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Original Article

Belonging relationship of leaders' multilevel skills for digital transformation

Relação de pertencimento das competências multiníveis dos líderes para a transformação digital

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ABSTRACT

Purpose: The research objective is to identify the alignment and interdependence between the leaders' skill levels for digital transformation (DT) in the metal-mechanical industrial sector.
Design/methodology/approach: This research adopted an exploratory and quantitative approach, carried out based on a survey with the leaders of twenty-two industries associated with Sindimetal RS, totaling 201 respondents. The technique of Exploratory Factor Analysis (EFA) and multinominal logistic regression was applied to identify the relationship between skills at the individual, team, and organizational levels.
Findings: The data obtained with the application of multinominal logistic regression demonstrate sufficient validity for the acceptance of the results considering the percentage of correctly classified cases and the relations of belonging of the leaders' skills to the organizations' DT. It is worth noting that the correlations between the organizational, team, and individual levels were evaluated and evidenced by the Spearman test, and the relationships between skills belonging to the lower/higher levels were analyzed by logistic regression demonstrating the existence of cyclical movement between the levels as a fundamental dynamic process in multilevel theory.
Originality/value: For academic, organizational, and societal purposes, the multilevel study of skills can be reapplied in research aimed at other industries. As managerial contributions, the multilevel model of leaders' skills for the industry's DT will serve as a basis for analyses regarding self-assessments of skills already existing in industry leaders and will assist in identifying multilevel development needs.

Keywords: Multilevel skills; Leadership; Digital transformation

RESUMO

Objetivo: O objetivo da pesquisa é identificar o alinhamento e a interdependência entre os níveis de competências dos líderes para transformação digital (TD) no setor industrial metal-mecânico.
Desing/metodologia/abordagem: Esta pesquisa adotou uma abordagem exploratória e quantitativa, realizada a partir de um survey com os líderes de vinte e duas indústrias associadas ao Sindimetal RS, totalizando 201 respondentes. A técnica de Análise Fatorial Exploratória (AFE) e regressão logística multinominal foi aplicada para identificar a relação entre as competências nos níveis individual, de equipe e organizacional.
Resultados: Os dados obtidos com a aplicação da regressão logística multinominal demonstram validade suficiente para a aceitação dos resultados considerando o percentual de casos classificados corretamente e as relações de pertencimento das competências dos líderes às TD das organizações. Vale destacar que as correlações entre os níveis organizacional, de equipe e individual foram avaliadas e evidenciadas pelo teste de Spearman, e as relações entre as habilidades pertencentes aos níveis inferior/superior foram analisadas por regressão logística demonstrando a existência de movimento cíclico entre os níveis como um processo dinâmico fundamental na teoria multinível.
Originalidade/valor: Para fins acadêmicos, organizacionais e sociais, o estudo multinível de competências pode ser reaplicado em pesquisas voltadas para outras indústrias. Como contribuições gerenciais, o modelo multinível de habilidades dos líderes para a TD da indústria servirá de base para análises sobre autoavaliações de habilidades já existentes em líderes da indústria e auxiliará na identificação de necessidades de desenvolvimento multinível.

Palavras-chave: Competência multinível; Liderança; Transformação digital

1 INTRODUCTION

When digitally transforming organizations for new business models, the leader must aggregate-integrate-balance existing skills with the generation of new skills to obtain a sustainable competitive advantage (Nylén & Holmström, 2015; Rodríguez & Bribiesca, 2021; Vial, 2019). In the context of Digital Transformation (DT), these new leadership skills suggest that, in addition to influencing people to achieve specific objectives (Hansen et al., 2011; Oberer & Erkollar, 2018), leaders also start to adopt other behaviors and attitudes, apply digital technologies, encourage the integration of implementation efforts in their subordinates (Fotso, 2021), and the development of knowledge focused on DT (Nasution et al., 2020).

To meet these requirements, DT leaders need to develop individual, team, and organizational multilevel skills (Henriette et al., 2015; Nylén & Holmström, 2015;

Rodríguez & Bribiesca, 2021; Vial, 2019). In this sense, individual multilevel skills give rise to and support organizational skills but, at the same time, are influenced by the team and organizational level (Brandão & Guimarães, 2001).

These phenomena are cyclical and can manifest themselves from the bottom up based on psychological characteristics, perceptions, and interactions between individuals (emerging) and are considered a fundamental dynamic process in multilevel theory (Kozlowski et al., 2016; Kozlowski & Klein, 2000). Team processes are represented as collective constructions that originate from individual cognition (models), motivation (collective efficacy), affect (group mood), and behavior (coordination) (Marks et al., 2001). However, most of the research is focused on contextual effects; that is, attention is focused on processes that shape and constrain lower-level phenomena embedded in the higher-level context (Kozlowski et al., 2016).

Brandão (2007) points out that studies on skills at different organizational levels are developed by investigating the skills for each level without any relationship between them. The contributions touch on the topic of leadership skills for DT, but do not identify and allocate these skills in multilevel models.

In view of the above, the literature points to the need for studies that aim to identify leaders' skills that exist and are relevant at the individual (Nasution et al., 2020), team, and organizational levels (Area-Moreira et al., 2020) aimed at digital transformation. Based on this research possibility, this study proposes the following question: "What are the belonging relationships of the multilevel skills for digital transformation identified by the leaders of small and medium-sized industries associated with the Union of Metallurgical, Mechanical and Electrical and Electronic Material Industries of São Leopoldo (Sindimetal RS) at the organizational, team, and individual levels?". The objective is to identify the belonging relationships of multilevel skills for digital transformation identified by Sindimetal RS industry leaders.

When it comes to the relevance of the industrial sector, it is worth highlighting that the Federation of Industries of the State of Rio Grande do Sul (Fiergs), through the Small

and Medium Industry Council, in partnership with the International Business Center (CIN), with the Credit Access Center (NAC) and with the Innovation and Technology Council (Citec), began, in 2022, a movement to boost industries in Rio Grande do Sul towards DT through the dissemination of knowledge, addressing DT, Industry 4.0, credit and export policies. Furthermore, the Union of Metallurgical, Mechanical and Electrical and Electronic Material Industries of São Leopoldo (Sindimetal RS), faced with the need to promote industries towards DT, is engaged together with Fiergs to promote actions that disseminate knowledge in relation to companies' DT (Fiergs, 2022).

This way, the research aims to assist companies associated with Sindimetal RS in identifying the individual, team, and organizational skills of leaders and promote awareness of the multilevel skills essential for leveraging DT in organizations.

2 LITERATURE REVIEW

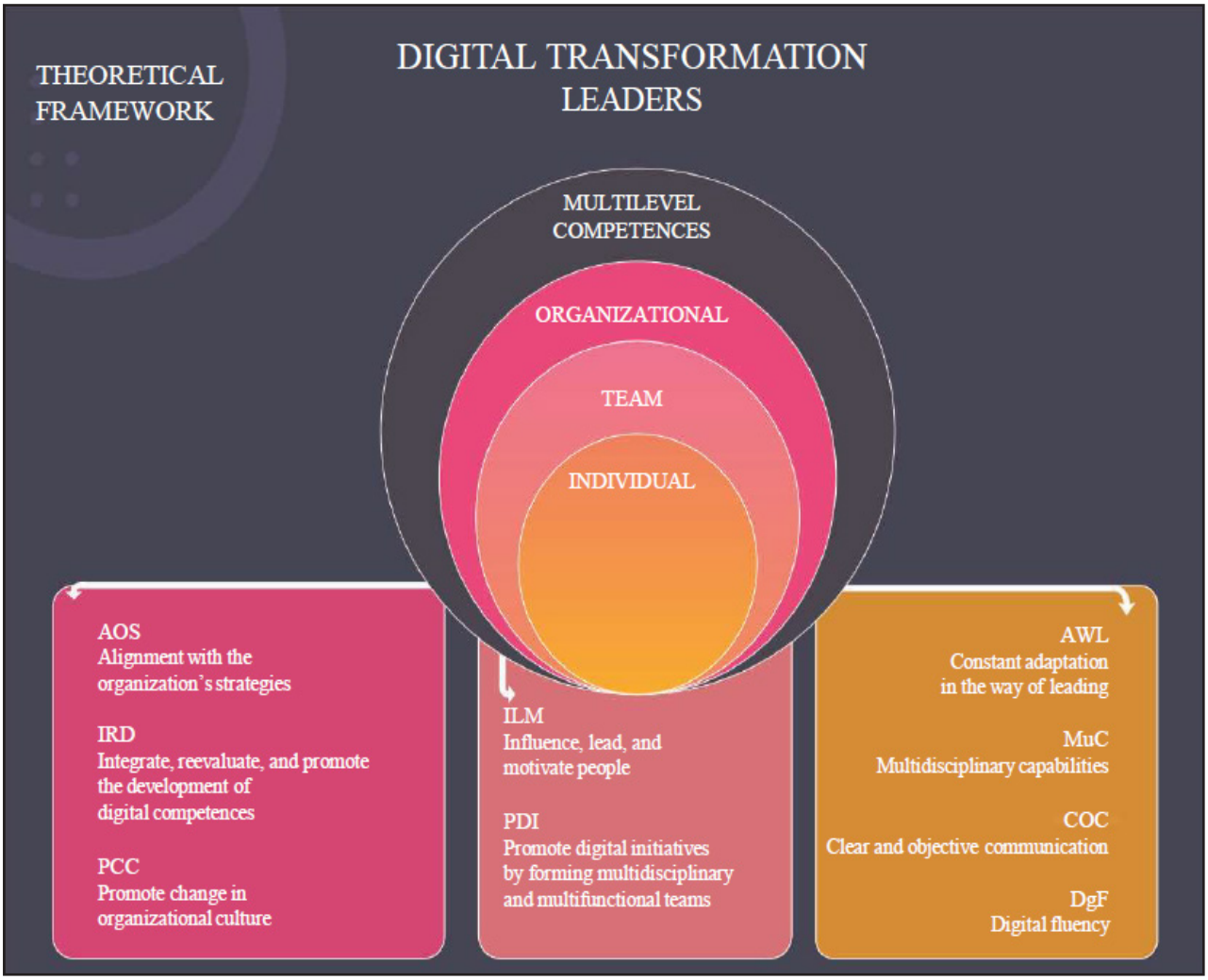
DT depends on the "ability [...] of the organization to acquire, deploy, and maintain multiple distinct technologies in parallel" (Saarikko et al., 2020, p. 836). However, substantial improvement in this capability is achieved by increasing the level of organizational digital awareness. Saarikko et al. (2020) conceptualize DT, considering that it is the sociocultural process of adapting companies to new forms and sets of skills necessary to remain viable and relevant in a digital scenario.

The leader plays a fundamental role in the success of business DT, in the development and execution of DT programs, and in integrating IT infrastructure, business processes, and data (Benitez et al., 2022). Assignments include a portfolio of skills focused on digital, market, business skills (encompassing product and customer understanding), and strategic leadership (intrapersonal and interpersonal skills to create commercial value through driving actions, strategic mindset, and decision-making) necessary to boost the company's DT (Hüsing et al., 2015).

The portfolio includes multilevel skills for leaders, and these are considered a phenomenon that manifests itself at different organizational levels: individual skills

(properties of the people who work in the organization) that give rise and support to organizational skills (properties of teams or organization) and that, at the same time, are influenced by the team and organizational levels (Brandão & Guimarães, 2001). They add economic or social value to individuals and organizations, contributing to the achievement of organizational strategies. Through these skills, the capabilities of people, teams, and organizations are recognized (Brandão & Guimarães, 2001). From the systematic literature review (SLR), Dillenburg et al. (2023) identified nine leadership skills for DT at the three levels of the organization, as shown in Figure 1.

Figure 1 – Framework: Leaders' multilevel skills for the digital transformation of industries



Source: Dillenburg et al. (2023)

At an organizational level, the skills of (1) alignment with the organization's strategies were identified, which consists of achieving the organization's objectives aimed at changing mentality and strategic management vision (Ljubica et al., 2021), as well as structural and technological aspects (Idris & Ali, 2008); (2) integrate, reevaluate and promote the development of digital skills in the quest to develop the knowledge of those involved in DT regarding technological capabilities, without leaving aside the analysis of existing knowledge (Nasution et al., 2020; Benitez et al., 2022; Karippur & Balaramachandran, 2022; and (3) promote change in organizational culture in order to create, manage, and monitor changes proposed for DT (Motiani & Kulkarni, 2021; Ötting et al., 2021; Nasution et al., 2020).

For the team level, the skills were: (4) influence, lead, and motivate the team, which includes supporting team members and encouraging them to take initiatives focused on digital, elevating the team's interests (Lorinkova, 2021; Motiani & Kulkarni, 2021; Karippur & Balaramachandran, 2022; and (5) promote digital initiatives by forming multidisciplinary and multifunctional teams with a focus on the performance of virtual teams and encouraging the autonomy of teams and individuals, rewarding initiatives and supporting work groups (Brown et al., 2021; Idris & Ali, 2008; Jäckli & Meier, 2020).

At the individual level, four skills were identified: (6) constant adaptation in the way of leading, which refers to the adequacy of the leadership style (behaviors) taking into account the situations and demands imposed by the environment (Dehghanan et al., 2021; Imran *et al*., 2021; Karippur & Balaramachandran, 2022); (7) multidisciplinary capabilities that involve issues of developing multifunctional skills and new practices required by DT in relation to the interaction of IT and knowledge in other areas that involve the process (Bharadwaj et al., 2013; Karippur & Balaramachandran, 2022); (8) clear and objective communication in which the leader needs the ability to know how to communicate visual content with the combination of vocal and digital stimuli to all business stakeholders (Fotso, 2021; Ötting et al., 2021); and (9) digital fluency defined as digital capabilities and "proficiency with digital tools for data analysis, communication,

virtual collaboration, task automation, and improved operations". Digital fluency involves connecting people, technology and innovation and navigating a digital environment and requires leadership that learns and applies new technologies and knows how to deal with technological complexity (Nasution et al., 2020, p. 362; Fotso, 2021).

The influence and interdependence between skill levels must be considered in empirical tests, as no isolated level can fully and appropriately explain the nature of organizational behavior (Kozlowski & Klein, 2000). In this sense, Kozlowski and Klein (2000) emphasize that the ideal is to seek the potential for evolution of the emerging phenomenon as it manifests itself across the entire range of the organization. To the authors, multilevel research must begin with theory and with caution in identifying and defining key constructs. For this reason, it is considered complex and challenging, as it requires detailed theory with careful and rigorous operationalization capable of capturing such complexity that involves the real life of the organization.

3 METHODOLOGY

The methodology is focused on a quantitative exploratory approach, carried out based on a survey with the leaders of twenty-two industries associated with Sindimetal RS (non-probabilistic convenience sample according to Malhotra, 2019), totaling 201 respondents. Six experts validated the measuring instrument applied, and after adjusting the considerations highlighted, the pre-test was applied to a sample of five participants from the target population, seeking to identify and eliminate potential problems (Malhotra, 2019). The questionnaire sought to identify the level of agreement of the leaders of the participating organizations in relation to their perception regarding the existence of the nine multilevel skills for DT (5-point Likert scale). Considering the general rule described by Hair Jr. (2009) of obtaining 5 times more respondents than the number of independent variables (IV) (36 in this study), it can be said that with 193 valid responses the author's definition was met and considered adequate (5.36).

The collection instrument had thirty-six questions prepared from the extraction and adaptation of questionnaires available in the literature in the context of leadership for DT. Data collection was carried out using a questionnaire made available on the internet via the Google Forms platform from September 11th to October 31st, 2022. The data were tabulated using Microsoft Excel software for the treatment of variables, and the Statistical Package for the Social Sciences (SPSS) software was used to perform Exploratory Factor Analysis (EFA) and multinominal logistic regression tests.

The reliability criterion is met based on the Cronbach's Alpha result of 0.968 (>0.05) according to Hair Jr. (2009). The degree of linearity presents multicollinearity of the data breaking the assumptions of normality and homogeneity, however the technical application of logistic regression allows the violation of these criteria, that is, failure to meet them will not have an impact on the development of the research making the application of the analysis tool appropriate (Hair Jr. et al., 2009).

Initially, the data was analyzed using Exploratory Factor Analysis, which identified the existence of five multilevel skills (components) perceived as existing in leaders in the metalworking sector with the aim of digitally transforming organizations. Of the five perceived skills, two are allocated at the organizational level (alignment with the organization's strategies and develop digital skills by promoting change in organizational culture), one at the team level (influence, lead, and motivate the team to adopt digital initiatives), and two skills were identified at an individual level (constant adaptation in the way of leading and digital fluency).

The application of EFA verified the relationships between the objects under investigation, and its results supported the application of multinominal logistic regression of these data with the purpose of identifying the alignment and interdependence between the levels of the organization in relation to the leaders' skills for the industries' DT in the metal-mechanical sector (Hair Jr. et al., 2009). Therefore, to apply the logistic regression test, it was necessary to create the dependent variables, as detailed in Table 1.

Table 1 – Procedure for creating the dependent variable for regression tests

Variable created	Calculation method	Reason for creation
LSDT_O_Average	The average response values for the 11 items of leader skills for DT at the organizational level (LSDT_O).	Organizational level factor (resulting from EFA).
LSDT_O_Presence	0 – does not have LSDT_O (averages up to 2.99). 1 – has LSDT_O (averages greater than 3).	A dichotomous variable for logistic regression tests is created to be considered a dependent variable (DV).
LSDT_T_Average	The average value of responses to the 7 items of leader skills for DT at the team level (LSDT_T).	Team level factor (resulting from EFA).
LSDT_T_Presence	0 – does not have LSDT_T (averages up to 2.99) 1 – has LSDT_T (averages greater than 3)	A dichotomous variable for logistic regression tests is created to be considered a dependent variable (DV).
LSDT_I_Average	Average response values for the 16 items of leader skills for DT at the individual level (LSDT_I).	Individual level factor (resulting from EFA).
LSDT_I_Presence	0 – does not have LSDT_I (averages up to 2.99) 1 – has LSDT_I (averages greater than 3)	A dichotomous variable for logistic regression tests is created to be considered a dependent variable (DV).

Source: Adapted from Montezano and Silva Filho (2022, p. 6)

The first procedure adopted to perform the multinominal logistic regression statistical analysis was the creation of non-metric dependent variables based on the average of the responses from each multilevel category coming from the database (after treatment) by summing the values of the respondents' perceptions in each of the variables that involve each component and dividing this value by the number of items in the component. The adoption of the averages of observations for each treatment group is commonly used in studies that address the respondents' behavior and perceptions (Hair Jr. et al., 2009; Siqueira, 2009; Fávero and Belfiore, 2022).

The calculation of the averages of the items at each level was carried out using descriptive statistical analysis. The average skills of leaders at the three levels were organizational, equal to 3.62; team, equal to 3.51; and individual, worth 3.56. The overall average of leaders' skills for DT across industries was 3.57. The procedure for creating

the non-metric (dichotomous) dependent variable for applying the logistic regression tests was defined considering the criterion of averages either above or equal to 3.00 as perceptions of the existence of leaders' skills for industry DT. Below this value, the non-existence of such skills is considered.

The application of logistic regression predicts the probability that the identified skills belong to the coded groups (Hair Jr. et al., 2009). In Table 2, the tests and adjustment measure necessary for analyzing statistical data when applying multinominal logistic regression are described according to specifications.

Table 2 – Logistic Regression Analysis – Tests and adjustment measures

Tests	**Adjustment measures**	**Purpose**
Likelihood ratio test (maximum likelihood)	*-2LL* from base model	The odds ratio is transformed into a logarithm and multiplied by -2, creating model fit indicators, such as *-2LL.*
	-2LL difference between the base and proposed models (G^2 / Chi-square test)	Evaluate significant differences by establishing whether the set of independent variables in the proposed model is significant or not in improving the estimation adjustment.
	Pseudo R^2 measurements	Pseudo R^2 measurements: they analyze the variation between the base model and the proposed model (the proposed model increases the fit; the *-2LL* decreases it). It varies from 0.0 to 1.0 (value of *-2LL* = 0.0 and R^2_{LOGIT} = 1, the perfect fit).
	Cox & Snell	The higher the values, the better the model fit.
	Nagelkerke	Modification of the Cox & Snell index (maximum = 1) (amount of variance explained in the logistic model).
	McFadden	Considers measurements above 0.4 as a good fit.
Coefficient significance test	Wald Statistics	Impact on the estimated probability and prediction of group membership when the logistic coefficient is significant.
	Exponentiated Logistics Coefficient - Exp(B)	It reflects the reason for inequalities, demonstrating the direction and magnitude of the relationship between the independent variable and the dependent variable (belonging ratio).
Model Adjustment	Classification	It compares its predictions versus the actual results of the subjects in the classes.

Source: Hair Jr. et al. (2009)

Logistic regression analysis statistics perform simultaneous analysis of multiple measurements on individuals or objects under investigation, allowing a given observation to be classified into more than two classes of the dependent variable. The probability of belonging to a class is calculated comparatively with the reference class; that is, for each observation, the probability of belonging to each of the classes of the dependent variables is calculated, classifying the class of membership by the probability of most significant occurrence (Hair Jr. et al., 2009; Fávero & Belfiore, 2022).

Based on the results arising from the EFA, the following research hypotheses were listed. They sought to identify whether:

1. There is a significant correlation between the leaders' skills of leaders for digital transformation (DT) of industries at the organizational, team, and individual levels (Variables: Average LSDT_Individual, LSDT_Team Average, and LSDT_Organizational Average) (Hypothesis 1);
2. The skills of industrial DT leaders at the team and individual levels predict the presence of industrial DT leaders' skills at the organizational level (Variables: DV = LSDT_Organizational Presence; IV = LSDT_Team Average, and LSDT_ Individual Average) (Hypothesis 2);
3. The skills of industrial DT leaders at the organizational and individual levels predict the presence of industrial DT leaders' skills at the team level (Variables: DV = LSDT_Team Presence; IV = LSDT_Organizational Average, and LSDT_Individual Average) (Hypothesis 3);
4. The skills of industrial DT leaders at the organizational and team level predict the presence of industrial DT leaders' skills at the individual level (Variables: DV = LSDT_Individual Presence; IV = LSDT_Organizational Average, and LSDT_ Team Average) (Hypothesis 4).

The analysis of the results of applying the multinominal logistic regression technique will be discussed below.

4 RESULTS

With the purpose of identifying the existence of a significant relationship between organizational, team, and individual skills, the Spearman Test was applied (no linear assumptions are required) to obtain the answer to Hypothesis 1 of the research.

Table 3 – Correlations between the levels of leaders' skills for the digital transformation of industries

		LSDT_Individual_ AVERAGE	LSDT_Team_ AVERAGE	LSDT_Organizational_ AVERAGE
AVERAGE_LSDT_ Individual	Correlation Coefficient	1,000		
	Sig. (2 ends)			
	N	193		
AVERAGE_LSDT_ Team	Correlation Coefficient	.769 **	1,000	
	Sig. (2 ends)	,000		
	N	193	193	
AVERAGE_LSDT_ Organizational	Correlation Coefficient	.752 **	.776 **	1,000
	Sig. (2 ends)	,000	,000	
	N	193	193	193

Source: SPSS (2022) output

**The correlation is significant at the 0.01 level (two ends)

Spearman's coefficient is a measure that varies between -1 and 1, where -1 indicates a perfect negative association, zero denotes no association between the variables, and 1 indicates a perfect positive association (Fávero & Belfiore, 2022). Table 3 presents the values of these correlations. The Spearman correlation demonstrated that there is a strong significant correlation between the leaders' skill levels for DT in the industries, presenting correlations above 0.7 (close to 1, which shows perfect correlation) at a significance level of 1% (0.6 ≤ correlation coefficients <1). These correlations indicate the existence of multilevel relationships between leaders' skills for industry DT and confirm Hypothesis 1, based on the notes of Kozlowski et al.

(2016), who report this cyclical movement between levels as a fundamental dynamic process in multilevel theory that manifests itself from characteristics, perceptions, and interactions between individuals.

Table 4 – Variables for the presence of skills between levels

(Continued)

Organizational_LSDT_ Presence[a]		B	Standard Error	Wald	df	Sig.	Exp(B)	95% Conf. Interval Exp(B)	
							Inferior limit	Upper limit	
Does not have Organizational_ CLDT	Interception	14,008	2,933	22,815	1	0			
	LSDT_T_ILMT_ Average	-2.114	0.79	7.16	1	0.007	0.121	0.026	0.568
	LSDT_I_CAWL_ Average	-2.631	0.912	8,316	1	0.004	0.072	0.012	0.431
	LSDT_I_DgF_ Average	-0.515	0.529	0.948	1	0.33	0.598	0.212	1,685

[a]Reference category: Has Organizational_LSDT.

Note: Model fit information: Deviance = 54.969; Sig.=0.000

Team_LSDT_Presence[a]		B	Standard Error	Wald	df	Sig.	Exp(B)	95% Conf. Interval Exp(B)	
							Inferior limit	Upper limit	
Does not have Team_LSDT	Interception	13,042	2,366	30,389	1	0			
	LSDT_O_AOS_ Mean	0.09	0.569	0.025	1	0.874	1,094	0.359	3,341
	LSDT_O_ DSPC_ Average	-1.291	0.681	3,588	1	0.058	0.275	0.072	1,046
	LSDT_I_CAWL_ Average	-2.545	0.709	12,885	1	0	0.078	0.02	0.315
	LSDT_I_DgF_ Average	-0.764	0.48	2,534	1	0.111	0.466	0.182	1,193

[a]Reference category: Has Team_LSDT.

Note: Model fit information: Deviance = 85.273; Sig.=0.000

Table 4 – Variables for the presence of skills between levels

(Conclusion)

Individual_LSDT_Presence[a]		B	Standard Error	Wald	df	Sig.	Exp(B)	95% Conf. Interval Exp(B)	
							Inferior limit	Upper limit	
Does not have Individual_ LSDT	Interception	13,652	2,607	27,425	1	0			
	LSDT_O_AOS_ Average	-0.508	0.581	0.765	1	0.382	0.602	0.193	1,878
	LSDT_O_ DSPC_ Average	-1.92	0.752	6,518	1	0.011	0.147	0.034	0.64
	LSDT_T_ILMT_ Average	-2.365	0.686	11,868	1	0.001	0.094	0.024	0.361

Source: SPSS (2022) output

[a]The reference category is: Has Individual_LSDT

Note: Model fit information: Deviance = 73.553; Sig.=0.000

Pseudo R^2: Cox & Snell R^2 = 0.394 / Nagelkerke R^2 = 0.672 / McFadden = 0.568

In the second hypothesis regarding the Independent Variables (IVs) extracted from the averages of skills at the individual level (constant adaptation in the way of leading and digital fluency) and team level (influence, lead, and motivate the team to adopt digital initiatives) as predictors of the presence of leaders' skill for DT in industries at the organizational level (DV), the likelihood ratio tests of *-2LL* (maximum likelihood) resulted significant with Deviance = 54.969, indicating that the estimated model of Hypothesis 2 can be helpful to discriminate team and individual skills with the presence of skills at the organizational level (model adjustment was significant at the 0.000 level).

According to Nagelkerke parameters, in the case of Pseudo R^2 values, the resulting value of variance explained by the logical model is 70.82% (100% indicates perfect fit), considered good (0.621) by the McFadden index (which considers values above 0.4 a model with good fit), according to parameters defined by Hair Jr. *et al.* (2009), reported in Table 2. Table 4 demonstrates the variables of the presence of skills between levels and their reason for belonging.

The presence of leadership skills for DT at the organizational level was considered as a reference category and, according to parameters defined by Hair Jr. *et al*. (2009) and to the Wald significance test (Sig. = 0.000), two of the three skills included in the model were significant at the 5% level: "influence, lead, and motivate the team to adopt digital initiatives" (LSDT_T_ILMT_Average) (Sig. = 0.007) and "constant adaptation to the way of leading" (LSDT_I_CAWL_Average) (Sig.=0.004), which constitutes a situation considered highly desirable (when most variables are likely to belong to the reference category). The skill that did not result in a significant presence of LSDT_O was digital fluency.

The direction and magnitude of the relationships between the independent variables and the reference category (LSDT_O_Presence) can be observed through the data from the exponentiated logistic coefficient - Exp(B) -, indicating that the odds ratio of the ability to "influence, lead and motivate the team to adopt digital initiatives" having the presence of organizational LSDT is 0.121; that is, for each observation of the skill "influence, lead, and motivate the team to adopt digital initiatives", there is a 0.121 chance of this skill belonging to the level of organizational skills for DT. In the case of the "constant adaptation to the way of leading" skill, the odds ratio of organizational LSDT present is 0.072 (for each observation of the "constant adaptation to the way of leading" skill, there is a 0.072 chance of belonging at the level of organizational skills for DT) (Hair Jr. et al., 2009).

The probability of organizational skills presents in the two skills mentioned above is 46.78% and 48.13%, respectively. Such percentages were extracted by applying the probability formula according to specifications by Hair Jr. et al. (2009) (Probability = ratio of inequalities / 1 + ratio of inequalities), with the ratio of inequalities being the values of Exp(B) minus 1. If the subtraction results in negative values, the probability of belonging is less than 50 %. For positive values, the probability is greater than 50%.

The accuracy rate of the model considered as the success ratio is 93.8%, perceived as satisfactory, indicating the adequacy of the model and proving

Hypothesis 2. The defined term "success ratio" is defined by Hair Jr. et al. (2009, p.298) as the percentage of correctly classified cases.

In the case of Hypothesis 3, which seeks to identify whether the skills of leaders for DT in industries at the organization and individual level (IVs) predict the presence of skills of leaders for DT in industries (DV) at the team level (LSDT_T), tests were carried out to verify how much the means of LSDT_O and LSDT_I are predictors of the model. The tested model presented good adjustment indices since the initial *-2LL* was 185.724, and, with the presence of the four independent variables, it increased to a *-2LL* of 85.273. This difference in *-2LL* for the base and proposed models indicates an improvement in the adjustment of the estimation; that is, the lower the value of *-2LL*, the better the model adjustment (Hair Jr. et al., 2009). The proximity to the minimum value of 0 corresponds to a perfect fit. In this analysis, there was a drop of 100.45 in the adjustment index, indicating that the model improved (Hair Jr. et al., 2009).

Nagelkerke's Pseudo R^2 explains the model in 65.7% (index 0.657), and the classification of correct cases is 90.7%, with the fit considered good based on the McFadden index (0.541>0.04). In other words, both R^2 values are greater than 0.5, pointing to a logistic explanation of at least half of the variation between the two levels.

According to data extracted from Table 4, in this model of Hypothesis 3, the skills of leaders at the team level are not present in the skill "alignment with the organization's strategies" (LSDT_O_AOS) and in the skill focused on "digital fluency" (LSDT_I_DgF), that is, they were not significant (Sig.=0.874 and Sig.=0.111, respectively).

The Wald test proved to be significant (Sig.=0.000) only for the skill of "constant adaptation in the way of leading" (LSDT_I_CAWL). The odds ratio - Exp(B) - of the team skill belonging to this skill is 0.078, and the percentage change in the odds ratio is -0.922. This negative variation indicates that the probability is less than 50%; that is, the relationship between the team-level skill and the independent variable is 47.96%.

The fourth and final hypothesis deals with the skills of industrial DT leaders at the organizational and team level, identifying whether these predict the presence

of industrial DT leaders' skills at the individual level (reference DV). As IVs, we have the averages of "alignment with the organization's strategies", "develop digital skills by promoting change in organizational culture" (both classified at the organizational level), and "influence, lead and motivate the team to adopt digital initiatives" (team level). For this model, the null hypothesis is rejected at the level of significance that individual skills do not belong to the organizational and team levels; that is, two variables are significant in explaining the probability of occurrence of the presence of LSDT_I.

The fourth hypothesis was tested in the same way as Hypotheses 2 and 3. For this model, the sample-derived estimate decreased from the initial model (*-2LL* = 170.110) to the model with the IVs (*-2LL* = 73.553), indicating the improvement of the model with the presence of individual-level skills in organizational and team skills. According to Pseudo R2 indices, the variation explained is 67.2% by the Nagelkerke test, and the indication is a good fit, according to McFadden.

The Wald coefficient was significant (Sig.=0). The presence of two of the three independent variables in the model equation was significant: "develop digital skills by promoting change in organizational culture" (LSDT_O_DSPC) presented Sig.=0.011, and "influence, lead, and motivate the team to adopt digital initiatives" (LSDT_T_ILMT) presented Sig.=0.001 (Table 4). The tested model correctly classifies 92.20% of the cases.

In the analysis of the Exponentiated Logistic Coefficient - Exp(B) -, the odds ratio of individual skills belonging to these two independent variables showed a statistical significance of 0.147 and 0.094, respectively. Such data reveal that the percentage variation in the odds ratio (taken by the formula "Percent variation in inequalities = Exp(B)-1" is -0.853 for developing digital skills promoting change in organizational culture. From this variation, it is possible to identify the probability of belonging to individual-level skills (inequalities ratio / (1 + inequalities ratio)), which, in this case, is 46.04%.

The reason why the coefficient of percentage variation in the odds ratio has a negative sign indicates the percentage of probability of belonging, remembering that when the numbers are positive, the probability is greater than 50%. When the numbers are negative, the probability will be lower than 50%. For the skill "influence, lead, and motivate the team to adopt digital initiatives", the percentage variation in the odds ratio is -0.906, with a probability of belonging to individual-level skills of 47.53%.

Table 5 – Summary of results from the application of multinominal logistic regression

Presence of leaders' skills for digital transformation across levels			
Tests / Skills	**Organizational**	**Team**	**Individual**
-2LL likelihood	Significant (Sig.=0.000)	Significant (Sig.=0.000)	Significant (Sig.=0.000)
Difference between *-2LL* from base to adjusted model	Improves with the insertion of IVs Initial= 147,416 With IVs=54,969 G^2 = 92.447	Improves with the insertion of IVs Initial= 185,724 With IVs=85.273 G^2 = 100.451	Improves with the insertion of IVs Initial= 170,110 With IVs=73,553 G^2 = 93.557
Nagelkerke's Pseudo R^2	70.82% variance explained	65.66% variance explained	67.2% variance explained
McFadden's Pseudo R^2	Good fit (0.6212)	Good fit (0.541)	Good fit (0.568)
Wald test	Significant (Sig.=0.000)	Significant (Sig.=0.000)	Significant (Sig.=0.000)
Classification of correct cases	93.80%	93.70%	92.20%
Odds ratio of belonging to the skills of leaders for DT in belonging to the levels of the organization			
Multilevel Skill	**Relationship of belonging between levels**		
O_Alignment with the organization's strategies	NC*	not significant (Sig.>0.05)	not significant (Sig.>0.05)
O_Develop digital skills by promoting change in organizational culture	NC*	not significant (Sig.>0.05)	Sig.=0.011 Odds Ratio=0.147 Prob=46.04%
T_Influence, lead, and motivate the team to adopt digital initiatives	Sig.=0.007 Odds Ratio=0.121 Prob=46.79%	NC*	Sig.=0.001 Odds Ratio=0.094 Prob=47.53%
I_Constant adaptation in the way of leading	Sig.=0.004 Odds Ratio=0.072 Prob=48.13%	Sig.=0.000 Odds Ratio=0.078 Prob=47.96%	NC*

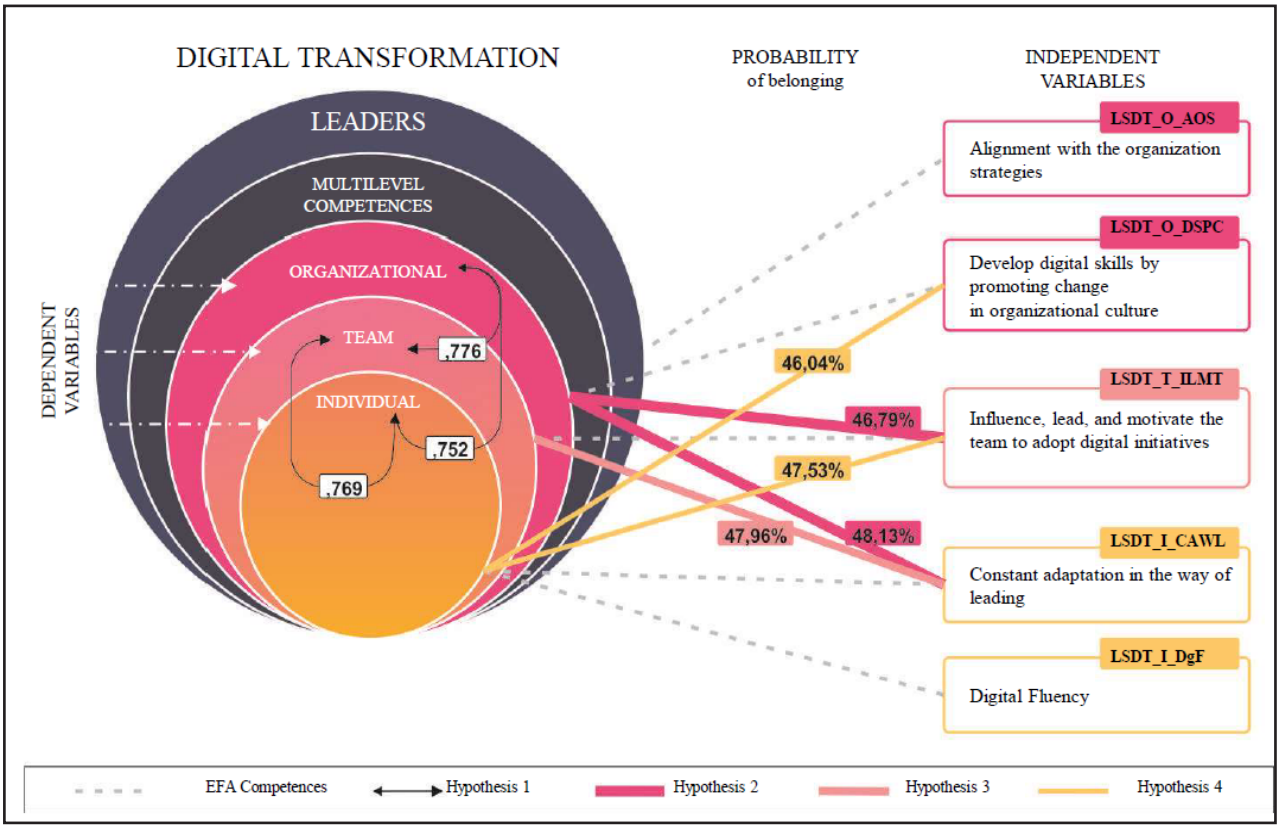
NC* = statistical calculation not performed; skill included in the categorization of the dependent variable

Source: Prepared by the authors (2023)

Given the statistical results regarding the presence of leaders' skills for DT at the three levels (DV), we observed that the model with the greatest explanatory power (70.82% of explained variance) and 93.80% of case classification correct is the presence of leaders' skills at the organizational level in team and individual skills.

The team and individual level models present results close to explanation, 65.66% and 67.2%, respectively, which indicates that, although there are chances of these levels belonging to the independent variables, these differences do not have explanatory power on the ascending and descending relationship models as well as the model that deals with the organizational level. The three relationships of belonging between the DVs and the IVs at each level present high success ratios, indicating the correct classification of the cases. Table 5 aims to summarize the results of the data.

Figure 2 – Probability of the odds ratio of belonging between dependent variables



Source: Prepared by the authors

When it comes to the odds ratio of leaders' skills for DT at the three organizational levels belonging to each level categorized as a dependent variable (Figure 2), it is clear from the result of applying multinominal logistic regression that LSDT at the organizational level are present in the skills "influence, lead, and motivate the team to adopt digital initiatives" (team) and in "constant adaptation in the way of leading". The same skill of "constant adaptation in the way of leading" presents LSDT at the team level. At the individual level of leaders' skills for DT, the evidence of belonging occurs in the skills "develop digital skills by promoting change in organizational culture" and "influence, lead, and motivate the team to adopt digital initiatives".

The model (Figure 2) refers to the movement reported by multilevel theory (Klein & Kozlowski, 2000), in which the higher level, in this case macro, of digital transformation is intertwined with levels focused on leaders, skills, and the funneling of these skills into a multilevel reason, falling into the essence that involves the individual and their ability to lead in the face of this new digital paradigm (Kozlowski et al., 2016). Likewise, multilevel theory reveals this inverse movement that can emerge from the need seen by the individual (cognitive) to acquire multilevel skills so that they are prepared to promote and leverage organizational DT involving the team and organizational levels (Marks et al., 2001).

This cyclical movement is reported by Kozlowski et al. (2016) as a fundamental dynamic process in multilevel theory, manifested from characteristics, perceptions and interactions between individuals. In this research, the theoretical relationships of DT, which point to the adherence of a strategic management of digital adaptation, contributed to the understanding of leadership skills in view of the objective of digitally transforming organizations. The theory integrates the proposed model, supporting these micro-meso-macro relationships of the multilevel skills necessary to break the new digital paradigm.

5 FINAL REMARKS

As a conclusion to the results of this research, it is worth highlighting that the existing correlations between the organizational, team, and individual levels were evaluated and evidenced by the Spearman test. The probability relationships of skills belonging to the lower/higher levels were analyzed by logistic regression, demonstrating the existence of cyclical movement between levels as a fundamental dynamic process in the multilevel theory described by Kozlowski et al. (2016).

The results revealed that the individual-level skill of "constant adaptation in the way of leading" presented the highest probability of belonging to the organizational and team levels, followed by the team skill "influence, lead, and motivate the team to adopt digital initiatives", which was also related to the organizational and individual level, making an upward and downward movement between levels. "Develop digital skills by promoting change in organizational culture" was defined as a skill of the organization, and the results indicate the chance of belonging at an individual level.

Organizational skill (alignment with the organization's strategies) and individual skill (digital fluency) presented non-significant results in belonging to other levels; that is, they are linked to their respective level without interrelationship with the other levels. When it comes to "digital fluency", this result is predicted in the literature, emphasizing that it is directly related to the term "proficiency with digital tools for data analysis", typical of an individual skill that the leader needs to promote DT (Fotso, 2021). This fluency in the use of digital technologies is also supported by Brock and Von Wangenheim (2019) and by Kappelman *et al*. (2019) as being a specific skill of the individual.

Regarding "alignment with the organization's strategies", the literature reinforces the importance of developing this skill to direct the organization toward the new digital paradigm (Marcato & Torraca, 2020). In this case, it can be assumed that the plans and efforts to transform the organization digitally are protected by the top management (board) and are not propagated to other organizational levels, that is, possibly the

levels of synergy for adherence to the new digital paradigm are not being created among those involved in the organization (Matt et al., 2015).

The interdependence between the skills of leaders for digital transformation (DT) of industries at the organizational, team, and individual levels resulted in a significant positive interrelationship with the application of Spearman's inferential correlation statistics, which confirms Hypothesis 1 of the research. The existence of such an effect that circulates between micro-meso-macro levels reaffirms the position of Kozlowski et al. (2013) when they deal with this movement of originating or emerging between lower or higher levels.

The data obtained with the application of multinominal logistic regression demonstrate sufficient validity for the acceptance of the results considering the percentage of cases correctly classified by the analysis technique and the relations of belonging of leaders' skills to the DT of organizations with the referenced multilevel structure (Hair Jr. et al. 2009; Fávero & Belfiore, 2022). Kozlowski and Klein (2000) emphasize the importance of considering the influence between skill levels in theoretical models and empirical tests.

The objective of the research sought to identify the relationships of belonging of multilevel skills for digital transformation identified as existing by the leaders of small and medium-sized industries associated with the Union of Metallurgical, Mechanical and Electrical and Electronic Material Industries of São Leopoldo (Sindimetal RS) among the three levels (organizational, team, and individual). It was answered with the application of multinominal logistic regression statistical analysis indicating, through the probability of the ratio, the chance of the skills listed at one level belonging to the reference level (Hair Jr. et al., 2009).

The result obtained will make it possible to assist companies associated with Sindimetal RS in identifying the individual, team, and organizational skills of leaders by promoting awareness of the multilevel skills essential for leveraging DT in organizations.

As a limiting aspect of the research during its development, the exploratory approach of the multilevel study stands out, which does not allow the generalization of

results (Kozlowski et al., 2016; Klein & Kozlowski, 2000) due to its characteristic of covering the levels of organization, dealing only with statistical indicators that reveal the odds ratio of the skills of industry leaders belonging or not to the levels defined as a reference category.

As relevant contributions for academic, organizational, and societal purposes, the multilevel study of skills stands out to assist in the discussion of results and the multilevel model that can be reapplied and restructured in studies aimed at other industries or other studies linked to leadership for digital transformation.

When it comes to managerial contributions, the multilevel model of leaders' skills for industry DT will serve as a basis for analyses regarding self-assessments of skills already existing in industry leaders and will assist in identifying development needs for the three levels of the organization (Area-Moreira et al., 2020). It also highlights the need for investment to develop the multilevel skills of industry leaders, expanding the interdependence between the three levels of analysis so that the organization can achieve the unification of DT purposes.

For leaders in the metalworking sector, it is suggested that actions be included aimed at developing essential skills and rethinking actions that promote strategic alignment, seeking dissemination at the micro and meso levels of the organization so that those involved in the organization adhere to the digital paradigm.

Suggestions for future research are proposed to replicate this study with another sample of industries, seeking to improve and revalidate the measurement instrument, which will possibly reveal the existence of new relationships of belonging between organizational levels. The multilevel model must be reapplied and expanded until the percentage of correctly classified cases (success ratio) exceeds the stipulated standards and perceptions are expanded to the point that skill is rooted in the organization at all levels (Hair Jr. et al., 2009). The literature suggests scientific development and the emergence of increasingly innovative empirical work when it comes to multilevel themes.

In addition to these options, it is also suggested to insert a dependent variable to expand the options in relation to existing statistical analysis techniques, such as the use of the "digital fluency" skill, as this presented a high factorial load in the EFA results, indicating that its conceptual structure is well defined. Another point is to carry out studies that relate specific skills to only one level of the organization, for example, identifying the reasons why the skills "alignment with the organization's strategies" and "digital fluency" did not demonstrate a chance of belonging to other levels of the organization.

Studies focused on this topic must be constantly updated with the intention of capturing the dynamics of the emergence and changes in paradigms, considering the need for constant readjustment that DT requires. Efforts to digitally transform organizations will continue to generate constant challenges for the strategic management of organizations. Therefore, research on this topic must also be constantly adapted to follow the movement of this digital paradigm.

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2. Development of hypotheses or research questions (empirical studies)	√	√	√
3. Development of theoretical propositions (theoretical work)	√		
4. Theoretical foundation / Literature review	√	√	
5. Definition of methodological procedures		√	√
6. Data collection	√	√	
7. Statistical analysis	√	√	
8. Analysis and interpretation of data	√	√	√
9. Critical revision of the manuscript	√	√	√
10. Manuscript writing	√	√	√
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