ICTs at T2, there was a positive and significant T1-T2 correlation of job demands ($r = .331, p < .05$), a negative but nonsignificant T1-T2 correlation for job control ($r = -.276, p > .05$), and a positive and significant T1-T2 correlation for social support ($r = .373, p < .05$). Thus, these correlations revealed that job demands and social support were relatively stable for the two subgroups of civil

Table 1. Means, standard deviations, and Correlations between variables (total $N = 162$)

Subgroups: with ICTs at T2 below the diagonal, without ICTs at T2 above the diagonal	Age ^a	Gender ^b	Job demands T1	Job control T1	Social support T1	Job demands T2	Job control T2	Social support T2	Perceived usability T2
Age (grades) ^a	/	-.134	-.084	-.060	-.031	-.216	.227	.115	.083
Gender ^b	-.014	/	.021	.073	.008	-.019	-.028	.146	.046
Job demands T1	-.055	-.165	/	-.772**	-.241	.331*	.085	-.263	.021
Job control T1	-.068	.142	-.720**	/	.472**	-.228	-.276	.279	-.091
Social support T1	-.100	.035	-.450**	.439**	/	.003	-.304*	.373*	.009
Job demands T2	-.038	-.233*	.572**	-.298**	-.264**	/	-.379*	-.402**	.026
Job control T2	.003	.089	-.211*	.109	.078	-.574**	/	-.010	-.008
Social support T2	-.064	.124	-.365**	.357**	.669**	-.525**	.345**	/	-.010
Means	1.93	/	1.75	3.34	3.31	1.90	3.06	3.26	4.37
Standard deviations	0.80	/	0.49	0.40	0.53	0.75	1.00	0.66	0.56

Note. ^a1 = between the ages of 25 and 30, 2 = between the ages of 31 and 35, 3 = between the ages of 36 and 40, 4 = 41 + years old. ^b1 = male, 2 = female. * $p < .05$, ** $p < .01$.

servants (positive and significant T1-T2 correlations), whereas there was no stability in terms job control after the introduction of ICTs compared to before their introduction (nonsignificant T1-T2 correlations) in the country's public services.

Repeated Measures ANCOVA Results

Table 2 displays results from the three ANCOVAs and the estimated marginal means. For the job demands variable, the introduction of ICTs in managing civil servant activities had no significant main effect, $F(1) < 0.001, p > .05$, with $M = 1.746$ before ICTs and $M = 1.937$ after ICTs. There was a marginally significant effect of the civil servant subgroup variable, $F(2) = 2.987, p = .053$, with a mean score slightly higher for the subgroup of civil servants without ICTs ($M = 2.006$) than with ICTs at T2 (MHU subgroup $M = 1.746$; VHU subgroup $M = 1.773$). The interaction between the two variables was significant, $F(2) = 4.509, p < .05$, job demands increasing for the subgroup without ICTs ($M = 2.006$ before ICTs and $M = 2.243$ after), whereas for the two other subgroups with ICTs, job demands remained stable ($M = 1.761$ before ICTs and $M = 1.732$ after ICTs for the MHU subgroup and $M = 1.709$ before ICTs and $M = 1.838$ after ICTs for the VHU subgroup). This result indicates that, before the introduction of ICTs in Gabon's public sector (T1), the groups of civil servants were identical, but that, at T2 after the introduction of ICTs, the group of civil servants without ICTs perceived more job demands than the subgroups with ICTs. For the job control variable, ICT introduction had no significant main effect, $F(1) = 0.196, p > .05$, with $M = 3.331$ before ICTs and $M = 2.948$ after ICTs. There was a significant effect of the civil servant subgroup variable, $F(2) = 45.088, p < .01$, with a mean score lower for the subgroup without ICTs ($M = 2.590$) than the

subgroups with ICTs at T2 (MHU subgroup $M = 3.488$; VHU subgroup $M = 3.342$). The interaction between the two variables was significant $F(2) = 39.966, p < .001$, job control decreasing for the subgroup of civil servants without ICTs ($M = 3.326$ before ICT introduction and $M = 1.853$ after), whereas for the two other subgroups with ICTs job control remained stable ($M = 3.488$ before and $M = 3.597$ after for the MHU subgroup and $M = 3.288$ before and $M = 3.396$ after for the VHU subgroup). This result indicates that before the introduction of ICTs in managing the administrative activities of civil servants (T1), the groups were identical, but that, at T2 (after the introduction of ICTs), the group of civil servants without ICTs perceived less job control than the subgroups with ICTs. The subgroups of civil servants with ICTs perceived more job control than those without ICTs. Finally, ICT introduction had no significant main effect for the social support variable, $F(1) = 0.028, p > .05$, with $M = 3.323$ before ICTs and $M = 3.245$ after ICTs. The effect of the civil servants subgroup variable was also nonsignificant, $F(2) = 0.168, p > .05$ (without ICTs subgroup $M = 3.388$, ICTs MHU subgroup $M = 3.256$ and ICTs VHU subgroup $M = 3.307$). The interaction between the two variables was significant $F(2) = 3.564, p < .05$, and social support was slightly lower for the subgroup of civil servants without ICTs after their introduction ($M = 3.092$) than before ($M = 3.240$), whereas for the two other subgroups with ICTs, social support remained stable ($M = 3.323$ before and $M = 3.245$ after for the MHU subgroup and $M = 3.326$ before and $M = 3.284$ after for the VHU subgroup). This result indicates that, before the introduction of ICTs in Gabon's public administration (T1), the groups were identical, but at T2 (after the introduction of ICTs), the group of civil servants without ICTs perceived less social support in the management of their administrative activities than the subgroups with ICTs. The group of civil

Table 2. Effects of ICT introduction on job demands, job control and social support at T2 (after) compared to T1 (before). Across the three subgroups of civil servants (without ICTs, with ICTs at T2 and moderate-to-high perceived usability [MHU] and with ICTs at T2 and very high perceived usability [VHU])

Dependent variable	Source	F(df)	p	η^2_p	Compared means
Job demands	ICT introduction (Time) (within-subjects)	0.000 (1)	.983	.000	T2 (after) M = 1.937
	Civil servant subgroups (between-subjects)	2.987 (2)	.053	.037	With MHU ICTs M = 1.746
	Civil servant subgroups*ICT introduction (Time)	4.509 (2)	.012	.055	With VHU ICTs/T1 M = 1.761 With VHU ICTs/T2 M = 1.732
Job control	ICT introduction (Time) (within-subjects)	0.196 (1)	.658	.001	T2 (after) M = 2.948
	Civil servant subgroups (between-subjects)	45.088 (2)	.000	.368	With MHU ICTs M = 3.488
	Civil servant subgroups*ICT introduction	36.966 (2)	.000	.323	With MHU ICTs/T1 M = 3.326 With MHU ICTs/T2 M = 3.597
Social support	ICT introduction (Time) (within-subjects)	0.028 (1)	.867	.000	T2 (after) M = 3.245
	Civil servant subgroups (between-subjects)	0.168 (2)	.846	.002	With MHU ICTs M = 3.307
	Civil servant subgroups*ICT introduction	3.564 (2)	.031	.044	With MHU ICTs/T1 M = 3.256 With MHU ICTs/T2 M = 3.358

Note. For each analysis, the effects of gender, age grades, and other JDCS variables at baseline (T1) were controlled.

servants with ICTs perceived more social support than the subgroups without ICTs. Overall, these results were inconsistent with the H1 and H2 hypotheses (given there were no differences because of perceived usability between subgroups with ICTs at T2 and because we observed changes for the subgroup without ICTs at T2). On the other hand, these analyses reveal the deleterious effects of not introducing ICTs in Gabon's public administration at the same time for all civil servants (the group not having ICTs yet obtained worse scores for the three DVs after the introduction of ICTs in the other subgroups of civil servants, see Figure 2). This negative effect was of great magnitude for job control (Figure 2b) and of lower magnitude for job demands (Figure 2a) and social support (Figure 2c).

Conditional Process Analyses Results

Conditional process analysis results revealed that perceived usability marginally moderated the effect of job control at T1 on job control at T2, $b = 0.308$, $p = .066$, lower bound of 95% CI = -0.02, upper bound of 95% CI = 0.636 indicated that, when perceived usability of ICTs was moderate-to-high (MHU), job control at T1 did not significantly predict job control at T2, while when usability was very high (VHU), job control at T1 significantly and positively predicted job control at T2 (see Figure 3). Concerning job demands, the interaction was nonsignificant, $b = 0.155$, $p = .343$, lower bound of 95% CI = -0.167, upper bound of 95% CI = 0.477. These results were consistent with H1 regarding the moderating effect of perceived usability on the T1-T2 correlation of job control measures. This was not the case for H2 (moderating effect of perceived usability of the T1-T2 association).

Discussion

This study sought to understand the impacts of ICTs on the psychological health of the employees of public establishments in Gabon from the perspective of the JDCS model (Karasek & Theorell, 1990). We started with the idea that the use of ICTs would impact job demands and job control for civil servants in the light of what has been observed in the literature (Beas & Salanova, 2006; Day et al., 2012; Karasek, 1979; Liu et al., 2008). Furthermore, we expected that the usability of ICTs would moderate the impacts of ICTs. The results showed that using ICTs impacted civil servants' job demands, job control, and social support during their administrative activities. The results also showed the moderating role of the perceived usability of ICTs in the T1-T2 association of job control measures. In all, the results concerning hypotheses were mixed.

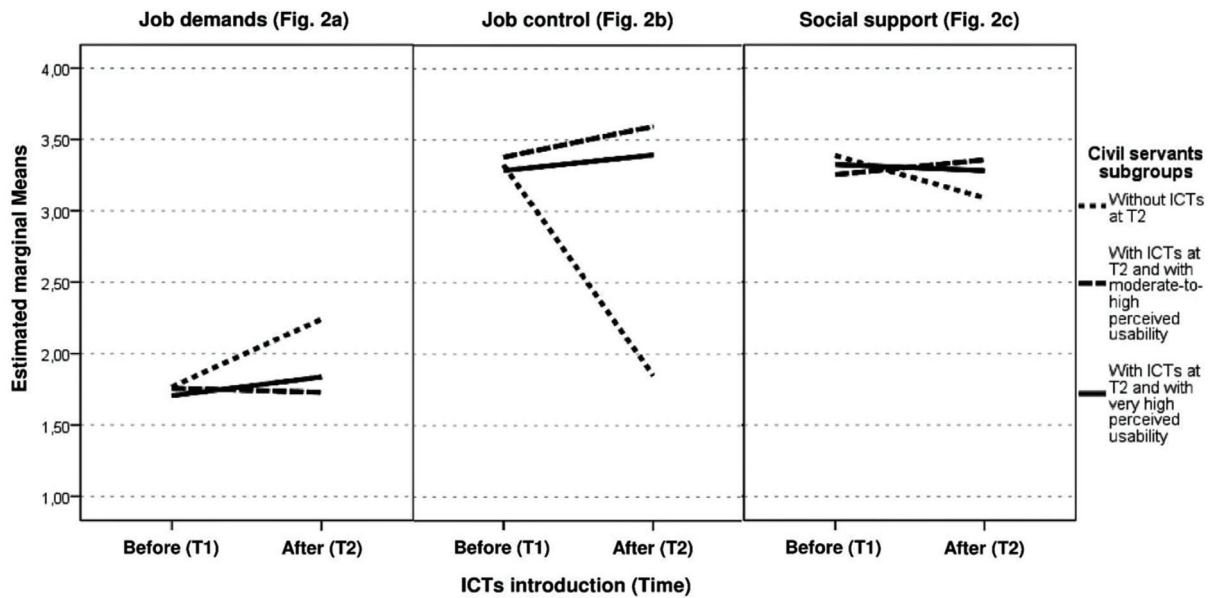


Figure 2. The dynamics of job demands, job control, and social support before (T1) and after (T2) the introduction of ICTs between the three subgroups of civil servants (without ICTs, with ICTs at T2 and moderate-to-high perceived usability and with ICTs at T2 and very high perceived usability).

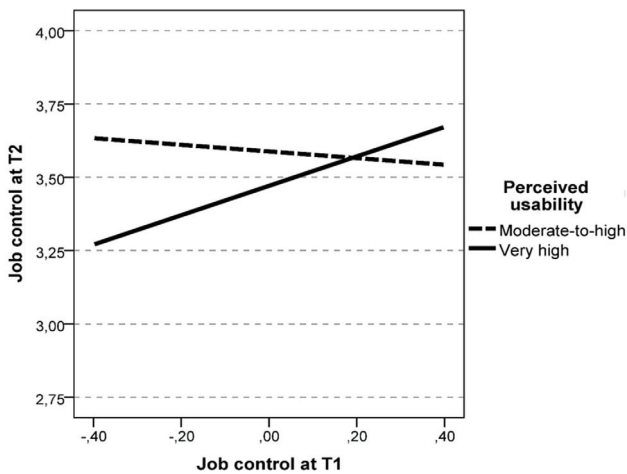


Figure 3. Perceived ICTs usability marginally moderated the temporal stability (T1 and T2 correlation) of the initially high job control of civil servants (simple slopes).

Main Observations and Contributions of the Study

First, the results found that civil servants who had not received ICTs for the performance of their administrative activities reported an increase in their job demands and a decrease in job control (and social support) at T2 compared to those who had received ICTs, while we observed no differences before the introduction of ICTs. This suggests that, for Gabonese civil servants, ICTs were a factor associated with positive perceptions of their working conditions. Com-

puterized activity seems to be perceived more positively than traditional activity by civil servants. Indeed, the group of civil servants who have used ICTs to manage their initially analog administrative activities see these technological tools as a source of enhancement for their work. With ICT, civil servants work more in collaboration with other establishments and collaborators, which considerably reduces their workload. However, a slight increase in cognitive workload is associated with mastering the uses of the ICTs introduced. However, this slight cognitive load is not perceived as an additional, uncontrollable workload by civil servants, causing them stress at work, since, at the same time, they benefit from having more room for maneuver and the social support of employees who have received ICT according to the JDCS model. Quite emblematically, the shift from analog to mediatized activity seems to mitigate the workload among Gabonese civil servants. This contradicts several studies (Chesley, 2014; Tarafdar et al., 2019; Wodociag et al., 2019) that have observed that using ICTs in organizations generates additional workload and job control impairment for workers.

Conversely, our results are consistent with studies reporting positive impacts of ICTs (Andersen, 2018; Assadi & Denis, 2005; Chan & Cho, 2022; Valenduc & Vendramin, 2016). Hence, these results imply that the features of the ICTs implemented (nature and functionality) in departments did not appear to conflict with prescribed and actual work objectives and methods. This resulted in stable average perceptions of job demands and job control for that group of civil servants.

The fact that civil servants who had not received ICTs had less positive perceptions of their working conditions (i.e., higher demands, lower control, and support) after the implementation of ICTs for other civil servants suggests the presence of an upward social comparison effect regarding resource allocation (as the studies of Kim et al., 2018, suggest). Indeed, studies following Adams' (1965) theory stipulate that, for a state of equity to be experienced by an employee in an organization, the employee must perceive that they received from the organization benefits that match their personal investment at work. This perception is not absolute but relative to the investments and benefits of relevant referent people. It is expressed in a ratio of the benefits the employee receives (i.e., results) and the contribution they made (i.e., inputs) relative to the perceived corresponding ratio for (a) referent work colleague(s) (Greenberg et al., 2007). Since they have the same functions, civil servants who have not received ICTs are likely to experience this situation as an organizational injustice, with deleterious effects on their perceptions of working conditions and, consequently, on their job performance (Frimousse et al., 2008).

The results also revealed that the perceived usability of the implemented ICTs moderated the effect of job control at T1 on job control at T2, as job control before the introduction of ICTs predicted job control afterward only for users with the highest perceived usability (as expected by H2, see Figure 3). However, this was not the case for job demands (contrary to H1). In addition, we observed no T1-T2 differential dynamics of mean scores between the two subgroups of civil servants receiving ICTs (contrary to both hypotheses). The mean scores of job demands (H1) and job control (H2) remained stable over time for both subgroups, and their difference in terms of perceived usability of ICTs had no effect on averaged perceptions (Table 2 and Figure 2).

Thus, concerning job control, the beneficial continuity pattern expected only for civil servants with high perceived usability in cases of initially high levels of job control (subhypothesis H2b) was observed in terms of idiosyncratic person-level differences in job control perceptions (within-group variance/covariance of T1-T2 perceptions). This is consistent with studies (Hsiao & Yang, 2011; Van De Leemput & Amiel, 2010) that showed that usability (the reliability of the technology, its usefulness, and robustness) moderates the impact of ICTs in the organizational context. However, we did not observe the beneficial continuity pattern regarding aggregated group-level perceptions (between-group central tendencies across repeated measures).

Perhaps two reasons might explain these discrepant observations. First, a third variable may have intervened to moderate the perceived usability \times ICT introduction interaction effect. In particular, coping strategies likely

played a critical role (e.g., Stanisławski, 2019). Perhaps because of a high technology readiness (Blut & Wang, 2020) most participants likely tended to use problem-solving strategies to adapt themselves to and master these new ICTs, and to accommodate their working habits. In fact, this type of strategy allows employees to sustain or recover their job control when facing a stress-inducing situation. Furthermore, the greater the mastery of these technologies, the more users are in control and can cope with job demands (Salanova & Schaufeli, 2000). Next, this absence of mean differences at T2 may result from the sample not including participants with clear negative usability perceptions (see Figure 1). These two reasons might also explain why we did not observe the detrimental discontinuity pattern regarding job demands, only expected for civil servants with low perceived usability and initially low-level job control (subhypothesis H1b).

This study contributed to knowledge in several ways: First, to our knowledge, this study is the first to examine the impact of ICTs and their perceived usability on JDCS variables through the hypotheses of beneficial or detrimental (dis)continuity. These hypotheses constitute a relevant basis for future studies. Second, this study is also, to our knowledge, the first to examine the impact of ICTs in sub-Saharan African countries in reference to the JDCS model. Furthermore, the temporal follow-up and comparison with a group of employees for whom ICTs have not been introduced is a methodological strength of the study, as it overcomes the limitations of correlational studies that do not include a control group. And finally, this latter aspect is important because this study highlights the negative effect of introducing ICTs among employees who do not yet have access to them. This unexpected result suggests the consideration of a potential phenomenon of unfavorable social comparison, a source of perceived injustice in allocating this resource and therefore of subjective and comparative degradation of working conditions. To our knowledge, such a phenomenon has not been reported in the literature to date.

Limitations and Future Research

The main limitation of this study was the somewhat limited variance observed for the JDCS variables and perceived usability. Because the large majority of participants obtained at T1 moderate-to-high scores for job control and low-to-moderate scores for job demands as well as moderate-to-very high scores for perceived usability at T2, we could not empirically investigate all implications of the proposed beneficial or detrimental (dis)continuity hypotheses (i.e., only the subhypotheses H1b and H2b). In addition, the specific sample studied – a relatively small and homogeneous group of executives from one particular

sector, notably public services – limits the generalizability of findings to other occupational groups. However, it is important to analyze public servants because they play a key role in public organizations and are the “pillars” of public services. Nevertheless, despite the small sample size, we observed significant relationships between some of the variables in the study.

Finally, the fact that we did not include samples of civil servants from other countries/continents (in particular, more industrialized and technologized countries) limited the study of potential intercultural and intereconomical differences regarding the above-mentioned hypotheses. The lack of studies on the issue of the use of ICTs and the psychological health of civil servants in developing countries such as Gabon prevented us from building a reference base to better understand our analytical model. Nevertheless, the results of this research enabled us to highlight important elements that to be considered in future research. In this context, future studies should use more diverse samples (i.e., other African countries), with data covering the full spectrum of values of the JDCS and perceived usability measures.

Implications for Practice

This research contributes to a better understanding of the changes in working conditions associated with introducing ICTs in public organizations. Moreover, it is essential to have carried out this study in a sub-Saharan African country (i.e., Gabon). The results of this research suggest, first of all, the idea that technological deployment in the administration in Gabon can be generalized (no aggrieved subgroups), as otherwise it may have adverse consequences on perceived working conditions (probable sense of injustice). This research also suggests that the perceived usability of technological tools imported from Western countries can play a moderating role. This moderating effect reinforces the importance of implementing technologies that are objectively (adjustment to actual activity) and subjectively (attitudinal level) very usable to ensure that civil servants' job control remains stable. Thus, the literature on perceived usability and acceptance of technologies may be useful in promoting the use of ICTs and preventing possible disruptions in perceived control in public organizations in sub-Saharan African countries such as Gabon.

Conclusion

This research enabled us to understand the organizational and psychosocial factors determining the psychological health of workers associated with implementing ICTs in a large public institution in Gabon. It is an addition to the

few studies that have focused on analyzing organizational changes, quality of life, well-being, and psychological health at work of Gabonese government employees. Our results invite the scientific community, particularly that of countries in the Global South, to rediscuss the interplay between technological changes, working conditions, and psychological health through the prism of intercultural and intereconomical differences. They could be used by the officials of the Ministry of Labour in Gabon to promote the deployment, usability, and acceptance of technologies to benefit the well-being of employees in public administration. This probably requires reconciling the socioprofessional specificities (face-to-face work and professional relationships) with the technological innovations the public sector is currently experiencing in Gabon. The aim is to adapt professional technologies to the socioprofessional context of the country, which demands the training of ergonomics engineers working in the public sector. Under these conditions, this sector of activity will experience the development so long awaited by the state authorities.

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History

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Publication Ethics


This study is part of a doctoral research. The Ethics Committee at the Department of Psychology, University of Lumière Lyon 2 approved the study, which was conducted in accordance with the 1964 Helsinki Declaration. We obtained informed consent from all individual adult participants included in the study.

Data Availability Statement


Research data are not shared.

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