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Encourage autonomy to increase individual work performance: the impact of job characteristics on workaround behavior and shadow IT usage

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Abstract
IT users are increasingly experienced at adapting technologies to their needs; resulting in the widespread use of workarounds and shadow IT. To ascertain the impact of job characteristics on this behavior, a survey was conducted among 415 IT users. The collected data underwent Reliability Analysis and Exploratory Factor Analysis in SPSS software. Subsequently, Confirmatory Factor Analysis and Structural Equation Modeling were conducted with the SmartPLS software. The main results indicate that autonomy is strongly related to workaround behavior and shadow IT usage. Workaround behavior and shadow IT use have also been proven to be strongly related. However, the level of skill variety and task identity do not seem to significantly affect workaround behavior and shadow IT usage. Finally, this study's findings demonstrate that both workaround behavior and shadow IT use are positively related to individual performance. Organizations are therefore encouraged to increase job autonomy in order to achieve enhanced individual performance by presenting workers with opportunities to adapt technologies in the form of workarounds and shadow IT. The use of such alternative solutions provides for faster and more dynamic communication and thus boosts collaboration among co-workers, external partners, and clients.

Keywords Job characteristics · Workaround behavior · Shadow IT usage · Individual performance · Autonomy

1 Introduction

Due to dissatisfaction with the information systems (ISs) available in organizations and the need to improve individual performance, many users adopt technological resources and systems not provided by their information technology department. The use of alternative systems and solutions is a widespread IT post-adoption phenomenon in organizations [1]. According to Li et al. [2], the effective use of the organization's systems is an unreachable goal. Thus, it is important to study individual behavior regarding the decision to use tools, solutions and systems, other than those provided by the IT department, that enable greater efficiency and productivity [3]. By choosing to adopt an alternative solution, an employee engages in workaround behavior.

According to Alter [4], workaround behavior is defined as conscious adaptations to work activities that are adopted to minimize the restrictions and impediments perceived by the employee when using information systems. Workaround behavior provides an alternative way to perform a task when the designated path is obstructed [5]. Although it may provide a solution to the obstruction, it may also lead to security risks, inefficiencies, and errors in tasks and activities throughout the organization [6–10].

A concept related to workarounds, Shadow IT, is defined by Rentrop and Zimmermann [11] as the adoption of technologies and systems developed by the business areas within an organization without the IT department's support. Opinions on the relation between workarounds and shadow IT differ. Some authors distinguish the two concepts on the basis of the duration of their use: workarounds being short-term solutions and shadow IT being longer term [11]. Other sources such as Alter's Theory of Workarounds propose that

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a shadow system is one of the many forms that workarounds can take [4]. The exact relation between workarounds and shadow IT has, to the best of our knowledge, not been studied empirically. Therefore, whether users that enact workarounds generally also use shadow IT, remains unclear.

While the opinions on the relation between workarounds and shadow IT differ, there is a general agreement that they are both caused by a misfit between the requirements of users to accomplish tasks and their implementation in the supporting technology [12]. Within Information Systems research, there exists an inherent link between task-technology fit and individual performance [13]. From the user's point of view, workarounds and shadow IT enable them to overcome the task-technology misfit, thereby increasing their productivity [4, 14], fostering the development of creative solutions [9, 15]. However, whether the use of workarounds and shadow IT is positively related to individual performance, has not yet been studied empirically.

Vaezi [16] notes that the more satisfied the users are with an IS, the less likely they are to adopt workaround behavior and use shadow IT, since they adopt alternative solutions and technologies when their expectations are not met. Hauff, Richter, and Tressin [17] claim that work satisfaction is influenced by several job characteristics, which Hackman and Oldham [18] defined to be skill variety, task identity, task significance, autonomy, and feedback. Job characteristics explain individual work behavior (e.g. engagement at work) [19], as well as the results related to the task execution by employees [20]. As such, they may influence the use of workarounds and shadow IT.

There are indeed indications that job characteristics such as skill variety are related to the use of alternative solutions. One industry that is particularly known for its use of workarounds and alternative systems such as Whatsapp, is healthcare [21, 22]. It is believed that alternative solutions are created more in healthcare than in any other context because of the complexity of delivering patient care [23]. Patient care is complex because of the specific skillsets needed and the heterogeneous tasks involved. However, it is unclear whether the variety of skills needed for a job can indeed explain the widespread use of workarounds and shadow IT or that there are other factors at play. Generally, the relation between skill variety and deviating behavior is yet to be determined.

Indications also exist for the relation between workaround and shadow IT practices with task identity. Studies performed in healthcare, but also in other contexts such as the NASA space agency, have shown that the use of alternative solutions often emanates from an information system user's feeling of identity with their work, which is tied to certain institutional logics [24, 25]. Similarly, employees who have autonomy at work feel responsible for their jobs and therefore tend to choose creative ways to carry out their tasks [26]. Liang et al. [27] believe that autonomy at work is beneficial to facilitate the employees' exploration of the system's functionalities. Thus, the relationship between autonomy at work and the use of IS has attracted the attention of scholars in recent years [28]. Potentially, a relation between autonomy and the use of workarounds and shadow IT may also be expected.

Therefore, this study analyses the impact of job characteristics on workaround behavior and shadow IT usage and their relation to individual performance. A questionnaire was applied to IT users in different companies. This study seeks to answer the following questions:

(1) What are the impacts of job characteristics on workaround behavior and shadow IT usage?
(2) What are the effects of workaround behavior and shadow IT usage on individual performance?

We contribute to the literature describing the relation between job characteristics and work behavior. Specifically, we show the relation between different job characteristics and deviating behavior of employees. Whereas most studies only approach workaround behavior and shadow IT usage separately, this study contributes to the field by jointly measuring the impact of job characteristics on these phenomena. In doing so, it provides insights into the alternative technological solutions adopted by employees and should be useful to organizations when deciding what course of action to take in response to such behavior.

2 Theoretical background: developing the model and research hypotheses

Motivated by their dissatisfaction with the means of work and available systems, employees adopt workarounds, a recurring phenomenon in organizations that can threaten the benefits from implementing IT. Workaround behavior refers to the activities performed to overcome obstacles in performing a certain task. The obstacle might be system or workflow failure; however, employee training or business policies can affect how an IS is applied [4, 24]. Users resort to workarounds to compensate for functionalities not found in the business systems [29].

Workaround behavior may manifest in unauthorized use of IT resources, referred to as shadow IT [30]. Given the similarity of the two concepts of workarounds and shadow IT, Haag and Eckhardt [31] have attempted to clearly define the terms. They suggest shadow IT is a type of workaround, although not every workaround is necessarily a shadow IT since a workaround encompasses additional features that go beyond shadow IT. Shadow IT is technology-related, as its concept suggests, while a workaround may also be related to non-IT devices (e.g., paper). Moreover, shadow IT is not

necessarily an alternative behavior. For example, employees in organizations might use shadow IT such as instant messaging (WhatsApp) due to pressure from colleagues who persuade them to use it to communicate with the team, rather than due to any difficulty to execute work tasks.

Scientists have long recognized that work performance depends on how employees perceive their jobs [32]. Workers' productive behavior, satisfaction, and attitudes depend on certain psychological conditions known as job characteristics [33]. According to Petter et al. [34], employees use IT to identify the system's required attributes, like system quality and support service, by considering aspects such as usability, efficiency, navigation, and reliability.

Considering the expected influence of job characteristics on the use of workaround behavior and shadow IT usage, and ultimately on individual performance, we propose the model presented in Fig. 1. We list each of the corresponding hypotheses with support from literature, in the following sections.

2.1 Job characteristics

Ali [35] advocates the importance of studying job characteristics since they affect the employees' performance in an organization. The author goes further to say that job satisfaction contributes to organizational effectiveness. This is in line with the findings of Ketchain [36], who notes that productivity is higher when employees are happy with their work and organization.

Several authors have studied the influence of job characteristics on satisfaction and superior performance [37–44]. Oftentimes, the focus of studies has been on implementing a technology from the perspective of frequency of use. A small number of studies have evaluated how job characteristics and performance can be altered as a result of large-scale technological implementations in organizations. The studies imply that understanding and designing user interaction with technology indeed affects work-related outcomes, such as individual performance [43].

Thus, job characteristics seem related to the employee's motivation and satisfaction and can affect their individual performance. According to Laumer et al. [45], user satisfaction also influences the manifestation of workaround behavior. In addition, György et al. [46] defines shadow IT usage as the phenomenon in which the user adopts an IT solution that meets their need to attain a certain level of job satisfaction.

According to Hackman and Oldham [18], the term 'job characteristics' is made up of five distinct constructs: autonomy, feedback, skill variety, task identity, and task significance. Carpenter et al. [47] showed that autonomy, task identity and skill variety are associated with increased satisfaction. Therefore, in this study, we focus on those three constructs and will discuss each of them below.

Autonomy is defined as the degree to which the job offers the freedom to choose how to complete the task and which procedures will be used [18]. Autonomy gives the employee the power to decide how to complete the required work and even plan the schedule for completion [42]. Workaround and shadow IT behavior is related to the decision of employees to adapt and carry out their tasks in a way different from that planned by the organization, and this decision may be directly related to the job autonomy. Both workaround behavior and shadow IT represent a decision-making aspect influenced by various conditions or requirements of the organization.

Accordingly, employees may engage in workaround behavior or use shadow IT depending on the degree of autonomy. Therefore, we propose the following hypotheses:

H1: Autonomy is positively related to workaround behavior.

H2: Autonomy is positively related to shadow IT usage.

Task identity was defined by Hackman and Oldham [18] as the degree to which the job demands the conclusion of one "complete" task. That is, concluding a "complete" job or executing a task from start to finish with a visible result [48]. Coelho and Augusto [49] affirm that task identity encourages the feeling that the work is meaningful and worthwhile and motivates the employee to work intelligently. The degree of identity one feels with the task and the work as a whole, may therefore influence the tendency to deviate from practice. Because the employee alone is responsible for performing the task he can choose to adapt it or use a shadow IT

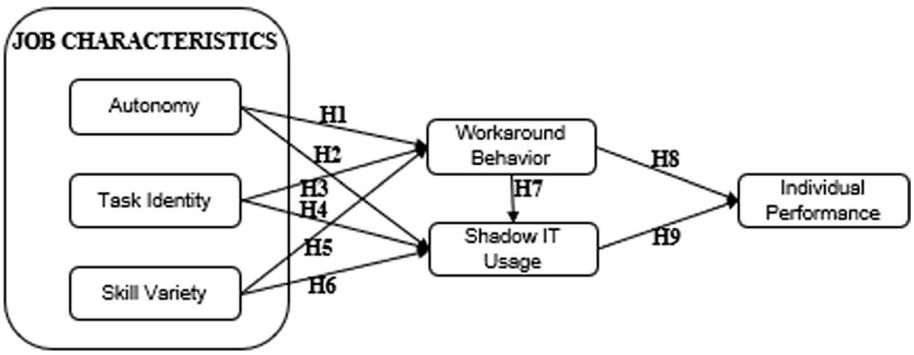

Fig. 1 Research model. *Source*: Developed by the authors

to demonstrate his effort and obtain better results. Based on the literature on task identity, we propose the following hypotheses:

H3: Task identity is positively related to workaround behavior.

H4: Task identity is positively related to shadow IT usage.

Skill variety is characterized by Hackman and Oldham [18] as the degree to which a job requires a range of skills to complete various tasks. Tombu and Jolicœur [50] argue that performance is impaired when multiple tasks are performed simultaneously since cognitive ability is lower for each individual task. The brain often cannot satisfy the demands of multiple, concurrent tasks (for example, responding to a warning in the middle of another primary task) [51]. Moreover, skill variety may be related to workaround behavior because it requires the employee to acquire a set of skills to perform their job, to follow a process, or to use a system. If the employee is dissatisfied with or unaware of the system or any process, they may resort to alternative practices. Thus, the variety of skills required to perform a task may thus drive workaround behavior and shadow IT usage. Based on various skills and types of knowledge, employees have the opportunity to demonstrate competence in the completion of different tasks [52].

Therefore, we formulate the following hypotheses on skill variety:

H5: Skill variety is positively related to workaround behavior.

H6: Skill variety is positively related to shadow IT usage.

2.2 Workaround behavior and shadow IT usage

Workarounds and shadow IT are often discussed together, but their exact relation remains unclear. Shadow IT usage is often defined as a long-term solution, while workarounds are usually a short-term solution [12]. Moreover, workaround behavior does not necessarily imply the adoption of unauthorized practices (i.e. shadow IT) and may be only alternative solutions pre-established by the company. Haag and Eckhardt [53] define shadow IT as the voluntary use of any IT resource that infringes IT norms at the workplace in reaction to perceived situational constraints, whose objective is to improve work performance. IS literature conceptualizes workaround behavior as the employee's decision to adapt and improvise the organizational IS in a way that makes it possible to overcome any anomalies and restrictions to the completion and effectiveness of work performance [4, 14].

Studying the relation between the two concepts, as well as their separate relations to job characteristics and individual performance, is important for a better understanding of the practices. Therefore, we propose the following hypothesis:

H7: Workaround behavior is positively related to shadow IT usage.

In this research, we adopt the same perspective proposed by Klotz et al. [54] who stated that workaround behavior is related to the misuse of official IT, while shadow IT is related to the use of unofficial IT. Also, workarounds are used at the individual level, while shadow IT is related to individual or group use.

2.3 Individual performance

IT users believe that workaround behavior and shadow IT usage overcome the anomalies and constraints in the system that make it impossible to perform tasks completely and effectively. Employees need tools that enable them to carry out their tasks to the best of their ability [55]. Workaround practices can be seen mainly as improvements in the work system [56]. Often, workaround practices enable the execution of urgent [9] or complex tasks [57], and represent greater efficiency [58], allowing to mitigate some of the negative consequences of the organization system [59]. Thus, users tend to improvise in their work when they identify problems, adapting the system to obtain better performance [2].

Thus, workaround behavior and shadow IT usage are expected to increase a user's productivity [4, 14]. Therefore, we propose the following hypothesis on workaround behavior and individual performance:

H8: Workaround behavior is positively related to individual performance.

Shadow IT usage is defined as the voluntary use of any IT resource that infringes IT norms at the workplace in reaction to perceived situational constraints whose objective is to improve work performance [53]. Mallmann and Maçada [60] argue that in the employee's perception, shadow IT improves individual performance when executing work tasks. Similarly, Silic and Back [61] demonstrate that the study of shadow IT at the individual level can lead to a greater understanding of the mechanisms related to business innovation and employee productivity. In light of all this, we arrive at hypothesis 9:

H9: Shadow IT usage is positively related to individual performance.

3 Method

3.1 Research setting

To answer our research questions and test our hypotheses, we employed a survey of IT users. According to Hair et al. [62], this is a suitable methodological procedure to collect

data from individuals that are either organized into groups or not.

3.2 Data measures

To prepare the instrument for data collection, we adapted previously validated measures for constructs from prior studies, resulting in four factors and twenty-two items. Each construct and its respective items consisted of a brief explanation of the concepts, as well as examples so that the respondent could understand the survey items. All items use a seven-point Likert scale with slight modifications for context. Table 1 provides the details of the measures and corresponding sources.

3.3 Data collection

The first step was to collect 90 responses from the pre-test survey to validate the research model. Although data analysis confirmed the model's validity, four items of the job characteristics construct presented a low factor load, which were excluded and not used in the data collected in the final survey. The G * Power 3.1 software was used to estimate the final survey's minimum sample size, requiring 68 respondents. Hair et al. [63] indicate that ten respondents per estimated parameter are adequate, while Kline [64] requires at least 200 respondents. Following the parameter stipulated by the G * Power 3.1 software and the recommendations by Hair et al. [63] and Kline [64], this study contains 411

Table 1 Constructs and items

Construct	Items	Source
Autonomy	I have autonomy to plan my work	Adapted from Morgeson and Humphrey [85]
	I can decide when and how my work should be done	
	I can decide which methods to use to complete my work	
Task identity	I can identify my effort in the results of my tasks	Hackman and Lawler [86]
	My job involves completing a task that has an obvious beginning and end	Morris and Vankatesh [41]
	My work is organized so that I can complete the work that I start	Tripp, Riemenschneider and Thatcher [42]
Skill variety	I do not consider my work repetitive	Adapted from Morris and Vankatesh [41]
	My job requires that I use a variety of different skills to complete my tasks	
	My job involves performing a variety of tasks	Morgeson and Humphrey [85]
Workaround behavior	I always use alternative solutions and avoid using my company's system,	Adapted from de Laumer et al. [45]
	When I believe necessary, I usually employ alternative solutions instead of using my company's system	
	Using alternatives instead of the system is an obvious choice for me	
Shadow IT usage	I use Internet-based software or Software as a Service (SaaS), such as communication and content-sharing software, to communicate and share work information with co-workers, clients, or partners, among other cloud services that are unauthorized or unrecognized by the IT department. Examples of these systems are WhatsApp, Facebook, Skype, Dropbox, Google Apps, etc	Mallmann and Maçada [60]
	I use a solution developed by me or another employee on the company's computers that is unauthorized or unrecognized by the IT department to perform my work tasks. Examples: a software developed by employees, Excel spreadsheet, etc	
	I use software installed by me or another employee on the company's computers that is unauthorized or unrecognized by the IT department to perform my work tasks. Example: free download software	
	I use my own devices at work without the IT department's permission. For instance, Smartphone, tablet, notebook, etc	
Individual performance	My productivity increases when I use shadow IT at work	Mallmann and Maçada [60]
	My productivity increases when I use alternative solutions	Pinto et al. [57]
	I perform my tasks faster when I use Shadow IT	Adapted from Mallmann and Maçada [60]
	I perform my tasks in less time when I use alternative solutions	Pinto et al. [57]
	I can perform complex tasks when I use Shadow IT	
	I can perform complex tasks when I use alternative solutions	

Source: Developed by the authors

Table 2 Respondents' profiles

Place of application	Number of respondents	%	Outliers	%
Financial sector	130	30.9	05	3.8
Technology Sector	95	22.6	01	1.05
Healthcare Sector	129	30.6	–	–
Public sector	67	15.9	–	–
Total	421	100	06	–

Source: Developed by the authors

respondents. The data were collected through an online survey by Google docs and the Type Form platform. Eight hundred IT users were invited to participate in the final survey, of which 421 answered the questionnaire, thereby obtaining a return rate of 52.6%. Of the 421 who responded, 415 were considered valid. Incomplete questionnaires and those with 80% or more of the answers in the same item or in only two items were removed, as suggested by Hair et al. [65]. Of the 415 respondents, 85.2% are from the service sector, 9.52% from the industrial sector, and 5.32% from commerce. Aside from that, 43.4% are analysts, 11.7% are managers, 6.44% are coordinators, and the remaining 38.46% have more than one position, including assistants, directors, consultants, managers, supervisors, or others. Table 2 details the respondents' profiles.

3.4 Data analysis

To perform the Exploratory Factor Analysis, we utilized SPSS statistical software. First, the Kaiser–Meyer–Olkin index (KMO) and the Bartlett's test of sphericity were calculated; both indicate the data's adequacy for factor analysis. For Hair et al. [66], values above 0.5 indicate that factor analysis is acceptable, the samples are adequate for applying factor analysis (KMO > 0.5), and that the Bartlett's test is demonstrating that the sample is significant. Finally, the Exploratory Factor Analysis was conducted in blocks. The values obtained in the analysis were higher than 0.4, according to requirements by Koufteros [67].

Subsequently, the Confirmatory Factor Analysis (AFC) and Structural Equation Modeling (SEM) were performed with SmartPLS 3.2.7 software. This software was used due to result of asymmetry and kurtosis. According to Hair et al. [66], skewness verifies whether the distribution of the data is symmetrical or asymmetrical, and kurtosis shows how much the data are centralized in a peak of the curve. In addition to skewness and kurtosis, the normality of the data was analyzed using the Shapiro–Wilk test. The analyses for kurtosis and skewness and the Shapiro–Wilk test follow a non-normal distribution; therefore, PLS-SEM is the most appropriate method.

Finally, a multi-group analysis was performed among the sample groups with SmartPLS 3.2.7 software. We present the results from the reliability test and the validity of the model in the following section.

4 Results

To validate the measurement model, we tested its reliability and the convergent and discriminant validity of the latent constructs of the total sample. First, Cronbach's alpha (α), the factor loadings, and the average variance extracted were used to assess the validity and reliability of each construct [63]. Convergent validity was ensured by the constructs' composite reliability (CR) over 0.7, Cronbach's Alpha (CA) over 0.7, and average variance extracted (AVE) at 0.5 or above [68]. As recommended by Hair et al. [69], the Fornell–Larcker criterion [68] and Heterotrait–monotrait ratio of correlations (HTMT) of Henseler et al. [70] were used to calculate discriminant validity. This study has satisfactory convergent and discriminant validity, as shown in Tables 3 and 4.

The results presented in Table 3 were obtained after excluding one item from the "task identity" construct since it presented low factor loading and interfered in the other analysis. The following item was excluded: (JC4) "My

Table 3 Convergent validity and descriptive statistics *Source*: Developed by the authors

	Item	Loading	Mean
Autonomy CR = 0.884; AVE = 0.717; CA = 0.806	JC1	0.802	3,680
	JC2	0.858	4,928
	JC3	0.878	5,361
Task identity CR = 0.635; AVE = 0.528; CA = 0.634	JC5	0.984	5,704
	JC6	0.297	5,646
Skill variety CR = 0.818; AVE = 0.602; CA = 0.704	JC7	0.695	6,364
	JC8	0.764	6,125
	JC9	0.859	4,788
Workaround behavior CR = 0.880; AVE = 0.711; CA = 0.797	WB1	0.861	2,780
	WB2	0.860	3,291
	WB3	0.806	2,807
Shadow IT usage CR = 0.854; AVE = 0.595; AC = 0.773	USIT1	0.737	3,735
	USIT2	0.778	3,504
	USIT3	0.761	3,195
	USIT4	0.808	3,610
Individual performance CR = 0.973; AVE = 0.859; CA = 0.967	IP1	0.914	3,816
	IP2	0.908	3,802
	IP3	0.939	3,639
	IP4	0.924	3,646
	IP5	0.940	3,612
	IP6	0.936	3,655

Table 4 Discriminant validity
Source: Developed by the authors

	Fornell–Larcker					
	AUT	IP	SITU	SKILLV	TASKID	WB
AUT	0.847					
IP	0.093	0.927				
SITU	0.192	0.719	0.771			
SKILLV	0.353	0.086	0.098	0.776		
TASKID	0.371	0.042	0.075	0.154	0.727	
WB	0.161	0.641	0.635	0.097	0.073	0.843

work involves completing a task that has a beginning and end". After the exclusion of the item "JC4", the construct remained with Cronbach's Alpha and the composite reliability below to 0.7, however, as the values were close to 0.7, it was decided to leave the construct.

The Fornell–Larcker criterion [68] states that the square root of the average variance extracted ($\sqrt{AVE}$) of one dimension must be greater than its transverse loads with the other constructs (Table 5).

The HTMT criterion [68] should have values lower than 0.85 but accepts values up to 0.90. Both criteria present satisfactory values.

4.1 Structural model and testing the hypotheses

After confirming the reliability and validity of the construct measures, we assessed the structural model. Based on steps suggested by Hair et al. [63], collinearity was first examined by using Variance Inflation Factor (VIF) values. The results showed that VIF values for all variables ranged between 1.274 and 2.031. This indicates that the results were not negatively affected by collinearity as they were larger than 0.20 and smaller than 5 [63].

The following results are based on the application of the bootstrapping procedure provided by SmartPLS. We adhere to orientation from Hair et al. [71] for a minimum of 5000 bootstrap samples. Figure 2 shows the structural model.

Regarding Path coefficients, the five paths are significant on the level of $p < 0.01$, as indicated in the footnote of Table 6, as illustrated in Table 6.

Hypotheses H1 and H2 were supported, confirming that autonomy in work is related to workaround behavior and shadow IT usage. Hypotheses H3 and H4, which tested the relationship of task identity with workaround behavior and shadow IT usage, were not supported. Neither were hypotheses H5 and H6, which tested the relationship of skill variety with workaround behavior and shadow IT usage.

Hypothesis (H7), which relates workaround behavior to shadow IT usage, was supported, consequently attesting that the IT user with deviant behavior may use an unauthorized technology. Hypotheses H8 and H9 were supported and therefore confirm that workaround behavior and shadow IT usage positively impact individual performance by providing more productivity to perform tasks more efficiently and in less time.

The R^2 value is a measure of the average variance extracted in each endogenous construct and the model's predictive relevance. The R^2 value of the shadow IT use, workaround behavior and individual performance endogenous constructs are 41.1%, 2.8%, and 57.4%, respectively. In social and behavioral sciences, Cohen [72] suggests assessing the R^2 values for endogenous latent variables as follows: 26% as a substantial effect, 13% as moderate, and 2% as weak. Therefore, the R^2 values are satisfactory, despite the weak effect of the workaround behavior construct.

Stone–Geisser's Q^2 measure was calculated to assess the model's predictive relevance. The blindfolding procedure with an omission distance of seven yielded cross-validated redundancy values for the endogenous constructs above zero [63], thereby supporting the model's predictive relevance.

Table 5 Discriminant validity
Source: Developed by the authors

	HTMT					
	AUT	IP	SITU	SKILLV	TASKID	WB
AUT	–					
IP	0.104	–				
SITU	0.239	0.827	–			
SKILLV	0.453	0.093	0.148	–		
TASKID	0.496	0.070	0.086	0.253	–	
WB	0.193	0.723	0.804	0.229	0.063	–

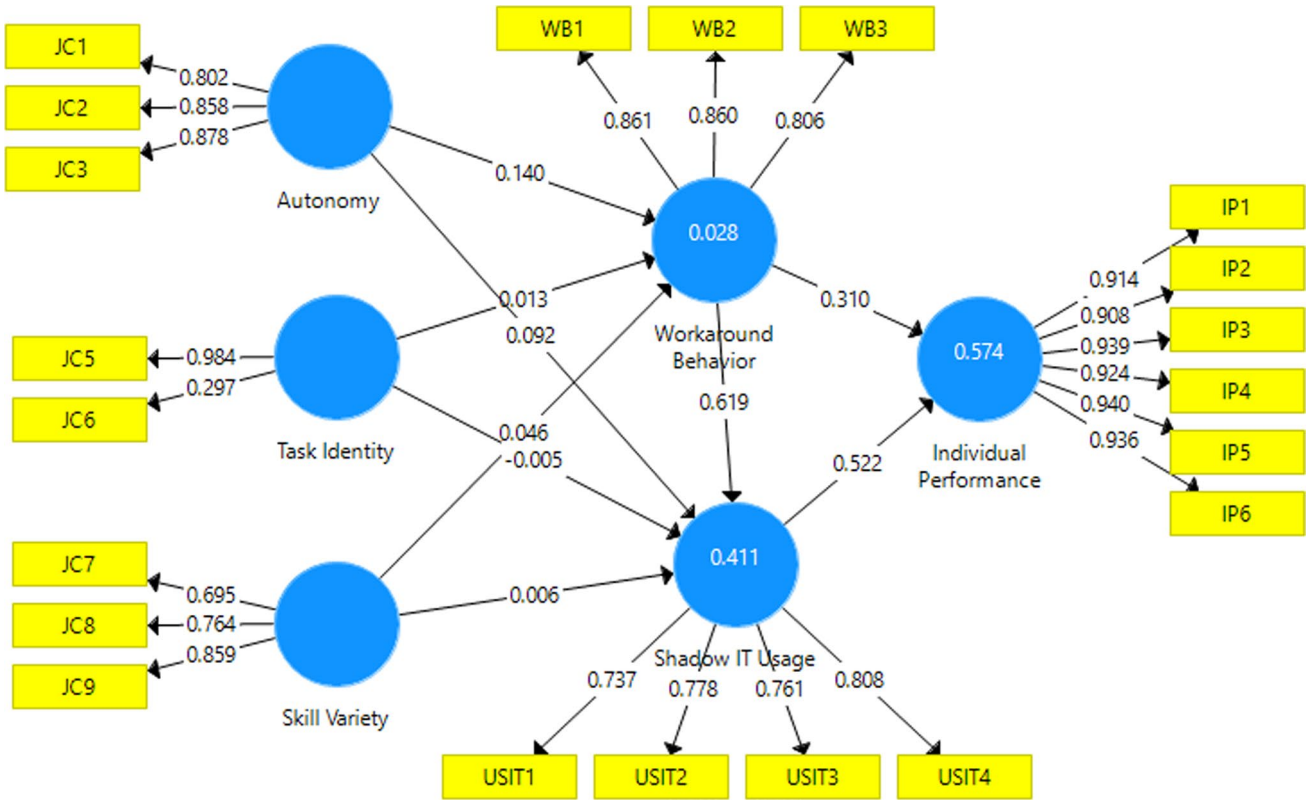

Fig. 2 Structural model. *Source*: Developed by the authors

Table 6 Testing hypotheses for relations among constructs

Hypothesis	Relation	t-Statistic[a]	Significance	Decision
H1	AUT → WB	2.053	0.040	Supported
H2	AUT → SITU	2.445	0.015	Supported
H3	TASKID → WB	0.170	0.865	Not supported
H4	TASKID → SITU	0.107	0.915	Not supported
H5	SKILLV → WB	0.843	0.399	Not supported
H6	SKILLV → USIT	0.134	0.893	Not supported
H7	WB → USIT	19.638	0.000	Supported
H8	WB → IP	6.744	0.000	Supported
H9	USIT → IP	11.874	0.000	Supported

Source: Developed by the authors

[a]t-values for two-tailed test: **1.96 (sig. level = 5%); ***t-value 2.57 (sig. level = 1%) [63]

Finally, the study assessed the standardized root mean square residual (SRMR) as an appropriate measure of model fit. Assuming a cut-off value of 0.08 as the most adequate for PLS path models [70], the resulting SRMR value was 0.068. Hence, the model shows an acceptable fit.

4.2 Multi-group analysis (PLS-MGA)

Finally, to verify the heterogeneity of the sample in the four different sectors, a multi-group analysis was conducted to see if there are significant differences in the estimated parameters of the groups. The Partial Least Squares Multi-Group Analysis (PLS-MGA) function was used in Smart-PLS 3.2.7 software to perform this analysis.

For a multi-group analysis, the first necessary step is to test the measurement invariance of composite models

(MICOM) [70]. The MICOM procedure contains three steps: (1) configural invariance, (2) compositional invariance, and (3) the equality of composite mean values and variances (2017). The MICOM procedure was tested with SmartPLS 3.2.3 software. Thus, the following six comparisons were made:

- Comparison 1: Technology Sector (n = 94) X Financial Sector (n = 125)
- Comparison 2: Technology Sector (n = 94) X Healthcare Sector (n = 129)
- Comparison 3: Technology Sector (n = 94) X Public Sector (n = 67)
- Comparison 4: Financial Sector (n = 125) X Healthcare Sector (n = 129)
- Comparison 5: Financial Sector (n = 125) X Public Sector (n = 67)
- Comparison 6: Healthcare Sector (n = 129) X Public Sector (n = 67)

If configural invariance (step 1) and compositional invariance (step 2) are confirmed, then there is partial measurement invariance. If partial measurement invariance is established and, the composites have equal mean values and variances across the groups, full measurement invariance is confirmed. When at least partial measurement invariance is confirmed for all latent variables of the model, the path coefficients can be compared by means of a multi-group analysis [69].

The results from the MICOM analysis confirmed that comparison 1 (Technology Sector X Financial Sector), comparison 2 (Technology Sector X Healthcare Sector), comparison 3 (Technology Sector X Public Sector), and comparison 6 (Healthcare Sector X Public Sector) presented partial measurement invariance, thus indicating that a multi-group analysis should be made.

On the other hand, following orientation by Hair et al. [69], Comparison 4 (Financial Sector X Healthcare Sector) and Comparison 5 (Financial Sector X Public Sector) did not confirm invariance, which means that a multi-group analysis should not be carried out.

After completing the MICOM analysis, the next step is to perform a multi-group analysis in the comparisons where invariance was confirmed. According to Ringle, Wende, and Becker [73], this multi-group analysis is a non-parametric significance test of the difference between specific results of two groups through the PLS-SEM bootstrapping results. Then, the PLS-MGA analysis compares each estimated bootstrap of a group with all the other estimated bootstraps for the same parameter in the other group to determine if there are significant differences between the groups [69].

As a result of the multi-group analysis, comparisons 1 (Technology Sector X Financial Sector) did not show significant differences between the technology and public sectors in hypotheses 3 (TASKID → WB), 4 (TASKID → SITU), 5 (SKILLV → WB), 6 (SKILLV → SITU), 7 (WB → USIT), 8 (WB → IP) and 9 (SITU → IP). However, significant differences between the sectors were presented in hypothesis 1 (AUT → WB) and 2 (AUT → SITU). Hypotheses 1 and 2 were confirmed in the financial sector ($p < 0.05$), but in the technological sector they were not supported ($p > 0.05$). Thus, greater autonomy at work can lead employees in the financial sector to use alternative solutions, however, this was not relevant in the technological sector.

Comparison 2 (Technology Sector × Healthcare Sector), comparison 3 (Technology Sector × Public Sector) and comparison 6 (Healthcare Sector × Public Sector) did not show significant differences ($p > 0.05$ and $p < 0.95$) in any of the proposed hypotheses.

5 Discussion

In this study, we analyzed the relation between different job characteristics (autonomy, task identity, skill variety) on workaround behavior and shadow IT usage. Additionally, we studied the relation between workaround behavior, shadow IT usage and individual performance. We will proceed with discussing each of the major findings.

First, we found autonomy to be strongly related to workaround behavior and shadow IT use (H1 and H2, respectively). In other words, autonomous workers are more likely to engage in workarounds and shadow IT usage. This is in stark contrast to the study by Rathert et al. [74], who found a negative relation between autonomy and workarounds. As the measures used for autonomy and workarounds were largely the same across the two studies, the difference may lie in the setting of the 2012 study: a specific acute care hospital where the large majority of respondents were nurses.

Second, our results show that the job characteristics task identity and skill variety, are not significantly related to either workaround behavior or shadow IT usage (H3–H6). Thus, performing a complete task from start to finish does not lead the employee to seek alternative means of completing the tasks. Also, when skill variety is high (i.e. specific knowledge and/or different skills are required for the task), an employee does not necessarily seek alternative solutions.

Employees can create processes that enable new ways to perform their work tasks [75]. However, it is demonstrated that aspects related to the tasks are not sufficient motivators for the workaround behavior and the use of shadow IT, which does not occur with the technological characteristics. These results corroborate the findings of other authors who report that the workaround behavior and the use of shadow IT have as main causes different deficiencies in IS and IT

[76], such as the lack of necessary functions to perform the tasks [77], or complex systems with confusing interfaces and excessive data entry with long lists of options, representing an inflexible system [59]

Third, our survey results demonstrate a positive, significant relation between workaround behavior and shadow IT usage. This is in line with the existing literature explaining the connection between the two constructs. Pinto et al. [57] research identified that the workaround behavior represents temporary practices, and is positively related to the use of shadow IT. Furthermore, the authors identified that the use of shadow IT can be very efficient replacing formal systems, which mediate the relationship of workaround behavior with individual performance. Thus, workaround behavior represents solutions that are related to the misuse of official IT.

For example, Baysari et al. [59] found that doctors entered requests using free text instead of selecting from the list of available options. It is also very common to use resources available in the organization in an unintended manner. According to Davison et al. [77] in almost all cases of systems failures, the Excel was useful and replaced the organization's system, despite not being a solution compatible with corporate expectations. By another hand shadow IT is related to the use of unofficial IT, such as installing other systems that are not available in the organization.

However, the slight differences in the results also leads us to join some authors in arguing that they should be studied separately to retain information on their distinctive features along the lines of long term against short term and process against technologies [12].

Last, we show a positive, significant relation between workaround behavior and individual performance as well as between shadow IT usage and individual performance.

This provides empirical evidence that employees generally perceive that using solutions and technologies offers superior individual performance. Indeed, according to Azad and King [78], a workaround is not necessarily an act of resistance by IT users but rather a necessity for completing tasks. This is in line with Petter et al. [34], who maintain that it is necessary to identify the essential attributes in the system, such as the quality of the system and service and usability aspects, like ease of use, efficiency, navigation, and reliability, for employees to fully utilize the technology adopted by the organization. Employees adopt alternative solutions and technologies to be productive and perform their tasks effectively.

In this research, we evaluated the positive influence of workaround behavior and the use of shadow. The literature considers that both the workaround behavior and the use of shadow IT can have a simultaneously positive and negative perspective. Brooks, Oshri, Ravishankar [9] reported the same workaround resulted in greater efficiency, while leading to information security risks. Then, a workaround can solve a problem and provide a benefit, but on the other hand end up creating new problems. To Reiz and Gewald [79] workaround behavior almost always cause some type of adverse effect on the organization, which can lead to rework, by ignoring the efficiency provided by the system that could benefit the organization as a whole. Likewise, the use of shadow IT can increase security risks [61] and improve the managerial control difficult [11], but as quoted, it also provides considerable benefits. Thus, a comparative study on the potential benefits and risks of woraround behavior and the use of shadow IT is highly recommended.

In our multi group-analysis, we did not identify any significant differences among the sectors in almost all the hypotheses. Nevertheless, the results of hypotheses 1 and 2 were different for the technological and financial sectors, showing that autonomy at work in the financial sector can lead employees to use alternative solutions and technologies, but in the technological sector this does not occur.

From the new insights on the positive impact of autonomy on both workaround and shadow IT behavior, and its resulting positive impact on individual behavior, it can be concluded that autonomy in organizational work practices is best encouraged, rather than discouraged. In previous studies, workarounds and shadow IT have been viewed as negative as well as positive phenomena. Our study follows the line of research showing that they may have negative effects, but generally increase individual performance. Rather than preventing their use, organizations may benefit from accepting or even formalizing these work practices [80]. As our study shows that autonomous employees engage in more workaround behavior and shadow IT usage, organizations may consider providing them with more autonomy in order to increase organizational learning and improvement.

5.1 Theoretical and management implications

Previous studies on alternative and unauthorized use of IS have shown concern over the negative impact of workaround and shadow IT usage on the organization. Research on workarounds and shadow IT is considered important because they offer a broader understanding of these solutions. However, Alter [4] states that studies on workarounds in IS are largely unexplored. Wolf, Sims and Yang [76] also state that workaround behavior is a recognized but little researched phenomenon. Moreover, most of the available studies adopt qualitative empirical approaches rather than quantitative research [10]. Moreover, Silic et al. [81] maintain that shadow IT is also a phenomenon that is currently misunderstood and relatively unexplored.

Our main academic contribution is evidence of the positive relationship between autonomy at work and workaround behavior and shadow IT usage. It is important to investigate the employee's behavior related to the reasons or factors

that motivate them to use alternative or unauthorized means to carry out their work tasks. The relationship between job autonomy and the use of IS has attracted the attention of researchers in recent years [28]. Users are increasingly technologically competent and have easy access to available web-based solutions and end-user computing tools [82]. When the IT user has the autonomy to decide which methods to employ and when to perform their tasks, it encourages workaround behavior and shadow IT use to become more frequent. The autonomy at work facilitates the exploitation of the system features by employees [27].

Another contribution of this study is its analysis of the impact of workaround behavior and shadow IT on individual performance. The literature usually presents the effects of workaround behavior and shadow IT usage at the organizational level and identifies the risks for the organization. Kopper et al. [83] argues that although shadow IT is more often seen negatively, researchers and managers are learning to cope with its benefits. Thus, in this study, we seek another viewpoint on how workaround behavior and shadow IT usage affect the IT user's individual performance.

As for managerial contributions, this study establishes crucial arguments about alternative and unauthorized practices that are not always easy to identify. It helps managers to comprehend factors affecting the use of workarounds and shadow IT and makes it possible to identify the positive and negative consequences of these solutions. Aside from that, this study's results aid managers in overseeing this phenomenon that is increasingly present in organizations, allowing them to develop measures, such as policies and norms, to prevent or minimize this behavior. On the one hand, alternative practices provide for better individual performance. On the other hand, these practices may compromise the security of sensitive data or affect workflow and reduce overall performance.

5.2 Limitations and suggestions

Due to restrictions in time, resources, and the scope of this research, we point to some limitations. The first refers to the period for data collection, which formed a cross section. We collected data in a specific short period and disregarded external interferences that affect the results momentarily. Another limitation concerns the selected items which compound the proposed research model, since other items could provide additional contributions.

The limitations of this study make space for future research. First, we recommend applying a long-term study to minimize the cross-sectional resource, which will make it possible to confirm or counter the results we obtained in this work.

Another important suggestion is to add new variables related to workaround behavior and shadow IT, such as "bring your own device," (BYOD) where employees use their own electronic devices to access organizational data and information. We expect that future studies assess how suitable IT governance practices can minimize the negative effects of workaround behavior and shadow IT use. According to Lunardi et al. [84], IT governance practices may minimize the risks associated with IT use. Based on Globalscape [8], in some cases, employees do not know or understand the organization's security policies regarding unauthorized devices or software in the workplace.

As a final research suggestion, we recommend studying workaround behavior with knowledge sharing as the use of alternative solutions provides faster, more dynamic communication and boosts collaboration among co-workers, external partners, and clients. Consequently, employees can gain the knowledge they need.

6 Conclusions

This research aims to measure the impact of job autonomy, task identity and skill variety on workaround behavior and shadow IT usage and their relation to individual performance. We applied a survey with 411 IT users to complete this objective. Statistical tests validated and demonstrated the reliability of the proposed model. The structural analysis allowed us to test our nine hypotheses.

We evaluated the autonomy, task identity and skill variety that are included in the job characteristics model of Hackman and Oldham [18]. Autonomy is positively related to workaround behavior and shadow IT usage, while the task identity and skill variety did not show any significance in the relationship. There is a significant difference among the different job characteristics, which reveals an existing research gap to be studied.

Since workaround behavior and shadow IT usage are similar concepts (although with important differences), one of the hypotheses analyzes if workaround behavior is related to shadow IT usage. This hypothesis proved to be significant and showed that workaround (which generally is temporary) is positively related to shadow IT usage, which involves long-term practices.

The results of this research demonstrate that workaround behavior and shadow IT usage are positively related to individual performance. Although several authors argue that workaround behavior and shadow IT use have a negative impact on the organization, employees perceive an increase in performance when they use alternative solutions and technologies. They obtain better productivity and execute tasks faster. Connecting this with the knowledge that autonomous workers engage in more workarounds and shadow IT, we

encourage organizations to evaluate their work processes and consider providing employees with more autonomy.

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Availability of data and materials The data used in this research can be directly requested to the corresponding author.

Code availability (software application or custom code) Not applicable.

Declarations

Conflict of interest Not applicable.

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