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Article

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Does digital transformation increase firms' productivity perception? The role of technostress and work engagement

The role
of technostress
and work
engagement

137

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Abstract

Purpose – To understand how organizations, public or private, must increase their productivity perception (PP), independently of the sector. This article aims to analyze PP in the digital transformation (DT) process to determine how it is affected by technostress (TS) and work engagement (WE), two concepts that seem to be forces opposing PP.

Design/methodology/approach – The authors use data from a questionnaire addressed to personnel in two organizations (public and private). The analysis applies partial least squares technique to the 505 valid responses obtained from these organizations. This analysis is based not on representativeness but on uniqueness.

Findings – The results suggest a positive, significant relationship between DT and PP. This article integrates DT and its effects on aspects of people's health, PP and WE. The model thus includes interactions of technology with human elements. In both business and administrative environments, PP is key to optimizing resources and survival of organizations.

Research limitations/implications – DT processes are different and complex because every organization is different. The authors recommend expanding this study to other sectors in both spheres, public and private. Aligning the objectives of the institutions for aid with DT is also quite complicated.

Practical implications – This study contributes to improving participating organizations. It also provides government institutions with a clear foundation from which to encourage actions that promote the health and WE of their workforce without reducing productivity. In addition, this study adds novelty to the research line.

Originality/value – The authors have deepened this line of research by developing fuller knowledge of the relationships among novel and necessary variables in organizations. The authors provide complementary, different and inspiring value in addressing this line of research.

Keywords Digital transformation, Technostress, Work engagement, Productivity perception

Paper type Research paper

1. Introduction

We are experiencing a digital transformation (DT) in all spheres, both public and private. The European Commission has classified the 2030s as the digital decade, the decade during which the business fabric will experience changes in its business models due to the process of DT.

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A report entitled “The digitization of the economy,” prepared by the Economic and Social Council of Spain (2022) convened by Telefonica, analyzes the impact of DT on organizations: more knowledge of customers, improved productivity, transformation of internal processes and creation of new products and services.

Outside our borders, the International Labor Office’s (ILO) governing body presented a significant report, “Decent work and productivity,” at its 341st meeting in March 2021 in Geneva. The report places special emphasis on studying this new paradigm of technological revolution, which identifies the indicators that lead to increased productivity, consideration of decent work, inclusive growth and shared prosperity. In response to this need, our study provides a novel vision of the impact of DT in two organizations in Spain, one public and one private, by contemplating DT’s relationship to technostress (TS) (Salanova, 2003) and work engagement (WE). This article studies DT as a technical system, analyzing it through the lens of Emery and Trist’s sociotechnical theory (1960), which argues that the DT process must be programmed so that implementation considers the interaction of people and machines, environmental issues and DT’s effect on these elements.

Because DT provides an immense range of technologies and applications, achieving a holistic view is difficult. In their study attempting to understand DT, Hausberg *et al.* (2019) verified that the literature contains little bibliography on finance, Human Resources (HR) and sustainability. DT and innovation in the business model caused by DT have changed consumers’ expectations and behaviors, producing changes in markets (Verhoef *et al.*, 2021). Further, organizational structure is important to achieving success. Our study’s results and conclusions therefore seek to contribute to this line of research, as well as to the line’s applicability to strengthening decision-making in organizations.

Studies have been performed to advance understanding of the phenomenon of DT and its characteristics (Mahraz *et al.*, 2019; de Bem Machado, 2022). The exhaustive review by Ragazou *et al.* (2022) of 765 post-pandemic articles published 2014–2022 shows that companies have begun to integrate emerging technologies such as big data, artificial intelligence (AI), machine learning and 3D printing into their business models. In addition, the technology-organization-environment (TOE) framework shows the relevance of the niche in the field of DT research on SMEs. The two participating organizations in this study, one semipublic and the other private, are leaders in their sectors. They have decades of activity and have for years been immersed in a DT process distinguished for its business models.

As for the semi-public organization, its activity focuses on health prevention. According to the report of the Union of Mutual Societies of Spain’s Ministry of Labor and Social Security (2019), it participates in two strategic alliances.

The private organization leads Spain in commercial, financial, sectoral and marketing information. This firm manages more than 400 companies around the world. Our analysis is based not on representativeness but on singularity. Our literature analysis yields few research findings on how employees perceive their increasingly automated work and its influence on WE. Authors researching work automation (Brougham and Haar, 2017b) have already noted that the type of work produced by the fourth industrial revolution can impact personnel’s professional satisfaction, especially their self-esteem.

Various studies have deepened understanding of the impact of DT in the company, on work and productivity in generation of expectations around AI and modern productivity (Brynjolfsson *et al.*, 2017) and the effect of TS on the firm’s human capital (Salanova and Cifre, 1999). This issue is vitally important for organizations for two fundamental reasons – the pressures they are under to adopt DT in their processes and their need to increase their productivity to face the competition. Further, persons, digital technology and organizations must understand one other to advance in a world with a gradual but increasing trend toward dehumanization of organizations (Ritzer, 2005).

Research on human resources management recognizes WE as one of the most significant predictors of productivity (Borst *et al.*, 2020), although some controversy is found among existing studies, based on the sector researched (Akingbola and Van den Berg, 2019).

These studies have asked whether WE benefits public vs. private-sector firms in similar ways. WE, such as bureaucracy, changes in political leadership and different motivations for working as a public servant. One question of interest for organizations is whether the positive effect of WE experienced in the private sector is also experienced in the public.

Given the opposing results and small number of studies of WE in public- and private-sector firms (Borst *et al.*, 2020), we believe it is necessary to analyze the effect of WE on the relationship between TS and working persons' productivity perception (PP) in two firms, one from the private and the other from the public sector. This distinction between organizations is especially important because environmental pressures for PP are stronger in private firms.

Our fundamental goal is thus to determine the mediator effect between the variables TS, PP and WE.

This study makes several important contributions to the literature. First, it fills a gap by studying the organizational DT process from a sociotechnical theory perspective (Trist, 1981). Considerable scholarly literature tackles technology use and its impact on people, although we must differentiate between the way people perform their activity with a specific technology and the way they perceive the DT process. This study focuses on the latter.

While the literature identified does not reach consensus on the relationship between technology use and productivity, our study advances understanding of this relationship through analysis of two examples from two samples in very different organizations.

Finally, our study aims to resolve the lack of consensus in research relating WE, TS and PP in the organizational DT process. Few studies tackle (as ours will) the importance of confirming WE during and within the DT process, not merely as a result of use of one or more technologies. We therefore consider WE and knowledge of it as important in this study.

To formulate the proposed objectives, we reviewed the literature on the research variables. Next, we justify the proposed hypotheses and subsequently describe the process of collecting information from the sample. We then validate the variables and contrast the hypotheses. Finally, we present the results, main conclusions, implications, limitations and future lines of study.

2. Literature review

The concept of DT is very controversial, due to its many definitions. We focus on the definition proposed by Multisectoral Association of Spanish Electronics and Communications Companies (AMETIC):

Digital transformation is a set of actions oriented to improving and modernizing organizations' and persons' processes, procedures, habits, and behaviors, which makes use of digital technologies to improve the global competitiveness of public administrations, companies, and citizens. (2017, p. 5)

This definition must be analyzed using sociotechnical theory (Trist and Bramforth, 1951), which argues that increasing DT's success requires performing it as a programmed process interdependently with progressive iterations of technological and human change.

Trist (1981) suggests that the social system and influence of the environment are key to design of the organization's work when the organization is facing a paradigm change. Relationships become more complex, including psychological, group and cultural factors that affect the daily life of an organization. An organization will be more efficient when the use of machines and their relationship to people generates a balance that strengthens organizational efficiency.

Technology use in organizations affects persons' stress – a phenomenon more concretely termed TS (Brod, 1984) – which can affect PP (Walton, 2019). Investigating the impact of five techno-stressors, two role stressors and productivity, La Torre *et al.* (2020) verified that different techno-stressors are significantly associated with women workers.

This study defines TS as “a negative psychological state related to technology use or the threat of its use in the future. This state is conditioned by the perception of misfit between demands and resources related to technology use, which leads to a high level of unpleasant psychophysiological activation and the development of negative attitudes toward technology” (Salanova, 2003, p. 225). As organizations are applying digital technologies in this fourth “technological revolution,” research has shown more TS to occur in people who hold positions related to use of these technologies (Tu *et al.*, 2005).

This study tackles PP from the work perspective – that is, from the perspective of the useful work a person performs when working with technology at a specific time, based on belief in efficacy. It is thus important to consider the self-efficacy the person can achieve when performing tasks related to or based on technology (if this is the case), as self-efficacy is a resource that mitigates the process of TS this person could ultimately develop.

In this study, we constructed the variable PP based on various studies by various authors authorship studies on jobs where digital technology is used.

Jorgenson *et al.* (2008) highlighted the considerable uncertainty concerning concept of productivity, specifically in the United States of America (USA) Very rapid growth of technology – specifically of information and communication technologies (ICTs) in the so-called “new economy” – caused expectations of change in business processes, resulting in increased productivity.

Deepening knowledge in this field, Brynjolfsson (1993) reported that only by understanding the “productivity paradox” can we learn, identify and act on the obstacles to increasing productivity. This author proposed a thorough review of the productivity of technology to study how to measure the productivity derived from technology use.

Brown (2014) continued to advance this research line by seeking evidence, for example, in the public sector. He attempted to prove the productivity benefits of ICTs, a question that remains unanswered. Brown has shown that the technology used had little influence on productivity gains, whereas research on private companies has shown that DT plays a key role in their productive efficiency (Tao *et al.*, 2022).

For Atanasoff and Venable (2017), technology use can improve efficiency, productivity and flexibility in the workplace, but it can also have negative effects on employees' cognitive state and psychological and physical health, generating TS. TS affects work satisfaction and employees' WE and results. The analysis by Langelaan *et al.* (2006) shows that personnel committed to their work can adapt more rapidly to changes in the environment and shift more easily from one activity to another than can people who are not committed to their work.

WE includes participation, commitment, passion, enthusiasm, absorption, concentrated effort and energy. Bakker *et al.* (2011) concluded that employed persons who are “engaged” can generate their own resources to maintain this level of WE to the firm. Our study is based on the concept of WE identified by Bakker *et al.* (2003), which focuses on “work commitment,” to the firm as a whole, not to a specific role.

2.1 Effect of the firm's DT on TS and employee PP

The speed of technological advances is altering organizations' leadership and design. Speed and fragmentation (Schwarzmueller *et al.*, 2018) change in work life and TS, information overload and physical presence in the workplace are key factors influencing productivity (Madden *et al.*, 2015). Roles of technology use and their overload in customer service

professionals in various organizations lead to TS (Christ-Brendemühl and Schaarschmidt, 2020). In the public sphere, research has verified that the use of ICTs increases TS (Camarena *et al.*, 2022).

While technology overload increases productivity in a mobile work environment (Hung *et al.*, 2015), it can also reduce productivity in the presence of communication overload unless proactive behavior is shown.

Based on all the foregoing, we thus propose the first hypothesis, which seeks to demonstrate the influence of the DT process on PP:

H1. The worker's perception of the firm's DT has an inverted-U shaped relationship to PP.

That is, in an environment of DT, workers can come to perceive that technology use is not helping them to be more productive, even though the incorporation of technology into their tasks is intended to obtain greater productivity.

Wilke *et al.* (1985) also explore their results in depth, suggesting a U-shaped relationship between technology, the stress technology causes and productivity. Years later, Karr-Wisniewski and Lu (2010) researched Parkin's principle of diminishing marginal benefit (Parkin, 2000), arguing that productivity is negatively affected when technology overload passes an optimal point.

Some studies contradict this negative relationship, however. Hung *et al.* (2015) found a positive correlation between general TS and productivity. This phenomenon can be explained by the Yerkes-Dodson Law (1908), which establishes that stress correlates positively with PP up to a point but that excessive stress causes a negative correlation between these variables.

Based on all the foregoing, we propose the second hypothesis, which permits us to advance in analysis of the model:

H2a. Workers' perception of the firm's DT increases their TS.

We can affirm that the stress caused by technology use (TS) affects PP, while studies have also confirmed that work stress impacts productivity. The new way of working represents an opportunity for organizational research to continue taking TS into account, among other factors (Giorgi *et al.*, 2022).

TS can affect people differently, depending on the user's type of work and socioeconomic status (Stadin *et al.*, 2016). Salanova *et al.* (2014) confirmed that TS is perceived differently in large and small organizations. It may thus be possible to mitigate TS by providing training to increase self-efficacy prior to changes in the ICTs used in firms. Interest in the study of work related TS has increased in recent years. Yue *et al.* (2022) analyzed a moderated mediation model, examining the relationship of two stressors resulting from the use of social networks for work purposes (time pressure and learning demand), with change-oriented organizational citizenship behavior.

Zainun *et al.* (2020) verified that TS was a predictor of WE to change in the public sector and concluded that techno-invasion and techno-insecurity were negatively associated with WE to change, whereas techno-uncertainty was positively related to WE to change.

Technology use is being considered as a source of increasing stress (Barley *et al.*, 2010), as it demands being more connected to work. In this line, analyzing the intensity of DT in 3,961 global Information and Communication Technology (ICT) companies in 2020, El Khouri *et al.* (2022) verified that electronic government and cyber security WE were key to boosting productivity.

Trist's sociotechnical theory (1981) argues that the organization achieves efficiency when the relationship between technology and persons is balanced. The effect of DT on TS breaks this balance, negatively affecting PP.

Based on the foregoing explanation, we propose the following hypothesis:

H2b. The worker's perception of TS has an inverted U-shaped relationship to PP.

This hypothesis seeks to show that people who work with technology can perceive that they are experiencing situations of TS because they have reached a point at which use of the technology itself overwhelms them. If people reach this situation, they could perceive that they are less productive because they are suffering from TS.

2.2 Work TE, PP and WE

Studies of the interaction between working persons and the DT process in the firm have shown that this interaction can generate responses of somatic stress (Riedl, 2013) related to tension at work (Stadin *et al.*, 2016). TS add to general stress at work, even when we control for job demands and sociodemographic conditions (Ayyagari *et al.*, 2011).

Some studies have related tension at work to willingness to rotate, productivity, WE to the organization and work satisfaction (Moore, 2000). Borst *et al.* (2020) showed in the public sphere that WE is very important for job well-being, resulting in high job satisfaction, high commitment, low turnover intention and high performance. The last two of these studies placed the most emphasis on studying the significance of the impact of TS, concluding that people who suffer tension – especially those who experience exhaustion – feel less WE to the organization and greater desire to leave it, while also being less satisfied at work. The public sector must consider the negative aspects of the relationship between people and technology in the workplace. Part of the literature on this topic addresses understanding of the relation between work-life balance and TS (Trittin-Ulbrich *et al.*, 2021).

Atanasoff *et al.* (2017) adopt the idea that technological instruments can negatively impact personnel's cognitive, psychological and physical health, affecting the WE of working persons. This study reinforces the need to research the effects of TS on organizations in different sectors and industries. Okolo *et al.* (2018) also conclude a positive and significant relationship between job design, TS and personnel commitment.

Recent studies of this topic have indicated that WE is associated with performance results, such as employee retention and PP (Hanaysha, 2016). Molino *et al.* (2020) use evidence of the positive relationship of resilience, information and training opportunities to the acceptance of technology to demonstrate a positive association with work commitment. WE is a key factor in work-related well-being that can change the effects of self-efficacy on job performance (Tian *et al.*, 2019).

Based on the material explained in this section, we propose the following hypothesis:

H3a. TS reduces the organization's employed persons' capability for WE.

H3b. Greater WE from employees increase the organization's PP.

2.3 Private-public context and effects on the model

Trist's sociotechnical theory (1981) shows that an organization is more efficient when technology, persons employed and context are in balance, whether the organization is private or public. Personnel with greater mastery of key technological variables have better results and greater work satisfaction.

DT is a continuous process requiring frequent adjustment of its processes, services and products, producing a change in organizational and bureaucratic culture in the public sector (Mergel *et al.*, 2019). Few studies have been performed on the effects of technology on productivity in the public sector (Fontaine, 2001). Dunleavy *et al.* (2006) foresaw that these changes in information technologies meant significant changes in organizational digitalization.

The public sector must be careful in transferring solutions to the private (Hofmann and Ogonek, 2018), due to the differences between the two sectors and the digital competences needed in each case.

Pilat and Criscuolo (2018) show evidence of an emerging relationship between productivity and DT in the private sector. Currently, numerous public entities perform smart work practices, with special emphasis on technology to improve its relationship to the workforce (Veglianti *et al.*, 2023).

Public-sector DT is a necessity for many governments at global level (Alvarenga, 2020), where the DT process not only brings business growth (as in the private sector) but also intensifies citizens' participation for economic progress and development.

Currently, DT's impact on working persons' productivity differs based on type of sector (public or private) in which the firm operates (Brynjolfsson *et al.*, 2017).

The foregoing leads us to formulate the following hypothesis:

H4. DT's effect on PP is greater in the private than in the public sector.

3. Methodology

The empirical part of our study uses data from surveys of numerous employees from two organizations to test the hypotheses proposed. As in other empirical analyses (Borst *et al.*, 2020), we believe it interesting to interview one organization from the public sector and another from the private, as various authors believe that significant differences may exist in the relationship among our study variables depending on the sector to which the organization belongs (Jansen *et al.*, 2010). Further, we compare two organizations of different natures, a private service firm that works in a digital field and a public firm (also a service firm) that focuses on improving organizational health and risk prevention. In the former, we start from the premise that the staff is more familiar with technology, a factor that may reduce TS. The second firm attempts to avoid TS, due to the firm's nature and WE to preventing health risks in the workplace. Thus, although these firms differ in legal status and mission, both include elements that can mitigate the factor of TS, ultimately making differentiation between them of great interest for this study.

The sample obtained from the public organization is composed of 404 records, of which 56.4% are women. Over 70% of respondents had been with the firm more than 10 years. The second sample, obtained from the private-sector firm, was composed of 101 records, of which 56.4% are women. As in the first case, 77% of respondents had seniority of over 10 years at the firm.

The data were gathered by online survey, a method appropriate for maximizing number of participants (Dillman *et al.*, 2009). In both firms, the questionnaires were sent, and the data gathered in 2019. The private firm's response rate was 29% and the public organization's 21.3%. For Camelo *et al.* (2011), this is a satisfactory response rate.

Chang *et al.* (2010) argues that telling respondents that their responses are confidential and anonymous reduces bias. To reduce common method bias in our survey (Podsakoff *et al.*, 2003), we stressed the WE to absolute confidentiality of responses. We developed a confidentiality agreement that explicitly requested a written WE. Finally, our questionnaire was based on point values, a format that Chang *et al.* (2010) reason has a lower tendency to common method bias.

We used structural equations method for the data analysis, adopting partial least squares technique (PLS-SEM) (Fornell and Cha, 1994) and the program Smart PLS 3.0 (Ringle *et al.*, 2015). PLS-SEM is appropriate for our study because it facilitates use of both formative and reflective scales, whereas covariance-based SEM have some limitations when formative

constructs are introduced (Chin, 1998; Henseler *et al.*, 2009). Our model used two formative variables, PP and WE. This analysis is based not on representativeness but on uniqueness.

The study variables were measured as follows:

Digital transformation: To analyze DT, we used 12 items. Eight were chosen from the scale used by McElheran (2015) and 4 additional items were generated. We subsequently consulted 2 recognized scholars and experts in DT and global digitalization, who helped us to agree on additional items to include in the questionnaire, especially on industry 4.0.

Technostress: The measure for TS used 17 items and was adapted from the scale validated by Salanova *et al.* (2007). The Resources/Experiences/Demands TIC (RED-TIC) study (Salanova *et al.*, 2007) can diagnose the phenomenon of TS and determine its antecedents (demands, and lack of work and personal resources), as well as the emotional consequences of TS.

Productivity perception: PP was measured using 6 items adapted from 3 leading study scales (Harter *et al.*, 2003; Schaufeli and Salanova, 2007; Syed and Jamal, 2012).

Work Engagement: WE was measured using 17 items and a scale adapted from that validated by Schaufeli and Bakker in 2003. WE indicate “work commitment” as a whole, not WE to a specific role (Schaufeli and Bakker, 2010). The UWES (Utrecht Work Engagement Scale) scale was developed empirically by these authors and carefully operationalizes constructs, including engagement.

All variables were measured using a Likert scale ranging from 1 to 7 points (1 = a little, 7 = a lot).

4. Results

Tables 1 and 2 present the results of the descriptive analysis of the data and the correlation matrix. The tables show higher means for the DT variables, PP and TS in the private firm operating in the digital environment. This finding indicates that workers in this firm perceive more impact of digitalization, stress involved and its effects on PP. In the public firm sector, these values are lower, showing that employed persons in this firm perceive neither the pressure from DT nor the effects of DT on TS and PP perceived by employees in the private firm. Instead, these effects are more moderate.

Table 1.
Correlation among
variables analyzed
(private)

	Mean	S.d	1	2	3	4
DT (1)	5.25	0.96	1	0.231*	0.388***	0.220*
WE (2)	5.10	0.68		1	0.237*	0.302***
PP (3)	4.34	0.87			1	0.091
TS (4)	5.86	0.89				1

Note(s): * $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$

Source(s): The authors

Table 2.
Correlation among
variables analyzed
(public)

	Mean	S.d	1	2	3	4
DT (1)	4.24	1.24	1	0.339***	0.214***	0.333***
WE (2)	4.21	0.79		1	0.244***	0.487***
PP (3)	4.47	0.68			1	0.124**
TS (4)	5.01	0.99				1

Note(s): * $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$

Source(s): The authors

We performed an exploratory analysis of reliability and dimensionality (Anderson and Gerbing, 1988). Tables 3 and 4 display information from analysis of the reflective variables.

Next, Tables 5 and 6 present the weights of the formative variables, enabling us to confirm their behavior.

Although some loadings are not significant, the analysis of the weight-loading relationship for these indicators (Hair *et al.*, 2014) shows that their corresponding load is high (>0.6) and eliminating a dimension would alter construction of the scale. We therefore believe it best to maintain the items. Elimination of indicators also risks changing the construct itself (Diamantopoulos and Winklhofer, 2001). We only dismissed two items in the case of private and public firms due to collinearity problems (Variance Inflation Factor (VIF) above 3.3) (Mooi and Sarstedt, 2011).

To confirm discriminant validity, we used a recently proposed Heterotrait-Monotrait criterion (Henseler *et al.*, 2014). This analysis also considered only the reflective variables (Chin, 1998). Tables 7 and 8 present the information on discriminant validity.

We evaluated common method bias using Harman's Test (Podsakoff *et al.*, 2003, 2012). The data obtained show no problem of common method bias in our data, since the total variance extracted from one factor was 17.42% in the public organization and 21.41% in the private – both values below the recommended threshold of 50%.

Prior to the mediation analysis, we validated the presence of quadratic effects between DT and PP, and between TS and PP, since prior studies argue for this effect (Hung *et al.*, 2015). Table 9 presents this relationship.

As the tables show, our results confirm a nonsignificant quadratic effect for both samples, indicating no support for either H1 or H2b.

		Factor loading	CA	CR	AVE
DT	DT3	0.515***	0.700	0.770	0.500
	DT5	0.558***			
	DT8	0.641***			
	DT9	0.568***			
	DT10	0.861***			
TS	TS3	0.865***	0.757	0.862	0.678
	TS7	0.88***			
	TS14	0.715***			

Note(s): * $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$

Source(s): The authors

Table 3.
Analysis of
measurement model
variables for sample
(private)

		Factor loading	CA	CR	AVE
DT	DT3	0.752***	0.743	0.827	0.500
	DT5	0.700***			
	DT8	0.700***			
	DT9	0.736***			
	DT10	0.700***			
TS	TS3	0.785***	0.700	0.821	0.606
	TS7	0.726***			
	TS14	0.843***			

Note(s): * $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$

Source(s): The authors

Table 4.
Analysis of
measurement model
variables for sample
(public)

Construct	Item	Weights	t-Value	VIF
PP	P1	0.021	0.445	1.094
	P2	0.551**	2.581	1.049
	P3	−0.048	0.675	1.136
	P4	0.422	1.512	1.080
	P5	0.668***	2.937	1.112
	P6	0.020	0.240	1.035
WE	WE1	−0.148**	2.521	2.645
	WE3	0.435***	3.394	2.029
	WE4	0.516***	7.576	1.698
	WE5	−0.306**	2.389	3.179
	WE7	0.083***	4.168	2.464
	WE8	−0.256	0.670	1.356
	WE9	0.181***	3.296	1.947
	WE10	−0.262*	2.333	2.730
	WE11	0.068***	4.690	2.319
	WE12	−0.099	0.660	1.420
	WE13	0.268**	2.832	1.410
	WE14	0.050**	2.589	2.414
	WE15	0.156	1.874	1.664
	WE16	0.167	4.197	2.634
	WE17	0.328***	3.297	2.758

Table 5.
Weights of formative variables (private)
Note(s): * $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$
Source(s): The authors

Construct	Item	Weights	t-Value	VIF
PP	P1	0.002	1.396	1.080
	P2	0.471***	7.608	1.074
	P3	−0.088	1.385	1.081
	P4	−0.091	1.637	1.086
	P5	0.774***	15.617	1.133
	P6	0.051	0.469	1.006
WE	WE1	−0.290***	8.345	3.178
	WE2	0.026***	14.648	3.104
	WE3	0.194***	15.782	1.719
	WE4	0.326***	16.551	1.658
	WE5	0.146***	9.025	1.679
	WE7	0.129***	16.536	2.068
	WE8	−0.097	0.933	1.215
	WE9	0.169***	10.367	1.668
	WE10	0.183***	11.362	2.072
	WE11	0.119***	13.994	2.416
	WE12	−0.001***	5.220	1.318
	WE13	0.139***	9.584	1.455
	WE14	0.078***	10.309	1.738
	WE15	0.062***	4.981	1.285
	WE16	0.030***	10.604	2.406

Table 6.
Weights of formative variables (public)
Note(s): * $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$
Source(s): The authors

Next, Table 10 presents our analysis of the interaction of the mediating effect in each sample. Evaluating the variance of the dependent latent variables explained by the constructs that predict them (R^2) indicates a variance higher than 0.1 (Falk and Miller, 1992). Simultaneous with our analysis of the size of R^2 as criterion of predictive relevance, we applied the sample reuse technique (Q^2 by blindfolding) proposed by Stone (1974) and Geisser (1975). Q^2 is greater than zero for the dependent latent variable, implying that the model has predictive validity. Finally, to evaluate the significance of the structural relationships, we applied the bootstrapping procedure (with 500 samples from the original sample).

Table 10 displays the 4 models designed to confirm the hypotheses proposed. First, we analyzed mediation models I and II, which show the results of the PLS-SEM analysis for the private and public firms. Both cases confirm a positive and significant relationship between DT and TS ($\beta = 0.36$ and $\beta = 0.39$; $p < 0.001$, respectively). The relationship between DT and PP is positive and significant in the case of private firm ($\beta = 0.39$ $p < 0.1$) but nonsignificant in the case of public firm ($\beta = 0.39$ $p < 0.1$). This result supports H2a but not H1, as mentioned above. That is, greater intensity of perception of the firm's DT process will influence working persons' TS and PP positively and significantly in the case of the private firm, but this perception will not affect PP in the case of the public firm.

Further, our analysis confirms that the relationship between TS and PP is positive and significant in the case of the public firm ($\beta = 0.35$ $p < 0.001$) but nonsignificant in the case of the private firm ($\beta = 0.35$ $p < 0.001$). As mentioned above, this result does not confirm H2b. Despite the argument established in the second hypothesis, TS has a positive and significant effect on personnel in the case of public organization but not in the case of the private one.

	1	2
DT (1)	0.641	0.345
TS (2)		0.823
Source(s): The authors		

Table 7.
Discriminant validity
(private)

	1	2
DT (1)	0.699	0.366
TS (2)		0.786
Source(s): The authors		

Table 8.
Discriminant validity
(public)

	Quadratic effect Private firm		Quadratic effect Public firm	
	Standardized beta	t-value Bootstrap	Standardized beta	t-value bootstrap
Quadratic effect DT → PP	0.101	1.43	0.034	0.955
Quadratic effect TS → PP	0.034	0.178	0.025	0.765
R^2 (PP)	0.22		0.15	
R^2 (TS)	0.09		0.14	
Q^2 (PP)	0.00		0.02	
Q^2 (TS)	0.04		0.07	

Source(s): The authors

Table 9.
Calculation of
quadratic effect

Table 10.
Validation of
hypotheses. Analysis
of interaction of
mediator effect in each
sample (private and
public organization)

	Mediation model I private firm		Mediation model II public organization		Mediation model III private firm		Mediation model IV public organization	
	β	<i>t</i> -value	β	<i>t</i> -value	β	<i>t</i> -value	β	<i>t</i> -value
DT → TS	0.36***	3.03	0.39***	9.05	0.35**	2.26	0.37***	8.39
DT → PP	0.39*	2.17	0.09	1.08	0.178	1.35	0.01	0.16
TS → PP	0.21	0.96	0.35***	4.83	-0.15	0.31	0.04	0.99
TS → WE					0.62***	5.03	0.52***	11.69
WE → PP					0.67**	2.50	0.61***	11.13
R^2 (PP)	0.21		0.15		0.36		0.39	
R^2 (TS)	0.10		0.14		0.10		0.13	
R^2 (WE)					0.36		0.26	
Q^2 (PP)	0.0001		0.02		0.02		0.06	
Q^2 (TS)	0.05		0.07		0.05		0.07	
Q^2 (WE)					0.04		0.09	
Note(s): * $p < 0.05$; ** $p < 0.01$; *** $p < 0.01$								
Source(s): The authors								

To confirm Hypotheses H3a and H3b, we follow the analysis proposed by Baron and Kenny (1986).

In this analysis, the independent variable must significantly affect the mediator variable, and the mediator variable must significantly affect the dependent variable. Mediation Models III and IV fulfill this condition. The relationship between TS and PP ceases to be significant, and positive and significant relationships occur between TS and WE ($\beta = 0.62$ and $\beta = 0.52$; $p < 0.001$, respectively) and between WE and PP ($\beta = 0.67$ and $\beta = 0.61$; $p < 0.001$, respectively). This finding supports hypotheses H3a and H3b; engaged employees achieve high PP, independently of the organization's activity and of the legal environment in which they operate.

Further, the findings support H4. The results show a greater effect of DT on PP in the private sector than in the public ($\beta = 0.39$ private firm, $\beta = 0.09$ public; $p < 0.01$ and $p < 0.1$, respectively). This finding supports Ragu-Nathan *et al.* (2008), who affirm that adoption and use of ICTs have led to redefinition of organizational structures and business processes and have altered the means of interaction among individuals and between individuals and the organization, causing TS in private organizations.

Next, Figures 1 and 2 present the double mediation model for the public and private firms.

To provide more rigorous analysis, we analyzed this effect using the "Variance Accounted For" (VAF) criterion (Hair *et al.*, 2014). In our case, the mediation effect of WE on the relationship between TS and PP is 84% in the public organization and 79% in the private firm, indicating total mediation in both firms ($VAF \geq 80\%$). The mediation models (Models III and IV) thus confirm that WE mediate the relationship between working persons' TS and their PP, and that PP depends on the type of firm.

Finally, the levels of R^2 obtained suggest that the causal model partially explains the endogenous variables studied. The proposed model also shows good fit according to most of the indicators considered.

5. Discussion and conclusions

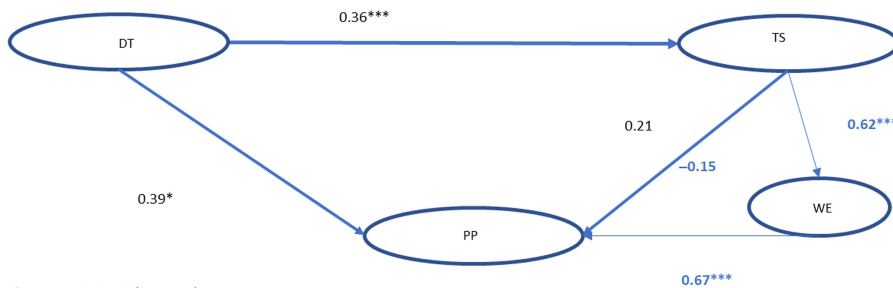
The DT process in organizations is causing us to relate to each other in different ways in the workplace, which can affect our PP. Trist (1981) affirmed that the design of an organization's work, as well as the social system and influence of the environment, are key when facing a

paradigm change, and millions of organizations are currently experiencing such paradigm change. [Trist \(1981\)](#) concluded that an organization is more efficient when it achieves a balance between persons and the machines they use. Special attention is thus paid to this issue, since organizations must work to make the DT process efficient and to preserve the balance between persons and technology based on the public or private context.

Our article therefore analyzes perception of the DT process and its relationship to TS, as well as its effect on workers' PP in two organizations with different sector-related and legal characteristics. Given the few studies of WE in public- and private-sector firms ([Borst et al., 2017](#)) and the contradictory results in the literature analyzed ([Ragu-Nathan et al., 2008](#); [Okolo et al., 2018](#)), we also investigate whether employed persons' WE is the means through which TS increases PP. TS can cause serious damage, and this damage can be mitigated better through personal than through professional methods ([Salo et al., 2022](#)).

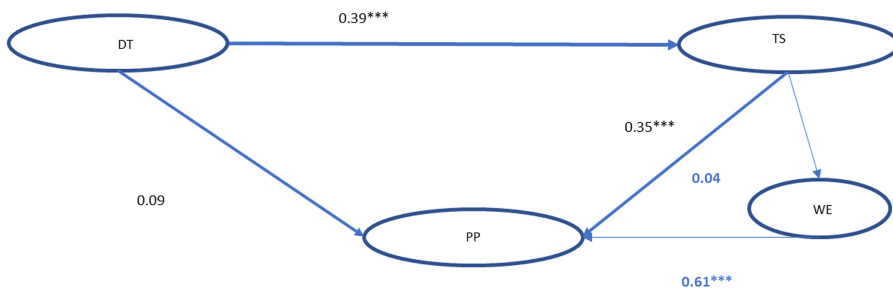
Our results show that the DT process influences generation of TS. Further, the data from our analysis affirm that the way the DT process is conducted in the firm is not significantly related to PP and thus does not support the first hypothesis proposed. This relationship may be explained by overload of information, communication and tools due to excessive ICT use, leading to lower productivity ([Karr-Wisniewski and Lu, 2010](#)).

Although one line in the literature ([Ahearne et al., 2004](#)) supports the second part of H2, our data (contrary to our predictions) show a positive relationship between TS and PP. The data indicate that persons employed in both the public and the private firm (each operating in a different work context) can neutralize the negative effects of TS on PP. Sociotechnical theory ([Trist, 1981](#)) explains that greater mastery of key technological variables by the firm's workers yields better results and ultimately greater work satisfaction.



Source(s): The authors

Figure 1.
Double mediation
model for private
organization



Source(s): The authors

Figure 2.
Double mediation
model for public
organization

According to Tarafdar *et al.* (2017), people with high self-efficacy have more control over the stressors that affect their PP. Their response to stressors is thus likely to be moderate (Spector, 1988). Pierce *et al.* (1993) conclude that people with high self-efficacy and greater faith in their capability at work show a less consistent relationship between stressors of work performance. Our analysis would therefore benefit from introducing items to measure self-efficacy in both samples, as this information would complement our results.

Finally, the results of the mediation analysis confirm that WE is the means through which TS influences working people's PP. WE mediates fully in the public-sector firm and partially in the private-sector firm. This finding suggests that persons who feel connected and committed to the work they perform in the firm translate DT more easily into greater PP. This effect is more salient in the public sector, where mediation is total.

As to the impact of the variables used on personnel, the private-sector firm has higher levels of DT, TS and PP than the public. The impact of WE is similar in both firms.

It is worth highlighting that this study tackles WE from the user's perspective (Blacker, 1986), focusing responsibility for mastery of technology on its users. The social sciences defend this stance, and it has a positive impact on psychosocial wellbeing, resulting in less stress and greater work performance, while also affirming that lack of resources in work performed with technologies can make technologies into stressors.

For our fourth hypothesis, the empirical data show that the relationship between DT and PP is more pronounced in the private-sector than in the public-sector firm. The information shows that the private sector uses DT to improve service delivery and change organizational processes and culture (Fountain, 2001). This process inevitably impacts its employees; more specifically, Mergel *et al.* (2019) concluded that organizational change because of the DT process involves both the most significant achievement and the most significant impact.

In conclusion, organizations undergoing the DT process must achieve people committed to the organization. This change is necessary and challenging, as the very nature of the process is quite dynamic and thus clearly more complex to analyze.

In both business and administrative environments, productivity is key to optimizing resources and survival of organizations. At this time of generalized DT in all sectors, this study invites us to design and implement the right measures to help mitigate the effects of TS, a process that requires managing WE as a vital factor.

Although the research performed advances our perception of the DT process in the firm, many questions remain to be studied. First, as this study focused on private and public firms, other sectors and public firms remain to be studied. A second question involves the extent to which we can generalize these results to large firms. The sample in our study focused on two organizations operating at national level. Future studies could translate our study to analyze the DT process in large global firms to determine working persons' level of WE in these firms, as well as in SMEs in other sectors and in different types of public organizations. DT processes are different and complex because no organization is the same. Aligning the objectives of DT aid institutions is also quite complicated, as these institutions must design the measures that contribute to this research line by comprehending the battery of aid resources with greater precision.

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