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Digital transformation and startup performance: intervention of management information and entrepreneurial creativity

ABSTRACT

Objective: This study analyzed the effects of digital transformation on startup performance, mediated by the use of management information and moderated by entrepreneurial creativity.

Method: A survey was conducted with technology startup managers listed in the *StartupBase*, and the structural equation modeling technique was applied to analyze the 215 questionnaires completed.

Originality/Relevance: This study innovates by investigating the interrelationship of the constructs of digital transformation, management information use, entrepreneurial creativity, and organizational performance in startups.

Results: The results denoted a positive influence of digital transformation on organizational performance. This suggests that if startups use new technologies, the chances of achieving the expected performance and surpassing their competitors are more significant. A mediation of the use of management information in this relationship was observed, indicating that using such information impacts the decision-making by managers. No moderation of entrepreneurial creativity was found in the proposed relationship, although creative entrepreneurs presumably can develop innovations through new technologies.

Theoretical/Methodological contributions: The results contribute by bridging gaps identified in the literature insofar as they reveal that digital transformation and the use of management information are important drivers of organizational performance.

Social/Management contributions: This study has practical implications by demonstrating that the digital transformation and the use of management information reflect on organizational performance, an important signal to managers about the primary focus to improve startup performance.

Keywords: Digital transformation. Management information. Entrepreneurial creativity. Organizational performance.

How to Cite (APA)

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1 INTRODUCTION

Constant innovations in information and communication technologies require organizations to renew themselves to ensure continuity and competitiveness (Vaccaro et al., 2012). From this perspective, Industry 4.0, or the fourth industrial revolution, has been changing business models through new enabling technologies (Büchi et al., 2020) and quick and efficient information sharing in the organizational context (Müller et al., 2020).

New digital technologies have become a challenge for organizations in the current scenario, given that no organization is free from their effects (Jafari-Sadeghi et al., 2021), whether opportunities or vulnerabilities (Büchi et al., 2020). The context of digital transformation (Henriette et al., 2015) to which organizations are exposed compels them to promote innovation in their business models (Bhatti et al., 2021) to evaluate and anticipate customer demands through the use of new digital technologies.

Information processing capacity has been deeply impacted by the digital transformation (Li et al., 2021), which, on the one hand, may indicate opportunities by identifying alternatives for the use of technological and digital innovation, and, on the other hand, may represent threats due to the turbulence and uncertainty that it has the potential to provoke. With the advent of digital transformation, it seems that sharing information with key stakeholders in real time has become feasible and a daily practice of organizations (Halpern et al., 2021).

This scenario has led organizations to conceive the use of management information as a requirement for process management and the decision-making of managers (Frare et al., 2023; Prajogo et al., 2018). According to Talón-Ballesteros et al. (2018), new technologies may favor using management information. However, there is a shortage of studies in the literature on the impact of digital transformation on the use of management information.

In this same direction, a research flow has been sparked to understand whether and how new technologies may affect organizational performance (Verhoef et al., 2021). Frare et al. (2023) argued that technological and digital innovation foster elements such as organizational performance. However, this relationship may not be direct, given that enhancing digital transformation within an organization may be associated with the entrepreneurial creativity (Moulang, 2015) of strategic-level managers. This instigates the assumption of a possible moderating effect of entrepreneurial creativity on this relationship.

Creativity (Pacauskas & Rajala, 2017) allows entrepreneurs to create and exploit opportunities so as to render their organizations more competitive and innovative (Fillis & Rentschler, 2010). Entrepreneurial creativity tends to influence organizational performance (Anderson et al., 2014). However, the interaction of entrepreneurial creativity in the effects of digital transformation on organizational performance remains unclear in the management literature.

Although the literature singularly addresses these constructs, the joint analysis may bring new knowledge and insights. It is conjectured that organizational performance may be influenced by digital transformation (Büchi et al., 2020) and by the use of management information (Wang et al., 2005) and entrepreneurial creativity (Moulang, 2015), especially in organizations that have at their core the manipulation of new technologies, such as startups. Therefore, this study aimed to analyze the effects of digital transformation on startup performance, mediated by the use of management information and moderated by entrepreneurial creativity.

The vulnerability of startups suggests that this process may have a more significant impact on them than on more consolidated companies. Startups are new organizations with limited funds that work under circumstances of intense uncertainty (Ries, 2011; Usman &

Vanhaverbeke, 2017). Although startups need opportunities in the market, infrastructure, and experience, they have versatility and agility and are based on good ideas and inventions (Fabrício Jr. et al., 2015), so they must be understood in their management to be successful (Radziwon & Bogers, 2019).

Investigating the interrelationship of the constructs of digital transformation, management information use, entrepreneurial creativity, and organizational performance in startups is justified by the fact that they usually operate with considerable chains of information, which requires that their systems work in real time and allow easy access to managers (Li et al., 2017). Technologies such as big data, cloud computing, and artificial intelligence applications are commonly used by startups to surpass competitors and improve their performance (Wang et al., 2016).

The relevance of this study lies in the observed gaps, which present questions not yet sufficiently resolved in the literature, which motivates this study. We envision the need for a theoretical model that contains these constructs and propose its analysis through structural equation modeling. This study also contributes to management practice by allowing for new understandings of digital transformation and its relationship with using management information, entrepreneurial creativity, and organizational performance. It also contributes to advancing the search for understanding these elements in the field of startups.

2 LITERATURE REVIEW AND HYPOTHESES

2.1 Digital Transformation in Startups

The absence of a consensus definition in the literature for startups requires its characterization in each study. It is assumed that startups are nascent technology-based organizations with a temporary nature and rapid growth potential in search of a repeatable and scalable business model (Blank & Dorf, 2012). It is a mistake to consider any small organization in its initial stage or any technology-based organization in its constitution phase as a startup. Ries (2011) warned that opening an organization identical to an existing business, with equal pricing, target customers, and products, does not characterize the creation of a startup since the success of this new venture depends only on the execution of the plan and not on innovation.

The digital transformation scenario led to the emergence of businesses centered on digital resources, such as digital startups, which are the target of this study. Digital startups differ from non-digital ones; although both are conceived and implemented in dynamic environments of extreme uncertainty, the former are constituted in scenarios of digital disruptions (Martínez-Caro et al., 2020). Their main procedures are architected so as to use structures based on technological and digital innovation, essentially rooted in digital processes and technologies that do not require large spaces or facilities, aimed at developing electronic information products (Frare et al., 2023).

Startups may be at different stages of the organizational life cycle. A classification of evolutionary stages aimed at startups is the one presented by Abstartups (2022), anchored in the following phases: (i) ideation – the business idea exists, but its viability is still being evaluated; (ii) operation – it is in operation and the business model is accepted by the market, but it still needs investments for new strategies; (iii) traction – it is in operation, focused on sales revenue, active customers, and leverage, ready for scalability; (iv) scale-up – it registers growth, both in revenue and the number of employees, and directs its attention to more investments with a view to expansion. This classification allows a better understanding of the responses of startups to digital transformation.

2.2 Digital Transformation and Organizational Performance

Digital transformation implies the implementation of digital resources to reformat the business model (Henriette et al., 2015). It is defined by the use of new digital technologies (smartphones, artificial intelligence, cloud blockchain) to improve or conceive new business models, accelerate operations, and/or improve the customer experience (Warner & Wäger, 2019). In startups, given their particular characteristics, it represents a continuous process of using new digital technologies, focusing on the agility of strategic renewal.

For an organization, digital transformation may bring consequences to operation processes, resources, and users in a way that requires changes in habits and in how it works and seeks to orient itself, with intensive collaboration and interactions (Henriette et al., 2015). Digital transformation can modify an organization and provide new competitive advantage alternatives, given the addition of value to customers (Lanzolla et al., 2020; Verhoef et al., 2021).

In digital transformation, value is created from data captured and shared with stakeholders and used in real time via smart data capabilities (Halpern et al., 2021). Organizations seek innovative strategies to obtain better economic-financial results, improve their processes, and develop new organizational capabilities (López-Nicolás & Meroño-Cerdán, 2011). However, organizational performance needs to be monitored to mitigate the risk of business discontinuity and identify needs to increase the profit of the organization (Rompho, 2018).

For performance to flow, all efforts must be dedicated so that a given target is achieved (López-Nicolás & Meroño-Cerdán, 2011). Thus, technologies are implemented and used to achieve superior performance. New technologies may provide managers with previously unattainable insights by allowing the processing of large volumes of data and the discovery of patterns and relationships (Raisch & Krakowski, 2021), particularly in startups that intensively use technology to innovate (Lapierre & Giroux, 2003).

Büchi et al. (2020) surveyed manufacturing companies in Italy and found that more significant openness to enabling technologies is linked to performance, which is measured by the extent of opportunities for the businesses. The study provided evidence that technologies generate opportunities in terms of flexibility, speed, increased production capacity, reduced errors and costs, and improved product quality.

Duman and Akdemir (2021) analyzed the effects of new technologies on the performance of industrial companies in Turkey. The results showed that new technologies improve organizational performance, such as profitability, sales revenue, production volume, production speed, capacity utilization, quality of processes and products, and possible cost reductions. The authors concluded that companies must invest in new technologies to obtain positive effects on organizational performance.

Raisch and Krakowski (2021) explored the concepts of automation and augmentation in the management domain based on three books on artificial intelligence. They assumed that automation implies that machines perform human tasks, while augmentation in the management domain means that humans collaborate with machines to perform tasks. The books recommend prioritizing augmentation in the management domain for better performance. However, the authors warned that, in the management domain, these concepts are not separable, and they suggested complementarity for superior performance.

Therefore, the studies brought to this discussion, albeit developed with different propositions and contexts, allow inferring by analogy and in startups that new digital technologies may positively affect organizational performance. In this sense, the following is

proposed:

H1: Digital transformation directly and positively influences organizational performance.

2.3 Mediation of the Use of Management Information between Digital Transformation and Organizational Performance

The use of management information has a vital role in the evolution of several organizational skills, such as customer relationships, process management, and performance (Prajogo et al., 2018). However, the volume of available information can overwhelm managers in decision-making, which is why new technologies may be relevant for handling this information load (Frare et al., 2023; Rodríguez-Hernández & Ilarri, 2021). In this case, the use of information may act as a facilitator to promote digital transformation (Frare et al., 2023).

Vandenbosch (1999) argued that the use of management information should primarily focus on areas that most present problems in organizations, given that information can support managers in controlling them (Wee et al., 2014). It follows that the management information prepared for a specific purpose can more easily influence the performance of the organization (Wang et al., 2005). Thus, using management information can contribute to business management since it supports the decision-making process with information the manager needs (Schaefer & Minello, 2017).

The use of information is a central requirement and driver of the purpose of digital transformation in organizations (Müller et al., 2020). Associated with new technologies, the use of information tends to have more significant credibility because it allows the rapid interaction of systems (Sternberg et al., 2021). One of the purposes of digital transformation is to assist in the strategic alignment, efficiency, and evolution of organizational performance (Paré et al., 2020). Due to the impacts of technology, market professionals and researchers discuss the managerial challenges imposed by digital transformation (Teubner & Stockinger, 2020).

Frare et al. (2023) found total mediation of the use of management information in the relationship between organizational mindfulness toward digital transformation and market agility. Although the authors considered fragments of digital transformation and organizational performance in this relationship, it is assumed that, by analogy, the results may substantiate the hypothesis proposed; the mediating variable is even the same: the use of management information. Hence, from the discussions and studies with incursions into relationships proposed herein, the following is assumed:

H2: There is a mediating effect of using management information in the relationship between digital transformation and organizational performance.

2.4 Moderation of Entrepreneurial Creativity between Digital Transformation and Organizational Performance

Creativity, in general, implies proposing new ideas to be implemented (Amabile, 1988). Creativity is a determining factor in the organizational field, especially in organizations operating in circumstances of uncertainty and environmental turbulence, helping to ensure their continuity (Woodman et al., 1993). Creativity also figures as one of the ways to improve organizational performance and add value to processes (Shahzad et al., 2016).

In the literature, creativity is addressed with different approaches, but entrepreneurial

creativity is specifically important in this study. From this perspective, creative entrepreneurs are characterized by recognizing opportunities and offering creative products and services (Moulang, 2015). Corroborating this understanding, Bujor and Avasilcai (2016) reinforced that creative entrepreneurs are people who are able to turn their ideas into products and services for the population.

Entrepreneurial creativity may play an important role in organizations in general, but particularly in startups working in digital technology, conceived in dynamic environments of uncertainty, given that it can provide new ideas and result in innovation (Frare & Beuren, 2021). Innovation toward digital transformation is an important means for an organization to achieve market agility and swiftly improve its products and services, aiming to meet customer demands (Frare et al., 2023).

From this perspective, it is necessary to understand which management mechanisms instigate the creativity of individuals in organizations (Amabile, 1988). Given this, it is assumed that improving the creative process may help in digital transformation to generate value for companies (Shahzad et al., 2016). The strategic alignment of digital technology with business and the increase in Information processing capacity (Li et al., 2021) may jointly enhance organizational performance.

In a systematic survey, Wamba-Taguimdje et al. (2020) found that a structured approach to deploying new technologies may result in benefits due to its ability to improve both organizational performance and process performance. Improving operational inefficiencies and automating tasks through technology have direct effects on performance, such as reducing costs, improving response time, and improving customer relationship management (Shahzad et al., 2016).

Mikalef and Gupta (2021) examined the relationship of new digital technologies (artificial intelligence capability) with organizational creativity and performance, and the evidence pointed out that this digital transformation results in more considerable organizational creativity and performance. Zou and Jian (2021) found positive and significant effects of new digital technologies (cloud application) on team performance and employee creativity and inferred that new digital technologies are critical to the success and survival of organizations.

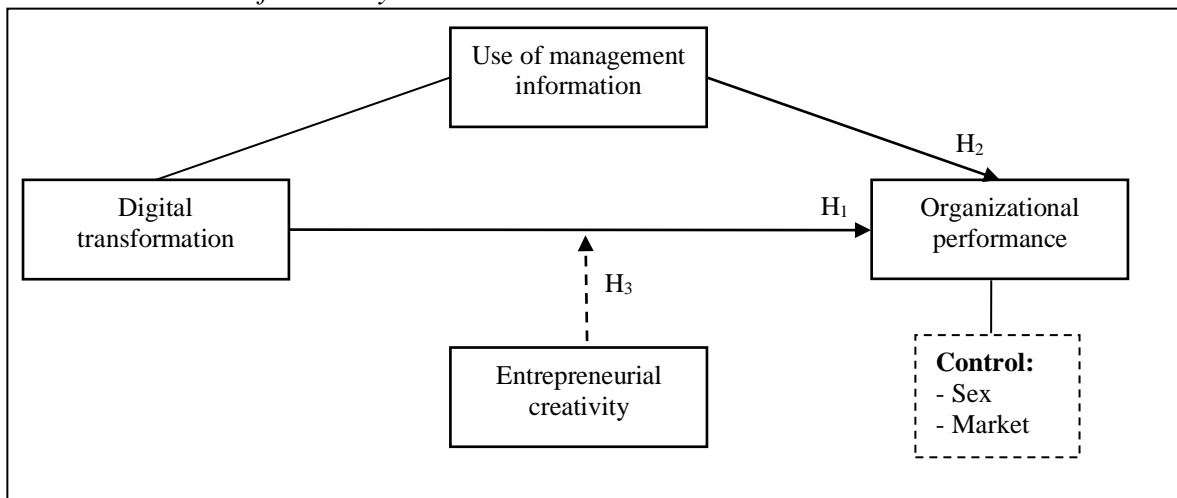
Opazo-Basaez et al. (2021) observed in Spanish manufacturing companies inserted in global value chains that creativity may influence when it is linked to new technologies and have the potential to increase organizational performance. Based on the above, it is assumed that creativity may influence the direction and strength of digital transformation in organizational performance; therefore, the following is conjectured:

H3: There is a moderating effect of entrepreneurial creativity in the relationship between digital transformation and organizational performance.

From the hypotheses formulated, Figure 1 presents the theoretical model of the study.

The study predicts a mediating effect of the use of management information and a moderating effect of entrepreneurial creativity in the relationship between digital transformation and the performance of startups. Control variables were also inserted in the model: the sex of the respondent and the market of operation of the startup.

Figure 1
 Theoretical model of the study



Source: Devised by the authors.

3 METHOD

3.1 Population and Data Collection

The study population comprised startups listed on StartupBase. Aligned with the purpose of the study, it was decided to investigate startups in software development, big data, mobile, and the Internet since they are organizations focused on technological innovation. In StartupBase, on October 20, 2021, 1,035 startups in the digital technology area were identified. In possession of this list, we sought to identify these startups in the professional network LinkedIn, but not all had a profile; in total, 864 startups were found.

The following step was to identify professionals with strategic positions (e.g., CEOs, managers, directors) in these startups; however, not all had professionals registered in the selected positions. Invitations were sent to the 1,076 professionals identified on LinkedIn, with 541 accepting to participate in the study, to whom the questionnaire was sent through the QuestionPro platform. For there not to be a polarization of responses from a single startup, we limited the sending of the questionnaire to up to three respondents per startup.

Thus, a total of 215 valid responses were obtained from October to December 2021. This amount satisfied the minimum sample size determined by version 3.1.9.4 of the G*Power software according to the parameters and criteria outlined by Faul et al. (2009). Based on the model, with three predictors (digital transformation, use of management information, and entrepreneurial creativity) for the dependent variable (organizational performance) and two control variables that may also influence the model, a minimum of 74 valid responses are required, with a confidence of 0.95 and an error of 0.05.

3.2 Study Variables

The constructs comprised multiitems, based on the literature (Appendix A). All items were measured using a five-point Likert scale.

Digital transformation was measured using the research instrument by Halpern et al. (2021), composed of the following: the extent of use of digital technologies, developed based on the theoretical framework of these authors, with a scale from 1 = not at all to 5 = to a large

extent; the range of use of digital technologies, using the research instrument of these authors, with a scale from 1 = not at all to 5 = to a high degree; and the use of digital technologies to add value, using the research instrument of these authors, with a scale from 1 = strongly disagree to 5 = strongly agree.

The use of management information was measured through five assertions for internal management information and five for external management information adapted from the work of Prajogo et al. (2018), with a scale from 1 = strongly disagree to 5 = strongly agree. The adaptations consisted of replacing the term "partners" from the supply chain with "stakeholders".

The organizational performance was measured using ten assertions by López-Nicolás and Meroño-Cerdán (2011), with a scale from 1 = strongly disagree to 5 = strongly agree. Finally, entrepreneurial creativity was measured through eight assertions by Moulang (2015) with some semantic adaptations, considering the scale from 1 = hardly ever to 5 = almost always.

Control variables were also included in the model. The binary variable for the sex of the respondent was controlled, with 0 = male and 1 = female, to determine whether the startups surveyed had no distinction in performance when led by male or female professionals (BarNir, 2012). The variable for the market of operation of the startup was controlled, with 0 = local/regional operation and 1 = national/international operation, to determine whether the perceptions of the respondents were homogeneous regarding the impact of the market of operation on organizational performance (Gomez-Conde et al., 2021).

3.3 Data Analysis Procedures

To analyze the hypotheses, the technique of Partial Least Squares Structural Equation Modeling (PLS-SEM) was applied, in which the direct relationships were examined by the path coefficients and the indirect relationships by the total indirect coefficients (Hair Jr. et al., 2017). In the mediation, the antecedent variable influences the mediating variable and the mediating variable influences the consequent (Bido & Silva, 2019; Hair Jr. et al., 2017). Total mediation occurs when the direct effect is not significant and the indirect effect is significant; in turn, partial mediation occurs when the direct and indirect effects are significant (Bido & Silva, 2019).

The recommendations by Hair Jr. et al. (2017) were followed to verify the effect of moderation: ascertain whether the inclusion of the moderating variable influences the direction and strength of the relationship between the independent and dependent variables.

4 ANALYSIS OF RESULTS

Regarding the sample profile, 179 respondents were male. Most respondents were 31 to 40 years old. Academic training at the specialization and/or Master of Business Administration (MBA) levels was predominant. Most of the respondents held senior management positions, such as directors and founders, and had been in the positions for four to six years. Regarding the startups, most were located in the state of São Paulo and had fewer than 51 employees. It was also observed that most of these startups were in the traction phase and that their markets of operation were concentrated in the national market. The profiles of these startups corroborated that they represented a force in generating new jobs and were drivers of growth in the regions where they operated (Oliva et al., 2021).

4.1 Statistical Analysis

Harman's one-factor test (Podsakoff et al., 2003) was initially performed to verify whether the common method bias affected the data. The results indicated that no single factor individually represented more than 50% of the variance, as recommended by Podsakoff et al. (2003), with the first factor explaining 36.34% of the total variance, suggesting that the study data did not present limitations related to the common method bias. This allowed proceeding to the modeling.

In structural equation modeling, the first step consists of the measurement model, which evaluates the assumptions about the factor loadings of the items, the reliability of the internal consistency, and the convergent and discriminant validity (Hair Jr. et al., 2019). Table 1 presents the reliability and validity values of the investigated variables.

Table 1
Reliability and validity of the model

Constructs	EC	OP	DT	UMI	G	M
EC	0.786					
OP	0.452	0.715				
DT	0.479	0.683	0.722			
UMI	0.502	0.616	0.602	0.725		
G	0.106	-0.004	0.096	0.037	1	
M	0.042	-0.109	-0.023	-0.018	0.099	1
Average Variance Extracted (AVE) > 0.50	0.618	0.511	0.522	0.526	1	1
Cronbach's Alpha > 0.70	0.894	0.862	0.917	0.897	1	1
Composite Reliability (CR) > 0.70	0.918	0.892	0.931	0.916	1	1

Note 1. EC = Entrepreneurial Creativity; OP = Organizational Performance; DT = Digital Transformation; UMI = Use of Management Information; S = Sex; M = Market.

Note 2. n = 215. The diagonal elements represent the square roots of the average variance extracted, and the elements outside the diagonal represent the correlations between latent variables.

Source: Study data.

The reliability of the indicators (assertions) of each construct was verified, with values higher than 0.70 being recommended, and factor loadings from 0.40 to 0.70 should only be excluded if this exclusion leads to an increase in AVE and CR (Hair Jr. et al., 2017). Thus, nine assertions (DT3, DT5, DT9, DT11, DT12, DT19, EC6, OP8, and OP10) were excluded because they had loadings of less than 0.40.

After that, all variables presented Cronbach's alpha and CR values greater than 0.70, the minimum value recommended by Hair Jr. et al. (2019), indicating that the set of assertions was reliable. Regarding convergent validity, according to the AVE values, each variable explained more than half of the variance of its indicators, higher than the minimum established in the literature. Thus, the convergent validity of the variables was attested.

The discriminant validity was analyzed using the Fornell-Larcker criterion, which compares the square roots of the AVE values of each construct with the correlations (Pearson) between the variables; the square roots of the AVE values must be greater than the correlations between the variables (Hair Jr. et al., 2017). The values of the discriminant validity of all variables were higher than the coefficients of the correlation matrix (both vertically and horizontally), denoting acceptable discriminant validity.

To ensure the absence of multicollinearity among the latent variables, the Variance Inflation Factors (VIFs) were analyzed, the values of which should ideally be less than 3 (Hair Jr. et al., 2019). The absence of multicollinearity among the variables was confirmed since values below 2 were found. These analyses indicated that the measurement model was valid, which allowed proceeding to the structural relationship analysis stage, as shown in Table 2.

Table 2
Structural model results

Hypotheses	Beta (β)	t-value	p-value	Decision
H1 DT \rightarrow OP	0.263	3.023	0.003*	Not rejected
H2 DT \rightarrow UMI \rightarrow OP	0.505	7.591	0.000*	Not rejected
H3 Moder. EC x DT \rightarrow OP	-0.055	1.628	0.104	Rejected
C1 Sex \rightarrow Performance	-0.043	1.294	0.196	Rejected
C2 Market \rightarrow Performance	-0.105	2.298	0.122	Rejected

Note 1. DT = Digital Transformation; OP = Organizational Performance; UMI = Use of Management Information; EC = Entrepreneurial Creativity; Moder. EC \times DT = Moderation of Entrepreneurial Creativity in the relationship between Digital Transformation and Organizational Performance.

Note 2. C1 = Control 1; C2 = Control 2.

Note 3. n = 215. Significant at the level of *p < 0.01; **p < 0.05; ***p < 0.10.

Evaluation of the structural model (R^2): Use of management information = 0.691; Organizational performance = 0.641

Predictive relevance (Q^2): Use of management information = 0.333; Organizational performance = 0.336

Source: Study data.

In the analysis of direct effects, H1, which predicted a direct positive relationship between digital transformation and organizational performance, was not statistically rejected ($\beta = 0.263$; $p < 0.10$). This indicates that digital transformation can increase organizational performance, for example, by providing new ideas and techniques that optimize processes (Chege et al., 2020) and reducing costs by replacing labor with the help of robots or virtual agents, in addition to earning gains with new technologies such as artificial intelligence and blockchain (Verhoef et al., 2021).

In addition to the direct effects, mediating and moderating effects were also analyzed. Mediation occurs when the influence of the independent variable on the dependent variable is mediated by a third one (Carrión et al., 2017). Partial mediation was observed in this study, given that the insertion of the mediating variable annulled the effect of the independent variable on the dependent variable (Hair Jr. et al., 2017), i.e., the direct and indirect effects presented statistical significance (Bido & Silva, 2019). Thus, H2, which predicted the mediation of the use of management information in the relationship between digital transformation and organizational performance, was not rejected.

Moderation occurs when the intervening variable modifies the strength or direction of the relationship between two variables (Hair Jr. et al., 2017). In the structural model, the effect of the moderation was obtained through the interaction term since the moderating variable was continuous, measured by multiple assertions using Likert scales (Hair Jr. et al., 2017). Thus, H3, which postulated the moderation of entrepreneurial creativity in the relationship between digital transformation and organizational performance, was rejected.

The empirical results did not point to the statistical significance of the control variables ($p > 0.10$), whether in the individual scope (the sex of the respondent) or the organizational scope (market of operation of the startup). These findings allowed inferring that the control variables had no influence on the proposed model.

Indicators of the general fit of the model were also examined. The R^2 , which points out the predictive validity/explanatory power of the model (Hair Jr. et al., 2019), was 0.691 for the use of management information and 0.641 for organizational performance; therefore, it was above 26%, which represents a considerable power of explanation of effects (Cohen, 1988). The Q^2 , which verifies if the values of the endogenous variables are greater than zero (Hair Jr. et al., 2019), indicated results above zero: 0.333 for using management information and 0.336 for organizational performance, which shows the accuracy of the model.

4.2 Discussion of Results

The discussion of the results was based on the results of the hypothesis tests. H1, which predicted a positive and significant relationship between digital transformation and organizational performance, was not statistically rejected. The results were in line with those obtained by Büchi et al. (2020), Duman and Akdemir (2021), and Raisch and Krakowski (2021), which showed that digital transformation has a direct impact on organizational performance. Managers implement technologies that can leverage their business (Raisch & Krakowski, 2021), assuming that they improve production and enable greater proximity to their customers (Büchi et al., 2020). Digital transformation has been recognized as an important mechanism to increase organizational performance (Martínez-Caro et al., 2020).

These new digital technologies can improve the decision-making process by providing useful and timely information (Raisch & Krakowski, 2021). In the studied startups, the survey data demonstrated that digital transformation was more prominent in the use to add value ("The data are analyzed quickly to foster decision-making"), in the range of use ("Processes [e.g., security, e-commerce]"), and in the extent of use ("Cybersecurity"). These findings seem particularly relevant to startups in the digital technology field, which require a diverse range of information and systems working in real-time and easily accessible to decision-makers (Li et al., 2017).

H2, which conjectured that using management information mediated the relationship of digital transformation with organizational performance, was not statistically rejected. The relationship between digital transformation and organizational performance is mediated by the use of management information, confirming the intervention of this variable in the proposed relationship. Shahzad et al. (2020) found positive effects of technological compatibilities in performance and the intervention of the capabilities of new information technologies. Despite the dissimilarities of the model, one may infer the need for alignment of technological capabilities for the quality of the information in startups. Management information needs to be inserted in the organization and supported by technology (Müller et al., 2020) to be within reach of decision-makers in real-time and efficiently (Halpern et al., 2021) and improve organizational performance (Mazzone & Elgammal, 2019).

If the organization is able to use and keep its information system powered, strategic alignment becomes more feasible (Singh et al., 2021). Regarding the use of internal management information, in the studied startups, the highlight was "Our company has a high degree of integration of the information system for production processes". This denotes that they are concerned with designing appropriate information systems so that they may integrate their information and better manage their business (Prajogo et al., 2018). For this, they must be attentive to the technologies they implement to manage information better and achieve superior performance (Shahzad et al., 2020).

Digital technologies may reduce information uncertainty by increasing the quantity and quality of information available for decision-making (Sternberg et al., 2021). Concerning the use of external management information, in the startups studied, the highlight was "We keep each other informed about events or changes that may affect the other party." Prajogo et al. (2018) pointed out that exchanging information is relevant and opportune for feedback from suppliers and customers. Digital technologies used to manage information can predict failures and prescribe actions to be taken (Frare et al., 2023).

H3, which postulated that entrepreneurial creativity moderates the relationship of digital transformation with organizational performance, was statistically rejected. This finding does not corroborate those of Mikalef and Gupta (2021), Opazo-Basáez et al. (2021), and Zou and Jian (2021), who found that creativity allows organizations the opportunity to seek

strategies through new technologies and thereby improve performance. While respondents highlighted creative activities, such as "I usually research innovations and potential improvements within my business unit", the organizational performance was more underlined, e.g., in "It offers higher quality products" and "It delivers orders faster". It is possible that the survey respondents did not perceive the reinforcement and direction of entrepreneurial creativity in the analyzed relationship.

Opazo-Basaez et al. (2021) found that digital transformation intensifies creativity; thus, it is possible to increase organizational performance even in more complex markets. However, this was not observed in the case of the digital technology startups studied, which have a focus and field different from the study carried out with Spanish manufacturing companies that integrate global value chains. The finding of the present study is supported by the work of Frare and Beuren (2021), who found that, in the field of startups, creativity seems to be part of everyday life because it is inherent in this business model and its survival. It may also be substantiated by the arguments of Bauer and Vocke (2019) that, in the era of digital transformation, other skills may prevail in organizational performance, such as digital competence.

Finally, the control variables of the sex of the respondents and the market of operation of the startups had no impact on the proposed model. The result suggests that the startups in the sample have no distinction regarding organizational performance when led by males or females, a result perhaps affected by the fact that 83.26% of the respondents were male. Similarly, the market of operation did not seem to lead to differences in the performance of the studied startups; this result may have been affected by the fact that 80.46% of them operate in the national market.

5 FINAL CONSIDERATIONS

5.1 Conclusions

The results of the study revealed that digital transformation directly influenced the performance of the studied startups, which indicates that digital transformation is a relevant factor for organizational performance. Similar results have also been found in the literature in other contexts (Büchi et al., 2020; Duman & Akdemir, 2021; Raisch & Krakowski, 2021), suggesting that using new technologies helps startups stand out in the market. A mediating effect of the use of management information was observed in the relationship between digital transformation and organizational performance, indicating that using management information impacts the decision-making of managers. However, no moderating effect of entrepreneurial creativity was observed in this relationship, which signals that other individual or organizational characteristics may affect it. Similarly, the control variables did not influence the performance of the startups, indicating that the sex of the respondents and the market of operation of the startups were not determinants of performance. These findings allow concluding that digital transformation and the use of management information are important drivers of the performance of startups; in contrast, entrepreneurial creativity does not seem to affect the strength and direction of digital transformation on organizational performance.

5.2 Theoretical Implications

This study brings implications for the literature upon exploring in a paired and joint manner the constructs of digital transformation, use of management information,

entrepreneurial creativity, and organizational performance. Firstly, it bridges the gap observed in the literature on the effects of digital transformation on organizational performance (Halpern et al., 2021; López-Nicolás & Meroño-Cerdán, 2011; Verhoef et al., 2021). Secondly, having found significance in the mediation of the use of management information (Müller et al., 2020; Prajogo et al., 2018) in the relationship between digital transformation and organizational performance but not for the moderating variable of entrepreneurial creativity (Frare & Beuren, 2021; Moulang, 2015), it advances the understanding of the interaction of these variables. Thirdly, it expands the understanding of digital transformation, the use of management information, and entrepreneurial creativity (Lanzolla et al., 2020; Martinez-Caro et al., 2020; Wang et al., 2016) in organizational performance in a field lacking in research despite the representativeness of startups for the Brazilian economy, whether due to their employability or their entrepreneurial capacity.

5.3 Implications for the Management Practice

The findings also have implications for the management practice of startups in general, particularly for digital technology startups such as the survey respondents, insofar as they provide information on the effects of digital transformation on performance. The focus on startups was because, although they are still new organizations (Ries, 2011; Usman & Vanhaverbeke, 2017) with specific vulnerabilities such as insufficient resources, they seek businesses with fast and scalable growth. Nevertheless, the results of this study may help managers in the digital transformation toward organizational performance, given that they are usually conceived in turbulent contexts of considerable uncertainties. The evidence indicates that startups may use new technologies to provide management information to support decision-making. By identifying positive results in the relationships, conditions are exposed so that the startups may improve their performance with digital transformation, with the intervention of using management information, whereas entrepreneurial creativity does not seem to signal reinforcement and direction in the analyzed relationship. Thus, new understandings on these topics are provided that offer guidelines to direct startups in digital transformation with a view to achieving superior performance.

5.4 Limitations and Suggestions

This study has several limitations that may encourage future research. Initially, the survey method for data collection results in a transversal approach to the problem; therefore, future research may propose longitudinal analysis techniques, such as case studies, to delve into aspects that may interfere with the relationship between digital transformation and organizational performance. Different constructs have been examined in the literature to measure the variables of the theoretical model of this study, so the choices made instigate considering alternative constructs to capture various aspects of the model and compare the findings. There are different ways of measuring entrepreneurial creativity, which in this study was directed to the startup managers; thus, future research may focus on team creativity rather than individual creativity. Lastly, future studies may investigate other startup segments since this study was limited to capturing the essence of technology startups; other segments may present different results depending on how much they are involved with digital transformation.

Appendix A

Research instrument

1 Digital Transformation (Halpern et al., 2021).

1.1 Extent of use of digital technologies

Scale: 1 = not at all to 5 = to a large extent.

DT1. Augmented reality (e.g., QR codes).

DT2. Big Data Analytics (e.g., marketing strategies, demand and trend forecasting).

DT3. Blockchain (e.g., transaction validation, smart contracts).

DT4. Cloud computing (e.g., Google Drive, Dropbox).

DT5. Cognitive computing (e.g., virtual assistants).

DT6. Cybersecurity (e.g., antiviruses).

DT7. System integration (e.g., ERP systems).

DT8. Internet of things (e.g., use of applications).

DT9. Virtual modeling and simulation (e.g., digital twin).

1.2 Range of use of digital technologies

Scale: 1 = not at all to 5 = to a high degree.

DT10. Processes (e.g., security, e-commerce).

DT11. Operations (e.g., operational activities).

DT12. Infrastructure management (e.g., construction, energy, waste).

DT13. Resource management (e.g., assets, workforce).

DT14. General management (e.g., accounting, payroll, purchasing).

1.3 Use of digital technologies to add value

Scale: 1 = strongly disagree to 5 = strongly agree.

DT15. The data are collected from a wide variety of sources.

DT16. The systems and processes that collect data are connected and integrated.

DT17. The data are analyzed quickly to foster decision-making.

DT18. The data are analyzed and used in real-time decision-making.

DT19. The data are shared in real time with the key stakeholders.

2 Use of the Management Information (Prajogo et al., 2018).

2.1 Use of internal management information

Scale: 1 = strongly disagree to 5 = strongly agree.

UIMI1. Our company has an integrated database of information (e.g., production, logistics, distribution).

UIMI2. The company departments have easy access to the primary operational data in this integrated database.

UIMI3. Our company has a highly integrated information system to link all departments.

UIMI4. Our company can recover the status of the inventory in real-time.

UIMI5. Our company has a high degree of integration of the information system for production processes.

2.1 Use of external management information

Scale: 1 = strongly disagree to 5 = strongly agree.

UEMI6. We share confidential information (financial, production, design, research, and/or competition) with our stakeholders.

UEMI7. We provide our stakeholders with key information that can help them.

UEMI8. The exchange of information takes place frequently, informally, and/or opportunistically.
 UEMI9. We keep each other informed about events or changes that may affect the other party.
 UEMI10. We have frequent in-person communication with our stakeholders.

3 Creativity (Moulang, 2015).

Scale: 1 = hardly ever to 5 = almost always.

- C1. I regularly come up with creative ideas.
- C2. I regularly experiment with new concepts and ideas.
- C3. I regularly perform tasks creatively.
- C4. I usually engage in problem-solving intelligently and creatively.
- C5. I usually research innovations and potential improvements within my business unit.
- C6. I usually generate and evaluate several alternatives to new problems within my business unit.
- C7. I often generate new perspectives on old problems.
- C8. I usually improvise methods of solving a problem when an answer is not apparent.

4 Organizational Performance (López-Nicolás & Meroño-Cerdán, 2011).

Scale: 1 = strongly disagree to 5 = strongly agree.

- OP1. It is growing faster.
- OP2. It is more profitable.
- OP3. It achieves higher customer satisfaction.
- OP4. It offers higher quality products.
- OP5. It is more efficient in the use of resources.
- OP6. It has more internal processes aimed at quality.
- OP7. It delivers orders faster.
- OP8. It has more satisfied employees.
- OP9. It has more qualified employees.
- OP10. It has more creative and innovative employees.

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Transformação digital e desempenho de startups: interveniência da informação gerencial e da criatividade empreendedora

RESUMO

Objetivo: Este estudo analisa os efeitos da transformação digital no desempenho de startups, mediada pelo uso da informação gerencial e moderada pela criatividade empreendedora.

Método: Uma survey foi realizada com gestores de startups da área tecnológica listadas na StartupBase, e para análise dos 215 questionários respondidos aplicou-se a técnica de modelagem de equações estruturais.

Originalidade/Relevância: Esta pesquisa inova ao investigar a inter-relação dos construtos transformação digital, uso da informação gerencial, criatividade empreendedora e desempenho organizacional em startups.

Resultados: Os resultados denotam influência positiva da transformação digital no desempenho organizacional. Isso sugere que se as startups utilizam as novas tecnologias, maiores são as possibilidades de atingirem o desempenho previsto e sobrepujar-se aos seus concorrentes. Foi observada mediação do uso da informação gerencial nessa relação, o que indica que o uso das informações gerenciais impacta na tomada de decisão dos gestores. Não foi constatada moderação da criatividade empreendedora na relação proposta, embora presumivelmente empreendedores criativos possam desenvolver inovações por meio das novas tecnologias.


Contribuições Teóricas/Metodológicas: Os resultados contribuem ao preencherem lacunas identificadas na literatura, na medida em que revelam que a transformação digital e o uso da informação gerencial são importantes propulsores do desempenho organizacional.

Contribuições Sociais/para a Gestão: O estudo traz implicações práticas ao demonstrar que a transformação digital e o uso da informação gerencial refletem no desempenho organizacional, uma importante sinalização aos gestores sobre o foco basilar para melhorar a performance das startups.

Palavras-Chave: Transformação digital. Informação gerencial. Criatividade empreendedora. Desempenho organizacional.

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