Organizational Factors in Human-System Interaction Assessment Scale (OF-HSI)

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In the current office environments, organizations have adopted practices, which were named Organizational Factors, in which the new technologies are used as accessory element of work organization for obtaining results. The objectives of the study were (a) to identify and conceptualize the organizational factors; and (b) to develop and validate an instrument for its assessment. The sample was of 118 workers of both sexes, in consultantship functions, allocated in a financial institution in Brazil. The results showed that the developed instrument opens wide range of application, both in further research as to aid in the management of productive processes.

INTRODUCTION

As pointed out in several studies, it is increasingly evident that office environments have been experiencing major changes in the early 21st century. Ferreira (2014), in reference to data indicated in 2013 by the International Labor Organization (ILO), draws attention to the fact that the technological, social, and organizational changes observed in work contexts at the beginning of this century are the source of emerging risks to the health and safety of workers.

Research Problem

Technological developments, as well as increased competition in different levels of business, have brought a new challenge to the productive reality of directors, managers, and workers: the use by organizations of new information and communication technologies resources to support administrative actions in order to achieve expected results, which was identified in this study as *organizational factors*. Among the participants in this process, workers seem to represent the most affected portion by the actions resulting from this new production configuration, especially given their limited or absent participation in planning/structuring the work they perform.

In this passive condition, workers find themselves exposed to risks in their workplaces given the daily confrontation with work situations designed under the logic of production, where their room for manoeuvre becomes increasingly smaller, as new technological advances emerge. Therefore, this use of technology in order to prioritize production without considering the consequences for workers' health constitutes the problem of the present research.

Human-System Interaction: Characteristics

One of the main productive contexts in which work organization is performed with the support of technological artifacts are computerized offices. These environments have as important characteristic the activities with human-system interaction.

According to ISO 9241-210 (2010), activities with human-system interaction are those that develop in the user interface with information technology artifacts and involve several components of an interactive system (software or hardware) that provide information and forms of control for the user to accomplish specific tasks in their computerized offices.

It is believed that the study of human-computer interaction (or human-system interaction) has evolved from a focus on physical and ergonomic issues in the early 1970s to an integrated view of the use of computers within organizational, social and global contexts nowadays (Carey, in Zhang et al., 2002). Consistent with this observation, it is noticed that, due to the profusion of interactive media in office workspaces – which has made tasks with interface with computerized systems increasingly frequent – human-system interaction has been the subject of attention in several areas of research, particularly in ergonomics.

Objectives

Although we understand the interests of organizations seeking survival and development in a highly competitive environment, it is not considered justifiable, in the analytical perspective of this study, to neglect attention to the safety, health and quality of life of workers included in this high-tech environment. In this sense, the objectives of this study are:

- to identify and conceptualize organizational factors, as characterized in this study;
- to develop, test, and validate an instrument for assessing organizational factors.

Literature Review

Before building the instrument to assess the aforementioned organizational elements, we performed a review of articles focusing on devices developed for use in occupational activities that occur at the interface with interactive systems, similar to the context in this study. In the group studied, we found that the identified tools predominantly measured workers' perceptions of the available technology, such as hardware, software, infrastructure elements and systems, and technical support. However, the present study sought to evaluate the perception of organizational elements, instrumented with technological artifacts, present in activities with human-system interaction, which was not found in the literature.

Although part of the studies analyzed revealed, albeit narrowly, some approach to computerized work with possible intervention by the work organization, we observed no focus on situations that reflected the use of technological devices as management support tools. Examples of tools covered in these studies surveyed include:

- Computer Attitude Scale (CAS), as reported by Nickell and Pinto (1986): main focus on interface elements (complexity and difficulties with computers) and usability (possibilities of use and information gain). Based on the scale, only one item, which dealt with the issue of computer overuse, was close to the orientation of the present study since it referred to organizational aspects.
- Questionnaire for User Interface Satisfaction (QUIS 5.0), as reported by Chin, Diehl, and Norman (1988): predominant focus on interface (screen organization, system terminology), usability (error and help messages, system task development fluidity), and system speed and reliability. The tool revealed no organizational references in the context of the present study.
- After-Scenario Questionnaire (ASQ): usability approach (ease, time expenditure, and support information for completing tasks); Printer-Scenario Questionnaire (PSQ): focus on usability (operating instructions, time spent, and ease for completing tasks); Post-Study System Usability Questionnaire (PSSUQ): focus on usability (ease of use of systems, quick and effective completion of tasks, support information, etc.) and interface (clarity in the system documentation

and online information); and Computer System Usability Questionnaire (CSUQ): approaches usability (ease of system use, effectiveness and speed in the completion of tasks, etc.) and interface (organization of information on systems screens), as reported by Lewis (1995). None of the scales presented references to organizational elements as discussed in this study.

- System Usability Scale (SUS), as reported by Bangor, Kortum, and Miller (2008): the prevailing approach relies on the interface (complexity in the use of systems), usability (integration of system functions), and elements that refer to reliability, support and technical support in the use of computerized systems. The scale presented no organizational items.

Additionally, Karr-Wisniewski and Lu (2010), in their report on the development and validation of a measurement scale of overload in the use of information technology resources, presented, in the description of the items of the instrument, interface elements (unnecessary characters and complexity of software) and usability elements (inadequacy of software packages in handling tasks). Their questionnaire also addressed issues related to infrastructure and technological resources, such as hardware failures, network slowness and systems unavailability. From the perspective adopted in this study, the tool featured in the research of these authors is restricted to the issue of overloading or lack of information, leading respectively to distractions at work and lack of information necessary for decision making. It also addresses the issue of the heavy flow of communication between workers due to excessive time in connection with interactive systems.

The literature review therefore revealed a field to be investigated in this study, whose scope goes beyond the approach of characteristics and functionalities of computers and systems, which constitute the most visible elements and, thus, easier recognition and evaluation by users of computer devices. The interest advances to other issues, including elements such as surveillance, control, and work rate induction, which are manifested as extensions of the use of the machine, starting from its genuinely mathematical utility, to serve as an element of support to organizational action.

In this perspective, the elements identified in Brusiquese (2009) – such as legal aspects of work, the disseminator power of corporate digital media, and time pressure – were not found as a priority approach object in the studies investigated. Altogether, this reinforced the motivation for the construction of a tool that could evaluate these elements as well as other organizational elements.

Theoretical Framework: Activity-Centered Ergonomics

According to Ferreira and Mendes (2003), activity-centered ergonomics refers to the scientific approach that investigates the relationship between individuals and the context of production. Its main objective is to understand the critical indicators present in this context to transform them in order to meet the needs of workers, managers, users, and consumers. Therefore, the assumptions of activity-centered ergonomics, which is characterized by the analysis of work from the perspective of those who perform it, were the basis of the conception of the measurement tool, which made possible to cover, through the identification of elements present in the reported situations, those that represented factors of potential constraint to the work activity.

Thus, since *activity* is understood as a strategy to adapt to the actual work situation, which is object of prescription (Guérin, Laville, Daniellou, Duraffourg, & Kerguelen, 2001), it is possible to identify, among work experiences, requirements to workers that can impact their safety and well-being, which, for this reason, are elements subject to evaluation. Thus, by examining the research findings reported in Brusiquese (2009) and the literature review carried out during the present study, it was possible to find approaches in which we could identify inputs that originated the potential items that contributed to the composition of the initial version of the instrument under construction.

CONSTRUCTION OF THE INSTRUMENT

Object and Attribute

In order to define the measuring instrument, we sought to list – following the recommendations of Pasquali (2010) – the properties or attributes that constituted the object of interest of this study: the human-system interaction. As revealed by the literature review, the work context in which human-system interaction takes place comprises attributes of different natures, such as those related to equipment and systems (e.g., hardware, software and Internet) among others, whose group includes the central element of any study that addresses human productive activities: the worker. Whereas the interest of this study relies on the influence of elements of work organization in worker's well-being, we defined Organizational Factors as the attribute to be studied, given its potential to interfere in the whole context of work.

Dimensionality

Based on the qualitative data analysis of the exploratory study described in Brusiquese (2009) and in the literature review, and as performed by Karr-Wisniewski and Lu (2010), we compiled, in line with the theoretical basis of activity-centered ergonomics, the elements that were seen as potential to the constitution of the items that would compose the instrument. In this task, we sought, as did the aforementioned authors, to simplify the descriptions, remove redundant words and phrases, and to ensure that the descriptions were generic and applicable to the work context and object under study.

In the literature review, we identified several approaches referring to the attribute Organizational Factors, such as those related to time elements, work control, training, legal implications of the activities, communication, usability, and interface (Brusiquese, 2009; Chin, Diehl, & Norman, 1988; Green, 2004; Karr-Wisniewski & Lu, 2010; Nickell & Pinto, 1986; Roberts & Henderson, 2000). Based on the analysis of the findings of this review, we defined the following dimensionality of the attribute: legal aspects; time pressure; control; usability; interface; communication; and training.

Definitions of the Constructs

After identifying the attributes and their dimensions, we conceptualized the constructs in detail, in order to obtain the constitutive and operational definitions as recommended in Pasquali (2010). In order to limit what to explore when measuring the construct, aiming to cover most of the semantic range of concepts, we elaborated the constitutive definitions of constructs, which are presented in Table 1.

TABLE 1
CONSTITUTIVE DEFINITIONS OF CONSTRUCTS

Construct	Constitutive definition
Worker	A person who spends, directly or indirectly, physical and mental energy, aimed at the production of goods (Liedke, 2006) in a formally established occupation with an organization, for remuneration.
Hardware	Set of physical components (electronic material, boards, monitor, peripheral equipment, etc.) of a computer (Houaiss Dictionary, 2014).
Software	A collection of programs, procedures and documentation that controls or performs some task in a computer system (Houaiss Dictionary, 2014).
Internet	An international computer system that makes it possible to receive and send information throughout the world (Oxford Dictionary, 2001).
Legal aspects	Elements of worker's accountability, established on the basis of laws and in the organization's internal regulations, depending on the service performed.
Time pressure	Worker's state of submission to time in carrying out activities.
Control	Supervision and domain exercised over the activities of individuals and/or departments, so that such activities do not deviate from the pre-established standards (Aurélio Dictionary, 1988).
Usability	Degree to which a product can be used by specified users to achieve specified goals with effectiveness, efficiency, and satisfaction in a specified context of use (ISO 9241-11, 1998).
Interface	All components of an interactive system (software or hardware) that provide information and controls for the user to accomplish specific tasks with the interactive system (ISO 9241-210, 2010).
Communication	A process involving the transmission and reception of messages between an emitting source and a receiver recipient (Houaiss Dictionary, 2014) with a definite purpose.
Training	Efforts of organizations to provide learning situations that provide improved performance at work (Tamayo & Abbad, 2006).

In addition to the constitutive definitions, we realized the need to conceptualize the construct Organizational Factors in the context of human-system interaction. Thus, we proposed the following definition for Organizational Factors: elements of the productive context, under the control of work organization, through the actions of leaders and managers, through the use of information and communication technology resources, which determine and condition the way in which work must be performed/delivered in terms of quality, quantity, and time.

After concluding the constitutive definitions, we elaborated the operational definitions of the constructs that, according to Pasquali (2010), enable the approach to the concrete aspect inherent to the measuring tool. Following the design indicated by said author, we sought to give the broadest possible meaning of the construct in the elaboration of these definitions, as presented in Table 2.

TABLE 2
OPERATIONAL DEFINITIONS OF THE CONSTRUCTS

Construct	Operational definition
Organizational factors	Corporate support; allocation of resources; strategic planning; management style; functional responsibility; professional profile.
Legal aspects	Legal and regulatory framework; accountability; judgment; punishment.
Time pressure	Acceleration of the work (or activities); limitation of the possibility of dedication to tasks (or less time for dedication to tasks); intensification of work; electronic time system; timekeeping.
Control	System access logs (e.g., individual key and password identification); temporal record of connections (year, month, day, hour, minute); granting access to operating systems.
Usability	Structure and navigability of applications and systems, ease of use (Cowan, Vigentini, & Jack, 2009); comprehensiveness of functionality; possibility of customization; help functions; operational flow menus.
Interface	Iconography, graphic elements, images (Yun, Yufen, & Yingjie, 2004); organization and rationality of the information on the screen; layout; colors; language accessibility; adjustment settings.
Communication	Information overload; English language and computer science neologisms; email flow.
Training	Online courses; reaction evaluation; interactivity.

Operationalization – Construction of Items

During the preparation of each item, we tried to adopt the criteria presented by Pasquali (2010), such as seeking to express a behavior; indicating a single idea; varying the language; preferring simple, unambiguous, and non-extreme expressions, consistent with the attribute, with preference for familiar language to the target population; and prioritizing positive phrases, seeking, thus, to facilitate understanding.

With regard to the quantity of items, and following the recommendation of the cited author, in order to cover most of the semantic extension of the construct explicit in the constitutive definitions, we opted to use twenty items in the tool that were selected from 61 initially potential items. The items were randomly distributed in the instrument. In the configuration of the instrument, we adopted a 10-point response scale, ranging from "1" (*strongly disagree*) to "10" (*totally agree*).

Theoretical Analysis of the Items – Pilot Instrument

In order to verify if all items were comprehensible to members of the population to which the tool was intended, we sought third-party opinion for a semantic analysis carried out by workers of the researched institution. Thus, initially, the participation of three subjects of this population was obtained, to which the items of the instrument were presented with the request that they reproduce them.

In situations where there were divergences in the reproduction of the item, it was considered that it was understood differently than expected when it was elaborated. In these cases, what was meant by the writing was explained, at which time the subjects presented suggestions for reformulating the items. After adjustments, we submitted the adjusted tool to another group of three subjects. Since the questionnaire left no doubt, we considered that the items were properly understood.

In addition to the analysis of the items, we asked the subjects to read the filling instructions of the instrument, which were considered clear, with no need for adjustments. After the theoretical analysis of the items, the adjusted version of the questionnaire was consolidated in the pilot instrument that was called Organizational Factors in Human-System Interaction Assessment Scale (OF-HSI), as shown in Appendix A, which was then submitted to a test and validation phase.

METHOD

OF-HSI testing and validation were performed with the IBM SPSS statistics 20.0. For statistical analysis, we used the exploratory factor analysis technique, according to Field (2009); Hair, Black, Babin, Anderson, and Tatham (2009); and Pasquali (2012).

Participants

The sample consisted of 118 workers invested in advisory functions in strategic units of a Brazilian financial institution established in Brasilia. Subjects performed their activities in computerized office environments in an eight-hour working day.

The number of respondents was defined taking into account the following recommendations: (a) between five and ten participants per variable, according to Kass and Tinsley (1979), as cited in Field (2009); (b) the sample must be composed of at least one hundred subjects per factor (Pasquali, 2012); (c) the sample should be more than fifty observations, more preferably greater than or equal to one hundred cases and, as a general rule, at least five times more observations than the number of variables to be analyzed, as suggested by Hair et al. (2009); and (d) a minimum of five participants per item, as recommended by Nunnally (1978), as cited in Lewis (1991).

Sample Characteristics

In the final part of the pilot instrument, after the presentation of the items to participants, we included the demographic data collection section. The composition of respondents was of 55 men (47%) and 60 women (51%) [three participants did not provide their gender information]; 55.1% were married and 26.3% were single; working time in the institution varied from up to 5 years (6.8%), 11-15 years (31.4%) and over 30 years (6.8%); level of education ranged from high school (3.4%) to postgraduate (70.3%); age ranged from up to 25 years (0.8%), 41-50 years (33.9%), and over 50 years (11%); time in current position/function ranged from up to 2 years (37.3%), 3-4 years (29.7%), and over 15 years (3.4%).

Missing Data

Based on the analysis of the pilot instrument responses, we could verify that the amount of missing data was not too much. Of the twenty variables of the instrument, ten presented only one missing data, each; five presented two missing data; one presented three missing data; and four variables presented four missing data. Therefore, considering the worst scenario, there were four missing data per variable, which represented only 3.4% of the sample, thus indicating no need for data treatment.

Outliers

To verify the presence of multivariate outliers, we used the Mahalanobis distance technique. As such, considering twenty degrees of freedom (in line with the number of variables under analysis), we interpreted the distances generated in the calculation based on the chi-square distribution table (X^2). This table revealed the minimum value of 45.32, which is significant at $p < .001$, and superior to the maximum Mahalanobis distance calculated, which was 37.12. Therefore, we concluded that there were no multivariate outliers in the data analyzed.

Instruments

Data collection for the validation of the OF-HSI instrument was performed using the pilot instrument, as mentioned in section *Theoretical Analysis of the Items – Pilot Instrument* with the support of the online survey software LimeSurvey, version 1.90+ Build 9071. The questionnaires were sent via corporate email system, so that the participants were able to access and send the questionnaires answered.

Procedure

This study is part of the doctoral thesis reported in Brusiquese (2016), whose research was submitted, reviewed, and approved by the Research Ethics Committee of the Institute of Human Sciences of the University of Brasilia. Prior to the beginning of data collection, the researcher formalized a commitment term with the research institution, aiming to ratify the commitment to comply with the ethical principles of research, such as ensuring the anonymity of the organization and participants, in accordance with their internal regulations.

Data collection took place from November 24 to December 04, 2014, at which time invitations were sent to workers' electronic addresses (corporate email) containing a link to access the electronic version of the instrument under validation. The texts of the invitation message and the initial part of the tool informed: (a) that the data collection was intended to test and validate a scale to be used in research, later reported in Brusiquese (2016); (b) the research objectives; (c) that the data collection was authorized by the institution to which the respondents were bound; (d) the questionnaire instructions for use; and (e) the anonymity condition of participants. After answered, the questionnaires were returned by the participants to the administrator's research data repository with automatic compilation by LimeSurvey.

RESULTS

Correlation Matrix

With the responses given to the pilot version of the OF-HSI scale, we constructed the R-matrix, that is, the correlation matrix. To perform the factor analysis, we initially inspected the matrix and analyzed the factorability possibilities to verify if it had enough covariance (correlation) between the items to proceed with the factor or component extraction.

Normality

In agreement with Hair et al. (2009) and according to Pasquali (2012), who argues that the factor analysis supports deviations from normality, we dispensed this verification.

Factorability Analysis of R-matrix

Initially, we verified the Kaiser–Meyer–Olkin measure of sampling adequacy (KMO), which was 0.70. This value is classified as good, according to Kaiser (1974), as cited in Field (2009), which indicates that the factor analysis is appropriate for the data collected.

In order to verify the existence of relationships between variables, we performed the Bartlett's test of sphericity. The test result was highly significant ($p < .001$), which shows, as reported by Field (2009), that the R-matrix is not an identity matrix, thus indicating that there are relationships between the variables and that the factor analysis is viable. To check for multicollinearity, we verified the determinant of the R-matrix, whose value was 0.006. According to Field (2009), values higher than 0.00001 indicate no problems with multicollinearity.

As recommended by Hair et al. (2009), before proceeding with the factor rotation process, communalities should be examined in order to identify variables with low values, indicating their elimination. According to these authors, high values of communality indicate that a large amount of variance in a variable was extracted by factorial solution, and low values show that a substantial portion of the variable's variance was not explained by the factors. The authors also report that practical considerations suggest a minimum level of 0.50 for communalities in this analysis.

Based on this parameter, of the twenty variables of the instrument under analysis, 19 showed communalities values above 0.50, except for the variable number 12, which showed a value very close to that threshold (0.49). Thus, according to Hair et al. (2009), we considered that the communalities were high enough for us to proceed with the continuity of the analysis.

After the analysis described above, we concluded that R-matrix of the OF-HSI pilot instrument showed favorable indexes, and was therefore factorable.

Calculation of the Quantity of Factors

In order to decide on the amount of factors that the R-matrix included, we performed the Principal Component Analysis (PCA). Table 3 shows that, based on eigenvalues analyses and considering Kaiser's criterion (eigenvalues > 1), as cited in Field (2009), up to seven components could be extracted from R-matrix. In addition to the Kaiser's criterion, we also used the information expressed by the scree plot and by the eigenvalues of a random matrix, by means of the parallel analysis. According to O'Connor (2000), through this analysis, the eigenvalues derived from empirical data are compared with the eigenvalues of random data.

TABLE 3
TOTAL VARIANCE EXPLAINED

Component	Initial Eigenvalues		
	Total	% of Variance	Cumulative %
1	4.244	21.218	21.218
2	2.035	10.174	31.392
3	1.519	7.593	38.984
4	1.346	6.731	45.716
5	1.340	6.699	52.415
6	1.123	5.616	58.031
7	1.021	5.104	63.135

Note. Extraction Method: Principal Component Analysis.

Scree plot analysis indicated the existence of two to six components. By the parallel analysis, performed with a random matrix of twenty variables with 118 hypothetical subjects, we found that three eigenvalues of the empirical matrix (Table 3) exceeded the corresponding values of the eigenvalues of the random matrix (Table 4).

TABLE 4
TOTAL VARIANCE EXPLAINED - PARALLEL ANALYSIS

Component	Initial Eigenvalues		
	Total	% of Variance	Cumulative %
1	1.821	9.105	9.105
2	1.665	8.323	17.428
3	1.472	7.358	24.787
4	1.441	7.207	31.994

Note. Extraction Method: Principal Component Analysis.

Factors Extraction and Rotation

Based on the Kaiser's criterion (up to seven components), on the scree plot (2-6 components), and, mainly, on the parallel analysis (three components), we initially performed, using the Principal Component Analysis (PCA), according to Field (2009), an extraction and an oblique rotation (oblimin) of two factors (initial value of the scree plot).

Initially, the total variance explained by the two factors was 31.39%. Prior to the rotation, factor 1 explained 21.22% of the variance, whereas factor 2 explained 10.17%. After the factor rotation and generation of new eigenvalues (4.24 and 2.04, respectively), we found that these values basically remained the same (21.22% and 10.21%, respectively).

The reproduced matrix showed that there were still 56% of covariance between the variables in the residual matrix (i.e., there were intercorrelations between the variables of the R-matrix that were not explained by the extraction of the two factors).

Thus, in order to increase the percentage of variance explained of the R-matrix and respecting the previously mentioned criterion of Kaiser, scree plot, and parallel analysis, we extracted three factors. After this new extraction, we reached 38.98% of the total variance explained of the matrix. Prior to the rotation, factor 1 explained 21.22% of the variance, factor 2 explained 10.17%, and factor 3 explained 7.59%.

After the factor rotation and generation of new eigenvalues (4.04, 1.97 and 1.99, respectively), we found that these values changed to 20.22%, 9.87%, and 9.94%, respectively. This showed a new configuration in the distribution of the variance explained: factor 1 remained the most important, although there was a slight reduction in its percentage of variance explained; while factor 3 received similar importance to factor 2, which left to explain part of the variance.

We also tried a new extraction, this time, of four factors, but only an increase of 6.73% of the variance explained of the matrix was obtained, in addition to the fact that the reproduced matrix indicated the remaining 53% of covariance between the variables in the residual matrix. Thus, we concluded that the extraction of three factors was more appropriate, given the understanding that the 6.73% gain of variance explained would not justify the increase in complexity of the factorial matrix as a function of the increase from three to four factors. This increase would contradict the fundamental logic of factor analysis, which is parsimony, as advised by Pasquali (2012).

Pattern Matrix

Table 5 shows the pattern matrix for the three factors with their respective eigenvalues after rotation, the percentage of variance explained, and the factor loadings for each variable.

TABLE 5
PATTERN MATRIX[a]

	Component		
	1	2	3
01. Most of the demands and information I receive at work come from emails			-.501
02. There are, in my company, investments in technology, such as applications and systems, which I consider to be of little use			-.521
03. I feel that systems and applications adopted in my company make the charges for meeting targets seem more rigid and imposing			-.623
04. It is common to receive unwanted emails in my work (e.g., spam, advertisements)	.431		
05. I usually have to make adaptations in the applications that I use in my work (e.g., taking notes, creating separate spreadsheets)			-.403
06. Its worrying to realize that the work I perform is registered in corporate systems	.555		
07. The resources that I use at work, such as furniture, computer, and Internet, are appropriate for the performance of my activities		.593	
08. I get work-related emails that are not of interest to my tasks (e.g., unnecessary copies)	.552		
09. I can read all the emails I receive at work in the same day they arrive	.387	.443	
10. I have the impression that computer systems and applications control my work more than I do	.703		
11. Systems and applications adopted in my company increase my pace of work (e.g., applications that control deadlines)	.589		
12. The views of workers who use the systems are taken into account when choosing new technologies to be used in my company (e.g., applications and systems)		.605	
13. I realize that the demand for quality and accuracy of work is greater when I perform tasks with computers applications and systems	.402		
14. Some programs or systems I use at work seem to take me more time to carry out the activities than if I performed them manually	.619		
15. I have difficulty in understanding the language and technical terms of the applications and systems I use at work (e.g., English words, computer terms)	.567		
16. I read work emails during vacations			
17. In important works, I prefer to communicate with colleagues formally, leaving my manifestation recorded (e.g., by emails) than personally			.521
18. I worry about the fact that my opinions sent by email or registered in systems can be seen and criticized by many people of the company	.654		
19. I get training before using new systems and applications in my work		.501	
20. I consider excessive the amount of information I receive daily in my work (e.g., by email, Intranet, and systems)	.673		
Eigenvalue	4.044	1.974	1.988
% Var.	20.220	9.870	9.940

Note. Extraction Method: Principal Component Analysis. Rotation Method: Oblimin with Kaiser Normalization.
a. Rotation converged in 14 iterations.

In order to identify the association of the variables with the components, we observed the magnitude of factor loadings, prioritizing the components in which the variables presented higher loads. As can be seen from the pattern matrix analysis, variables 4, 6, 8, 10, 11, 13, 14, 15, 18, and 20 showed higher loads on component 1; variables 7, 9, 12, and 19, on component 2; and variables 1, 2, 3, 5, and 17, on component 3. The variable 16 ("I read work emails during vacations") was excluded from the analysis since it did not present a minimum load of 0.40 in any component, according to Field (2009) and Hair et al. (2009).

Internal Consistency Analysis

Prior to the internal consistency analysis, we adjusted the variables of the OF-HSI scale so that all were in a unidirectional way (i.e., all variables would be on the same pole, negative or positive). This action was necessary since when designing the instrument, we created favorable and unfavorable items with respect to the construct to be measured. Thus, we reversed the variables containing inverted writing, which was done by adding "1" to the maximum value of the scale ("10") and, from this value, subtracting the original score assigned to the inverted variable, according to Field (2009) and Pasquali (2012).

To calculate the internal consistency we used Cronbach's alpha coefficient. Table 6 shows the results of the analysis for the three factors.

TABLE 6
RELIABILITY ANALYSIS

Factor	Cronbach's alpha	No. of items
1	0.80	10
2	0.44	4
3	0.38	5

Table 6 shows that the coefficient for factor 1 was 0.80, indicating good internal consistency, according to Field (2009) and Pasquali (2012). The item-component correlations were mostly good (values above 0.40), with the exception of the variable 13, which had a correlation of 0.29. However, this variable was considered valid and, therefore, maintained in this factor, for having a factorial load of 0.40 in factor 1, being, therefore, equal to the minimum load of 0.40, standard adopted by Field (2009) and Hair et al. (2009), as previously mentioned.

The Item-Total Statistics informs that the elimination of the aforementioned variable practically would not change the internal consistency coefficient, which would be 0.802. Similarly, there was no improvement in Cronbach's alpha value with the exclusion of any other item from factor 1; thus, all ten items were retained.

As shown in Table 6, the internal consistency coefficient for factor 2 (0.44) was not considered satisfactory, according to Field (2009), which reiterates that the Cronbach's alpha values must fall in the range of 0.70 to 0.80 (or thereabouts). According to the data, we observe that item-component correlations were low (values less than 0.40) and that the elimination of variable 9 would result in a slight increase in Cronbach's alpha, from 0.44 to 0.45, which would not solve the problem of the low value of this coefficient. Similarly, none of the other variables of this factor could increase its reliability if it were eliminated.

Table 6 also shows the coefficient of factor 3 (0.38), which was also considered not consistent. The item-component correlations were low (values below 0.40) and the possible change in Cronbach's alpha, by eliminating variable 17, would only raise it to 0.54, which would not change its unsatisfactory situation. The removal of any other item would not increase the reliability of the factor.

Thus, due to the weak internal consistency of factors 2 and 3, we decided to exclude both from this study. Factor 1, in turn, because it presented good internal consistency, indicated viability to be kept in the study.

Factor Interpretation

In order to interpret factor 1, we observed the semantic content of its items, giving more attention to the items with the highest loads. All of the ten items of this factor had factor loadings greater than 0.40 that, arranged in order of importance, showed the configuration seen in Table 7.

TABLE 7
FACTOR 1 - ORDER OF IMPORTANCE OF FACTOR LOADINGS

10. I have the impression that computer systems and applications control my work more than I do	.703
20. I consider excessive the amount of information I receive daily in my work (e.g., by email, Intranet, and systems)	.673
18. I worry about the fact that my opinions sent by email or registered in systems can be seen and criticized by many people of the company	.654
14. Some programs or systems I use at work seem to take me more time to carry out the activities than if I performed them manually	.619
11. Systems and applications adopted in my company increase my pace of work (e.g., applications that control deadlines)	.589
15. I have difficulty in understanding the language and technical terms of the applications and systems I use at work (e.g., English words, computer terms)	.567
06. Its worrying to realize that the work I perform is registered in corporate systems	.555
08. I get work-related emails that are not of interest to my tasks (e.g., unnecessary copies)	.552
04. It is common to receive unwanted emails in my work (e.g., spam, advertisements)	.431
13. I realize that the demand for quality and accuracy of work is greater when I perform tasks with computers applications and systems	.402

Note. Factor loadings arranged in descending order.

In the item analysis, we observed a predominant approach in subjects, such as: *work control* (items of numbers 10, 11, and 13); *accountability for the service performed* (items 6 and 18); *inadequacy of technological resources* (items 14 and 15); and *information flow overload* (items 4, 8, and 20).

By observing the configuration obtained for factor 1, we can see a confluence of items to a structure that mainly reflects issues related to organizational elements. By the analysis, we could also ratify the strong adherence of the items with elements of the human-system interaction approach under the focus of ergonomics. From this perspective, there is a concern embedded in the terms of the items on the issue of the adequacy of working conditions to the needs and expectations of workers, a situation that is one of the main objectives of ergonomics.

In this sense, Guérin et al. (2001) point out that the transformation of work, from the perspective of ergonomics, should seek the conception of work situations that do not alter the health of workers and enable them to exercise their competencies, aiming at their own objectives and those of the organization. In this perspective, the items of factor 1, as a whole, seem to indicate elements that represent potential input for this transformation of the work situation, aiming at its rationalization, both from the point of view of safety, well-being and comfort of workers, and the interests of the organization.

From the analysis of the content of the items, it was understood, therefore, that a possible denomination for this factor would be *Intensification and Control of the Work*. However, we considered that the use of this nomenclature would not be necessary since it is a unifactorial instrument. Therefore, we chose the name that was assigned to the pilot version: *Organizational Factors in Human-System Interaction Assessment Scale* (OF-HSI). The final version of the instrument is presented in Appendix B.

DISCUSSION

In the field of knowledge of ergonomics, in the domains of work organization, it is possible to verify, on a global scale, countless contributions of scientific studies, of the most varied natures, focused on the analysis of the working conditions of the people, aiming at their improvement.

Nonetheless, a lot of studies must be carried out in order to change the current productive scenario, in which a business focus centered on results prevails under justifications associated not only with corporate survival, but also with the search for market domination, with only a secondary look to the well-being of workers. On the other hand, this scenario proves to be quite conducive to the contributions of ergonomics, since its focus is broad enough to cover the interests of both parties, organizations and workers, as Carayon and Smith (2000) argue, when they say that the purpose of this discipline is to improve performance, health, and safety.

However, despite this vocation of ergonomics, studies focusing on the evaluation of actions in the scope of work organization, equipped with technological devices in order to optimize corporate results, were not found in the literature reviewed for this study. The parsimonious approach found brought issues such as information overload, as pointed out in Nickell and Pinto (1986), and the excess or insufficiency of information at work, as reported by Karr-Wisniewski and Lu (2010), which could represent situations arising from actions or inactions of organizational nature.

The identification and conceptualization of the aforementioned elements in the scope of work organization, instrumented by the new information and communication technologies, as well as the development of a way of measuring them through the perception of workers, therefore represented an important contribution of this study, both in the academic-scientific area, by the knowledge that was added to the researched area, and in the social and business sphere, by the possibilities provided for intervention and improvement of the work processes.

CONCLUSION AND IMPLICATIONS

The organizational factors, seen in the perspective of this study as yet little discussed in the literature, reach, through this work, a level that allows them visibility to awaken new research interests. The results of this study, materialized in the identification and conceptualization of organizational factors, as well as in the creation and validation of the OF-HSI instrument, reach, in this way, the proposed objectives. In this way, this scale will open a new front of research and application with a focus on organizational factors.

In this perspective, the OF-HSI instrument becomes an alternative, both for new research focusing on the impact of the use of new technologies in office work, and for aid in the management of productive processes, especially in the context of organizations that hold work environments similar to the one assessed in this study. In this case, the potential utility of the instrument is perceived in situations in which workers and employers recognize that the way in which technological devices are used can influence the welfare in the work, leading them to seek options for rationalization of resources and operational processes. In this sense, we perceive possibilities of contribution of the instrument, such as in the evaluation of the impact of organizational factors on the quality of working life, which may enable actions to improve working conditions with effect on workers' well-being and corporate efficiency.

LIMITATIONS

In spite of meeting the recommendations of the authors mentioned in section *Participants*, regarding the number of subjects used for the validation of the OF-HSI instrument, we considered, in agreement with Field (2009), that the use of a larger sample of participants could contribute to increasing the reliability of the factor analysis. In this sense, it is feasible to use at least three hundred cases for each factor analysis, as suggested by Tabachnick and Fidell (2007).

FUTURE RESEARCH

Regarding future research focusing on the object of the present study, we suggest, as one of the possible starting points, to work on factors 2 and 3, which did not show good reliability, by exploring more items that align with the central contents represented by both, in order to improve their internal consistency. In this sense, we offer, as a subsidy to further research, the observation that these factors seemed to congregate, in a predominant way, references to functional characteristics of the technology adopted in the work.

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APPENDIX A
ORGANIZATIONAL FACTORS IN HUMAN-SYSTEM INTERACTION ASSESSMENT SCALE (OF-HSI)

Pilot version used in instrument testing and validation (total of items: 20)

No. item	Content
1	Most of the demands and information I receive at work come from emails
2	There are, in my company, investments in technology, such as applications and systems, which I consider to be of little use
3	I feel that systems and applications adopted in my company make the charges for meeting targets seem more rigid and imposing
4	It is common to receive unwanted emails in my work (e.g., spam, advertisements)
5	I usually have to make adaptations in the applications that I use in my work (e.g., taking notes, creating separate spreadsheets)
6	Its worrying to realize that the work I perform is registered in corporate systems
7	The resources that I use at work, such as furniture, computer, and Internet, are appropriate for the performance of my activities
8	I get work-related emails that are not of interest to my tasks (e.g., unnecessary copies)
9	I can read all the emails I receive at work in the same day they arrive
10	I have the impression that computer systems and applications control my work more than I do
11	Systems and applications adopted in my company increase my pace of work (e.g., applications that control deadlines)
12	The views of workers who use the systems are taken into account when choosing new technologies to be used in my company (e.g., applications and systems)
13	I realize that the demand for quality and accuracy of work is greater when I perform tasks with computers applications and systems
14	Some programs or systems I use at work seem to take me more time to carry out the activities than if I performed them manually
15	I have difficulty in understanding the language and technical terms of the applications and systems I use at work (e.g., English words, computer terms)
16	I read work emails during vacations
17	In important works, I prefer to communicate with colleagues formally, leaving my manifestation recorded (e.g., by emails) than personally
18	I worry about the fact that my opinions sent by email or registered in systems can be seen and criticized by many people of the company
19	I get training before using new systems and applications in my work
20	I consider excessive the amount of information I receive daily in my work (e.g., by email, Intranet, and systems)

APPENDIX B
ORGANIZATIONAL FACTORS IN HUMAN-SYSTEM INTERACTION ASSESSMENT SCALE (OF-HSI)

Final Version (total of items: 10)

No. item	Content
1	I have the impression that computer systems and applications control my work more than I do
2	I consider excessive the amount of information I receive in my daily work (e.g., by email, Intranet, and systems)
3	I worry about the fact that my opinions sent by email or registered in systems can be seen and criticized by many people of the company
4	Some programs or systems I use at work seem to take me longer to perform the activities than if I did them manually
5	Systems and applications adopted in my company increase my pace of work (e.g., applications that control deadlines)
6	I have difficulty in understanding the technical terms of the applications and systems I use at work (e.g., English words, computer terms)
7	The fact that the work I do gets registered in corporate systems worries me
8	I get work-related emails that are not of interest to my tasks (e.g., unnecessary copies)
9	It is common to receive unwanted emails in my work (e.g., spam, advertisements)
10	The use of computer and systems increases the requirement for quality and precision of work