

**ANALYSIS OF THE DIGITAL TRANSFORMATION IN THE BRAGANTINE  
REGION**

**ANÁLISE DA TRANSFORMAÇÃO DIGITAL NA REGIÃO BRAGANTINA**

**ANÁLISIS DE LA TRANSFORMACIÓN DIGITAL EN LA REGIÓN  
BRAGANTINA**

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## Abstract

**Objective:** This research aimed to identify the degree of digital transformation (DT) of different companies in the region of Bragança Paulista. Reinforcing that DT goes beyond digitizing or automating files and tasks, demanding cultural, strategic, and even business model changes.

**Methodology/approach:** Quantitative-descriptive field research to study characteristics and dynamics of companies' DT process in the Bragança region. We interviewed executives and entrepreneurs from 36 companies, in a convenience sample, using the ICTD structured questionnaire from Instituto CESAR.

**Originality/Relevance:** The research contributes to knowledge of DT in the Bragantine region, and it is unique to do so. It contributes to an ongoing discussion on the conceptualization of DT. It develops the digital transformation ratification index (IRTD) and contributes to improving a model for analyzing the degree of DT, the ICTD.

**Results:** Companies are conducting DT according to their own strategies, people, and management models, which makes it difficult to understand, define or classify what digital transformation is. Large companies seem to have better conditions to drive digital transformation, but medium-sized ones seem more agile.

**Theoretical/methodological contributions:** Proposes a conceptualization of digital transformation. Contributes to improving a digital transformation analysis index.

**Social/management contributions:** Presents a DT analysis model that can help decision-making in organizations. It shows data on DT in the Bragantine region and discusses the factors involved in DT.

**Keywords:** Digital Transformation index; Information and Communication Technology; Strategy and Value Creation

## Resumo

**Objetivo:** O objetivo desta pesquisa foi identificar o grau de transformação digital (TD) de diferentes empresas, na região de Bragança Paulista. Reforçar que a TD vai além da digitalização ou automação de arquivos e tarefas, demandando mudanças culturais, estratégicas e até do modelo de negócios.

**Metodologia/abordagem:** Pesquisa de campo quantitativo-descritiva para estudar características e dinâmicas do processo de TD das empresas da região bragantina. Entrevistamos executivos e empresários de 36 empresas, numa amostra por conveniência, utilizando o questionário estruturado ICTD do Instituto CESAR.

**Originalidade/Relevância:** A pesquisa contribui para conhecer a TD na região bragantina, e é única nesse sentido. Contribui com a atual discussão sobre a conceituação de TD. Desenvolve o índice de ratificação da transformação digital (IRTD) e contribui para aprimorar um modelo de análise do grau de TD, o ICTD.

**Principais resultados:** As empresas estão conduzindo a TD de acordo com suas próprias estratégias, pessoas e modelos de gestão, o que dificulta entender, definir ou classificar o que é transformação digital. As grandes empresas parecem ter melhores condições de impulsionar a transformação digital, mas as médias parecem mais ágeis.

**Contribuições teóricas/metodológicas:** Propõe uma conceituação da transformação digital. Contribui para o aprimoramento de um índice de análise da transformação digital.

**Contribuições sociais/para a gestão:** Apresenta um modelo de análise da TD que pode auxiliar a tomada de decisões nas organizações. Mostra dados sobre a TD na região bragantina e debate sobre os diversos fatores implicados na TD.

**Palavras-chave:** Índice de transformação digital; Tecnologias da informação e comunicação; Estratégia e criação de valor.

## Resumen

**Objetivo:** El objetivo de esta investigación fue identificar el grado de transformación digital (TD) de diferentes empresas de la región de Bragança Paulista. Reforzar que TD va más allá de digitalizar o automatizar archivos y tareas, exigiendo cambios culturales, estratégicos y incluso del modelo de negocio.

**Metodología:** Investigación de campo cuantitativa-descriptiva para estudiar características y dinámicas del proceso de TD de las empresas de la región Bragantina. Se entrevistó a ejecutivos y empresarios de 36 empresas, en una muestra por conveniencia, utilizando el cuestionario estructurado ICTD del Instituto CESAR.

**Originalidad/Relevancia:** La investigación contribuye a conocer el TD en la región bragantina, y es única en este sentido. Contribuye a la discusión actual sobre la conceptualización de TD. Desarrolla el índice de ratificación de la transformación digital (IRTD) y contribuye a mejorar un modelo de análisis del grado de TD, el ICTD.

**Resultados:** Las empresas están realizando la DT según sus propias estrategias, personas y modelos de gestión, lo que dificulta entender, definir o clasificar qué es la transformación digital. Las grandes empresas parecen tener mejores condiciones para impulsar la transformación digital, pero las medianas parecen más ágiles.

**Aportes teóricos/metodológicos:** Propone una conceptualización de la transformación digital. Contribuye a mejorar un índice de análisis de transformación digital.

**Contribuciones a la gestión:** Presenta un modelo de análisis de TD que puede ayudar a la toma de decisiones en las organizaciones. Muestra datos sobre TD en la región bragantina y discute los diversos factores involucrados en TD.

**Palabras clave:** Índice de Transformación Digital; Tecnologías de información y comunicación; Estrategia y creación de valor.

## 1. INTRODUCTION

Globally, society faced a health crisis in 2020 that impacted companies' operations, markets, and interpersonal relationships in all areas of human coexistence. The COVID-19 pandemic has dramatically affected how society and companies employ digital communication technologies and process automation. As a result, health authorities recommended social

distancing to contain the virus's spread. This situation led companies to reformulate their relationship with customers, suppliers, and employees, as well as how to carry out the tasks necessary to keep their operations running.

The abrupt transition from in-office work to work and communication mediated by digital technologies forced the adaptation of interpersonal relationships, sharing work and running businesses. The urgency of the context has accelerated a transformation already underway, contributing to consolidating digital transformation, although it was forced.

Digital transformation, as explained by Rabelo and Hechenbichler (2017, as cited in Silva, 2019), is the complete transformation of a company's processes using technology to improve its results and performance, assuming that the technology usage must accompany the mastery and creative use, by people, of the facilities offered to solve the organization's tasks and problems, which often requires strategic structural changes and reformulation of the business plan.

In the pandemic context, we observed that, in some cases, there was neither time nor resources for a riskless and planned transition. Considering their structure, organizational culture, and shortage of capital for this purpose, some organizations have tried to migrate "as easily as possible." However, as shown by the interviews, in some cases, results cannot be classified as digital transformation as it is restricted to digital communication technologies for holding meetings and for collaborative editing of cloud files or spreadsheets.

These impressions point to gaps in the digital transformation process in organizations, aggravated by the pandemic context. Moreover, the urgency of stepping forward in the implementation and use of new technologies has turned the analysis related to digital transformation in the business environment even more relevant, whether to understand the transformation in communication processes and interpersonal relationships or to establish new strategies that minimize their losses.

The forced adaptation to new technologies, seen in part of the organizations, brought unexplored results related to organizational development and its internal and external relations. The effectiveness in selecting and adopting new technologies implicates, in some cases, changes in the work processes, aspects of the organizational culture, company's relationship with the market and its consumers and, sometimes, has implications for its business model.

Rangy changes such as these require attention and time to improve, elements that were absent during the pandemic, requiring organizations to be agile and innovative to remain competitive.

The questions previously presented drove the analyzes and results found in this research, which sought answers about the dynamics of the digital transformation process and its implications for companies in the region of Bragança Paulista, the countryside of São Paulo state.

We collected data within the scope of Personal and Organizational Development undergraduate classes, as the impacts of social isolation on daily life and organizational management were central subjects of analysis and discussions. The students, divided into groups, interviewed entrepreneurs and executives in different companies. Initially collected to support classroom discussions, results instigated and inspired further analysis of companies' digital transformation progress.

We used a structured questionnaire called Cesar Index of Digital Transformation (ICTD) to interview companies' representatives. CESAR is the Center for Advanced Studies and Systems of Recife. The questionnaire consists of forty questions in nine dimensions. It also characterizes the company by collecting information about the sector of activity, location, revenue, and the number of employees, as well as the company's perceptions about its development and future steps related to digital transformation.

The results showed a disparity in the digital transformation degrees among companies surveyed. For instance, only one of the 36 companies consulted achieved 94% of digital transformation. The global average was 71%. These results demonstrate how important the topic is for companies, although there are still missing actions to fully align their operations with digital transformation.

## **2. LITERATURE REVIEW**

Technology enabled new forms of communication, education, and work, directly impacting society's behavior, shaping its habits, and challenging organizations to innovate in order to keep up with consumers' expectations.

There is no single definition for Digital Transformation (DT). Vial (2019) showed that DT is a relevant phenomenon of corporate strategic research, but the enthusiasm toward the

theme needs more conceptual clarity. We found several authors (e.g., Pacheco, Santos & Wahrhaftig, 2020; Mendonça & Zaidan, 2019; Koeleman, Ribeirinho, Rockhill, Sjödin & Strube, 2019; Borges, 2021) who have contributed to the construction of its understanding, as also said by Vial (2019), but a definition that conflates the many different ideas expressed by authors of what DT means is still being constructed.

Meanwhile, Vial (2019) pointed out three important findings. First, DT primarily relates to organizations and their strategic planning. Second, definitions vary regarding the technologies involved and the nature of the ongoing transformation. Last, a few similarities among the definitions were found in his research, for example, using common terms such as “digital technologies.” Despite similarities, Vial (2019), who analyzed 28 different DT definitions, pointed to circularity, lack of conflation on the concept and its impacts, and unclear terminology, as some of the causes that compromise the conceptual clarity of DT.

Seeking a more comprehensive definition, Vial (2019, p.121) proposed that DT is “a process that aims to improve an entity by triggering significant changes to its properties through combinations of information, computing, communication, and connectivity technologies”.

A bibliometric analysis conducted by Shi, Mai and Wu (2022) showed that DT had been widely adopted in society, industries, and organizational management, generating significant socioeconomic development and impacts, surpassing sectoral limits and reflecting how different domains advanced on innovation and diffusion of digital technologies.

Keyword analysis by Shi et al. (2022) showed that digital transformation studies cover various themes at different levels going from emerging technologies, such as AI, big data, and blockchain, to security, risk, and information management in several fields as education, industry, systems, healthcare, public administration, and socioeconomic development.

It is common for authors to shorten DT meaning as the digitization or automation of files and tasks. Although the intensive usage of communication technologies has turned them more accessible and frequent, their usage, itself, does not characterize digital transformation (Mendonça & Zaidan, 2019).

According to Oliveira, Oliveira and Ziviani (2021), to enjoy the benefits of DT institutions need to adapt their business strategies to create value and improve processes, using

technologies to solve management problems. Digital transformation is not linear, cannot be patterned, and does not have a single, definitive, or finite procedure.

According to Kane, Palmer, Phillips, Kiron, and Buckeley (2015), DT is much more related to the company's strategy than the technology itself. Rogers (2017) also defends the idea that to achieve DT, companies must update their strategic mindset, once the technology does not respond alone to technology-driven society demands. Instead, innovation only creates value when it applies to solving problems.

In this sense, before adopting new technology and expecting it to be revolutionary, companies must establish their objectives and find different ways of acting, which may demand changes in the company's culture, strategy, and even business model changes.

Digital transformation involves two fundamental changes: the actualization of the business model to accommodate transformation and take better results from it, and operational improvement to support daily routine transformation (Koeleman et al., 2019).

Pacheco, Santos and Wahrhaftig (2020) explain that digital transformation must be based on three pillars: technology application in the organization's routine, change of business model and strategy performance, and last, transformation impacts on consumers, suppliers, and employees' lives, enabling all participants to engage and feel part of the transformation.

Rabelo (2019) complements this idea by suggesting that changes objectives must look up to value creation for the market and companies' customers.

The changes DT drives increases companies' competitiveness and the competition among them. Once new technology usage is no longer a differential, companies need their employees to be prepared to decide how, where, and when to apply technology to create value and stand out from competitors (Perides, Vasconcellos & Vasconcellos, 2020; Senna & Ribeiro, 2021). It is crucial remember that value creation starts from supplies providing. Therefore, employee preparation goes beyond the internal sphere involving the entire production chain (Revilla & Knoppen, 2015, as cited in Senna & Ribeiro, 2021).

To Borges (2021), DT continuously reimagines how companies use digital technologies to create value. Borges' definition (2021) incorporates the aspects regarded to technology, process, organizational culture, people, consumers, innovation, business model, and competitors helping us to understand the many factors involved in digital transformation.

Since the Brazilian General Data Protection Law (LGPD) publication, in August 2018, entrepreneurs who collect, store, and use data from customers and employees, must pay attention to personal data protection principles guaranteed and regulated by LGPD.

The principles to be observed, as explained by Botelho (2020, p.202), are: “respect and inviolability of privacy, informative self-determination, freedom of expression, information, communication and opinion, honor and image, economic and technological development and innovation, free enterprise, free competition and consumer protection, human rights, the free development of personality, dignity and the exercise of citizenship by persons”.

Considering the implications of the LGPD, Peixoto et al. (2020) define digital transformation as changing companies’ traditional operational models (analog) to a hybrid analog-digital world propelled by society empowered by digital platforms.

Therefore, our study led us to define digital transformation as the strategic use of technologies by all people involved in organizations’ management, seeking to create value for consumers, assuming responsibility for the use and exposure of data collected throughout the process. This concept involves current process and business model review to include digital tools, preparation of organizational culture to strengthen innovation and creativity initiatives, and digital inclusion of people involved in the chain production. Hence, they understand and use technologies in their professional routine, differentiation based on value creation provided by the digital transformation and organizations’ adequacy to the principles of data protection and privacy in digital environments.

### 3. METHODOLOGY

We did a quantitative-descriptive field research (Vergara, 2016) that seeks to study and present some characteristics and dynamics of the digital transformation process of companies located in the region of Bragança Paulista city.

We interviewed executives and entrepreneurs from 36 companies to collect data in a convenience sampling, using the ICTD structured questionnaire selected because it provides a “calculator” of the digital transformation index on the CESAR institute's website.

We consulted the CESAR institute before the beginning of the interviews, and they expressed no objection to using the questionnaire. The ICTD structured questionnaire consists



of 40 questions divided into nine dimensions: Culture and People, Consumers, Competition, Innovation, Processes, Business Model, Data and Regulatory Environment, Technologies, and Covid-19. Each dimension has five questions, except for the Data and Regulatory Environment and Technologies dimensions which have six questions each.

Respondents answered the questions using the Likert scale with five options ranging from “totally agree” to “totally disagree,” including a don't know/not applicable option.

We did not count the answers given to the Covid-19 dimension due to their exploratory nature concerning decision-making motivations and the existence of plans for the digital transformation of processes prior to the pandemic.

The CESAR itself does not consider these answers because of the understanding that Covid-19 is a context for digital transformation, but it is separate from it.

We collect data through 36 questionnaires, answered by the representatives of companies located in 13 cities in the region of Bragança Paulista. After the interviews had started, adaptations in the sample were necessary, resulting in the inclusion of two other companies located in cities that did not fully correspond to the initial geographic sample delimitation.

At the beginning of the research, we tried to expand the sample and involve a more significant number of companies. Therefore, we sent questionnaires by email to the representative entities and associations, but there was no response. Thus, we restricted the final sample to the questionnaires obtained through the interviews.

We created a two-part code to allow data comparison and to keep the companies' identities confidential. The first part (two letters) is related to the sector in which the company operates, and the second corresponds to the initials of the company's name.

Afterward, we inputted data into the ICTD “calculator” to obtain each company's digital transformation degree, according to CESAR scores. Finally, we expressed the ICTD in percentages, dimension by dimension, and, in the end, we calculated a global index that indicates the company's digital transformation degree. The final global index is the simple average of each dimension percentage.

However, during the analysis, we observed inconsistencies in the ICTD results. For example, identical data resulted in different percentages of digital transformation.

Nevertheless, during the analysis of collected data, we observed that identical answers given by different companies resulted in different percentages of digital transformation. Also, the opposite was true, i.e., different answers resulted in identical rates of digital transformation. For example, companies F\_GS and S\_M gave the same answer to four questions of the innovation dimension, but the fifth question was, respectively, answered “I agree” and “I don't know/not applicable” and even so, both reached 80%.

This finding took us to a new level of analysis, initially to understand the ICTD and to corroborate the scores produced by it.

Therefore, to understand and solve these differences, we transcribed the data into electronic spreadsheets and compiled them into a single base. After that, we reviewed data to ensure transcription accuracy. Then, we re-entered each company's data into the CESAR's calculator. From the results indicated by the CESAR calculator, we made other analyses to understand the calculation methodology used by ICTD. However, the numbers led to inconclusive results.

After all, it was impossible to identify the reasons for the divergences even after analyzing the characteristics of the companies that could, eventually, influence results, such as the nature and size of the company, location, and sector of activity. None of these hypotheses offered a plausible answer to the differences.

For this reason, seeking to mitigate inconsistencies, we developed the digital transformation ratification index (IRTD). This index simulated scores for each dimension of the questionnaire, aiming to ratify the ICTD percentages.

In the dimensions with five questions, each item represented an equal fraction of the total, which means 20%. Therefore, we attributed the highest score, 20%, to the “most positive” answer, and 0% to the don't know/not applicable answer. For the last two dimensions (Data and Regulatory Environment and Technologies), as they have six, not five questions, we divided the total into six parts, and the “most positive” answer represented 16,666%.

To identify what we called the “most positive” answer, we developed a trend indicator created from the qualitative analysis of the content of each item, associated with the inference that a “totally agree” answer would demonstrate a high degree of digital transformation, and

vice versa. For IRTD, as for ICTD, the final global index is the simple average of the scores produced in each dimension.

As ICTD, IRTD also assumed the percentages obtained in each dimension as its degree of digital transformation.

Then, we created a spreadsheet and inserted all data collected from companies in the sample. Next, we inserted the percentages obtained by the ICTD calculator in the left column, and the ones obtained by IRTD are in the right. The third column calculates the differences between them. Finally, we present these data and their analysis in the results section.

#### 4. RESULTS

We collected the data analyzed in this research in the city of Bragança Paulista and 13 other cities of the region. They are Itatiba, Pinhalzinho, Amparo, Valinhos, Campinas, São Paulo, Atibaia, Morungaba, Vargem, Joanópolis, Jundiaí and Louveira.

Characterization of companies considered the localization, sector, company size, and number of employees. Companies self-declared their size considering Brazilian Development Bank (BNDES) references, which classify companies based on revenue, according to the following range: Large (annual revenue > R\$300 million), Medium (annual revenue > R\$ 4.8 million and < R\$ 300 million), Small (annual revenue > R\$ 360 thousand and < R\$ 4.8 million) and Microenterprise (annual revenue < R\$ 360 thousand).

Table 1 shows the characterization of companies identified by the codification created by authors to avoid data exposure and to protect the companies' identities.

**Table 1**  
Characterization of interviewed companies

Code	Localization	Sector	Economic classification (small, micro, medium, or large enterprise)	Number of employees
3S_F	Bragança Pta	Third sector	Small	up to 19
3S_SF	Louveira	Third sector	Micro	up to 19
CC_B	Jundiaí	Construction	Medium	from 100 to 499
CC_I	Itatiba	Construction	Micro	up to 19
CV_H	Campinas	Construction	Large	500 +
E_NG	Pinhalzinho	Energy	Medium	up to 19
ED_CVL	Amparo	Education	Medium	from 100 to 499

ED_P	Bragança Pta	Education	Micro	up to 19
F_GS	Bragança Pta	Finance	Small	up to 19
IM_A	Bragança Pta	Manufacturing industry	Medium	up to 19
IM_B	Bragança Pta	Manufacturing industry	Large	500 +
IM_C	No official location	Manufacturing industry	Large	500 +
IM_GL	Valinhos	Manufacturing industry	Medium	up to 19
IM_HSA	Itatiba	Manufacturing industry	Large	from 100 to 499
IM_K	Morungaba	Manufacturing industry	Medium	from 20 to 99
IA_M	Itatiba	Food industry	Large	500 +
IM_MI	Joanópolis	Manufacturing industry	Small	from 20 to 99
IM_S	Bragança Pta	Manufacturing industry	Small	up to 19
IM_S	São Paulo	Manufacturing industry	Large	500 +
IMM_BLA	Itatiba	Machinery and equipment industry	Medium	from 100 to 499
S_AC	Bragança Pta	Services	Small	from 100 to 499
S_C	Itatiba	Services	Large	from 100 to 499
S_D	Atibaia	Services	Medium	from 100 to 499
S_JS	Vargem	Services	Micro	up to 19
S_M	Campinas	Services	Medium	from 100 to 499
S_S	Itatiba	Services	Micro	up to 19
S_TL	Bragança Pta	Services	Micro	up to 19
S_TM	Itatiba	Services	Small	up to 19
S_VAP	Bragança Pta	Services	Micro	up to 19
SA_F	Campinas	Health	Micro	from 20 to 99
SA_ODF	Jundiaí	Health	Small	up to 19
SC_S	Campinas	Services	Small	up to 19
T_C	São Paulo	Technology	Small	500 +
T_MU	São Paulo	Technology	Large	500 +
T_N	Itatiba	Technology	Small	from 20 to 99
TA_T	Itatiba	Transportation	Medium	from 100 to 499

Source: research data

As mentioned before, we found inconsistencies among some of the ICTD results. Due to these findings, we proposed the digital transformation ratification index IRTD, aiming to understand and ratify percentages presented by the ICTD calculator. To reach that was necessary to understand which responses should produce higher rates of digital transformation and which should result in lower rates. Therefore, we created trend indicators to determine whether a “totally agree” answer was a sign of a high rate of digital transformation or the opposite. Then, based on these trend indicators, we distributed percentages to each response, as shown in Table 2.

We established the trend indicators in Table 2, considering the coherence between the question’s contents and its representativeness for digital transformation. Items contributing to the increase in companies’ digital transformation received a positive trend indicator. The closer the answer to “totally agree”, the higher the digital transformation index is.

**Table 2**  
Examples of trend indicators

Dimension	Culture and people				
Number of the question	Q1	Q2	Q3	Q4	Q5
Trend indicators	↑	↑	↓	↑	↓
Totally agree	20,0%	20,0%	0,0%	20,0%	0,0%
Agree	16,0%	16,0%	4,0%	16,0%	4,0%
Disagree	4,0%	4,0%	16,0%	4,0%	16,0%
Totally disagree	0,0%	0,0%	20,0%	0,0%	20,0%
I do not know/Do not apply	0,0%	0,0%	0,0%	0,0%	0,0%

Source: research data

Therefore, we assigned trend indicators to each question to indicate the most favorable behavior leading to a high degree of digital transformation. For example, a question about the level of process automation answered closer to “totally agree” demonstrates a closer approximation to digital transformation and results in a higher index once it is favorable to digital transformation.

After associating trend indicators to each question of the eight dimensions of the questionnaire, and the consequent distribution of response percentages, we created a two columns spreadsheet showing the ICTD results on the left and the IRTD results on the right. We added a third column to evaluate the differences. The comparison between the two data groups confirmed the inconsistencies since, in most cases, the two indexes produced identical percentages, but not in other cases. In the Culture and People dimension, for 77% of the companies, the ICTD and IRTD indexes produced the same result, but for 23%, the results were different. For instance, the differences between ICTD and IRTD percentages ranged from 13% to 42%, as in the cases of IA\_M, which obtained 65% on ICTD and 52% on IRTD, and S\_TM, which obtained 9% on ICTD and 58% on IRTD. Although another nine companies had variations in the indexes, we did not find any pattern in these divergences (as shown in table 3).

**Table 3**  
Divergences in questionnaire dimensions

	Culture and people			Consumers			Competitors			Innovation		
	ICTD	IRTD	≠	ICTD	IRTD	≠	ICTD	IRTD	≠	ICTD	IRTD	≠
IM_B	72%	72%	0%	84%	84%	0%	80%	80%	0%	84%	84%	0%
E_NG	88%	88%	0%	60%	60%	0%	84%	84%	0%	72%	72%	0%
C_B	76%	76%	0%	88%	88%	0%	60%	60%	0%	60%	60%	0%
IMM_BLA	96%	96%	0%	100%	100%	0%	84%	84%	0%	88%	88%	0%
ED_CVL	92%	92%	0%	84%	84%	0%	96%	96%	0%	76%	76%	0%
S_VAP	68%	68%	0%	72%	72%	0%	80%	80%	0%	32%	32%	0%
T_N	72%	72%	0%	68%	68%	0%	56%	56%	0%	56%	56%	0%
IM_C	100%	100%	0%	96%	96%	0%	72%	72%	0%	56%	56%	0%
IM_A	76%	76%	0%	72%	72%	0%	80%	80%	0%	72%	72%	0%
CC_HM	80%	80%	0%	96%	96%	0%	76%	76%	0%	56%	56%	0%
IM_GL	92%	92%	0%	96%	96%	0%	100%	100%	0%	96%	96%	0%
S_TL	84%	84%	0%	92%	92%	0%	84%	84%	0%	80%	80%	0%
3S_SF	53%	53%	0%	60%	60%	0%	84%	84%	0%	60%	60%	0%
SA_ODF	92%	92%	0%	84%	84%	0%	92%	92%	0%	84%	84%	0%
S_S	84%	84%	0%	92%	92%	0%	92%	92%	0%	84%	84%	0%
IM_HSA	100%	100%	0%	95%	76%	19%	100%	100%	0%	100%	100%	0%
S_C	84%	84%	0%	80%	32%	48%	80%	48%	32%	80%	64%	16%
CC_I	60%	60%	0%	60%	36%	24%	75%	60%	15%	50%	20%	30%
TA_T	88%	88%	0%	88%	88%	0%	76%	76%	0%	60%	60%	0%
IM_K	92%	92%	0%	100%	100%	0%	92%	92%	0%	88%	88%	0%
S_AC	44%	44%	0%	56%	56%	0%	65%	52%	13%	80%	16%	64%
S_D	<b>84%</b>	<b>84%</b>	<b>0%</b>	<b>88%</b>	<b>88%</b>	<b>0%</b>	<b>80%</b>	<b>80%</b>	<b>0%</b>	<b>96%</b>	<b>96%</b>	<b>0%</b>
F_GS	68%	68%	0%	56%	56%	0%	80%	80%	0%	80%	64%	16%
S_M	96%	96%	0%	100%	100%	0%	68%	68%	0%	80%	48%	32%
IM_MI	64%	64%	0%	44%	44%	0%	30%	24%	6%	35%	28%	7%
T_C	64%	64%	0%	76%	76%	0%	72%	72%	0%	60%	60%	0%
T_MU	92%	92%	0%	84%	84%	0%	92%	92%	0%	72%	72%	0%
IM_S	84%	84%	0%	84%	84%	0%	84%	84%	0%	84%	84%	0%
IA_M	65%	52%	13%	0%	0%	0%	0%	0%	0%	80%	48%	32%
IM_S	75%	60%	15%	32%	32%	0%	65%	52%	13%	56%	56%	0%
S_SC	80%	64%	16%	90%	36%	54%	80%	64%	16%	80%	32%	48%
3S_F	95%	76%	19%	100%	100%	0%	92%	92%	0%	76%	76%	0%

S_JS	100%	80%	20%	60%	60%	0%	80%	80%	0%	56%	56%	0%
SA_F	60%	36%	24%	50%	20%	30%	60%	36%	24%	27%	16%	11%
ED_P	93%	56%	37%	100%	100%	0%	100%	100%	0%	92%	92%	0%
S_TM	90%	48%	42%	96%	96%	0%	56%	56%	0%	40%	40%	0%

Source: research data

**Table 3**  
Continuation of Divergences in questionnaire dimensions

	Processes			Business Model			Data and Regulatory Environment			Technologies		
	ICTD	IRTD	≠	ICTD	IRTD	≠	ICTD	IRTD	≠	ICTD	IRTD	≠
IM_B	68%	68%	0%	44%	44%	0%	70%	70,1%	0%	80%	80,2%	0%
E_NG	88%	88%	0%	88%	88%	0%	80%	80,2%	0%	77%	76,8%	0%
CC_B	92%	92%	0%	96%	96%	0%	70%	70,1%	0%	73%	73,5%	0%
IMM_BLA	96%	96%	0%	92%	92%	0%	97%	96,9%	0%	87%	86,8%	0%
ED_CVL	48%	48%	0%	88%	88%	0%	60%	60,1%	0%	73%	73,5%	0%
S_VAP	56%	56%	0%	44%	44%	0%	50%	50,1%	0%	60%	60,1%	0%
T_N	56%	56%	0%	20%	20%	0%	70%	70,1%	0%	30%	30,0%	0%
IM_C	96%	96%	0%	96%	96%	0%	93%	93,5%	-1%	92%	92%	0%
IM_A	76%	76%	0%	68%	68%	0%	77%	76,8%	0%	60%	60,1%	0%
CC_HM	56%	56%	0%	68%	68%	0%	60%	60,1%	0%	67%	66,8%	0%
IM_GL	100%	100%	0%	88%	88%	0%	83%	83,5%	-1%	93%	93,5%	-1%
S_TL	88%	88%	0%	84%	84%	0%	80%	80,2%	0%	87%	86,8%	0%
3S_SF	60%	32%	28%	36%	36%	0%	53%	52,8%	0%	25%	16,7%	8%
SA_ODF	92%	92%	0%	92%	92%	0%	83%	86,8%	-4%	53%	53,4%	0%
S_S	80%	80%	0%	96%	96%	0%	56%	46,8%	9%	47%	46,8%	0%
IM_HSA	100%	100%	0%	92%	92%	0%	90%	90,2%	0%	80%	66,8%	13%
S_C	92%	92%	0%	75%	60%	15%	84%	70,1%	14%	100%	33,4%	67%
CC_I	80%	80%	0%	64%	64%	0%	20%	16,7%	3%	40%	40%	0%
TA_T	60%	60%	0%	68%	68%	0%	80%	63,5%	17%	73%	73,5%	0%
IM_K	84%	84%	0%	100%	100%	0%	100%	100%	0%	100%	83,5%	17%
S_AC	65%	52%	13%	30%	24%	6%	80%	3,3%	77%	65%	52%	13%
S_D	100%	100%	0%	92%	92%	0%	100%	100%	0%	88%	73,8%	14%
F_GS	80%	80%	0%	60%	60%	0%	80%	80,2%	0%	60%	50,1%	10%
S_M	90%	72%	18%	50%	40%	10%	72%	60,1%	12%	60%	56,8%	3%

IM_MI	68%	68%	0%	28%	28%	0%	63%	63,5%	0%	50%	50,1%	0%
T_C	96%	96%	0%	72%	72%	0%	80%	80,2%	0%	87%	86,8%	0%
T_MU	84%	84%	0%	76%	76%	0%	77%	76,8%	0%	80%	80,2%	0%
IM_S	80%	80%	0%	84%	84%	0%	73%	73,5%	0%	83%	83,5%	-1%
IA_M	80%	80%	0%	85%	88%	-3%	70%	70,1%	0%	80%	26,8%	53%
IM_S	68%	68%	0%	68%	68%	0%	50%	50,1%	0%	50%	46,8%	3%
S_SC	80%	80%	0%	80%	64%	16%	80%	66,8%	13%	80%	26,7%	53%
3S_F	76%	76%	0%	84%	84%	0%	70%	70,1%	0%	57%	56,8%	0%
S_JS	84%	84%	0%	40%	40%	0%	47%	46,8%	0%	40%	40%	0%
SA_F	56%	56%	0%	27%	20%	7%	40%	13,4%	27%	56%	50,1%	6%
ED_P	92%	76%	16%	95%	80%	15%	67%	66,8%	0%	80%	80,1%	0%
S_TM	96%	96%	0%	76%	76%	0%	83%	83,5%	-1%	68%	56,8%	11%

Source: research data

Data presented from this point forward corresponds to IRTD calculation. We evaluated each of the questionnaire’s eight dimensions separately, as well as the standard deviations of the dimensions. We also calculated a global average for each company. The global average of all dimensions represents the degree of digital transformation of the studied company. Therefore, they can reach up to 100%.

The three companies that obtained the highest global index (Table 4) were IM\_GL with 94%; IMM\_BLA and IM\_K with 92%; and IM\_HSA with 91% digital transformation index. On the other hand, we observed the three lowest indexes in the company SA\_F with 31%; S\_AC with 37%; and IA\_M and IM\_MI, which tied with 46%. Table 4 shows the digital transformation degree of all companies in the sample.



**Table 4**  
Digital transformation degree and standard deviations

Companies	IRTD	Standard deviation
IM_GL	94%	0,057
IMM_BLA	92%	0,057
IM_K	92%	0,070
IM_HSA	91%	0,127
S_D	89%	0,095
IM_C	88%	0,154
S_TL	85%	0,040
SA_ODF	85%	0,131
T_MU	82%	0,073
IM_S	82%	0,038
ED_P	81%	0,156
E_NG	80%	0,099
3S_F	79%	0,133
S_S	78%	0,198
CC_B	77%	0,139
ED_CVL	77%	0,165
T_C	76%	0,118
IM_A	73%	0,062
IM_B	73%	0,132
TA_T	72%	0,114
CV_H	70%	0,137
S_TM	69%	0,218
S_M	68%	0,214
F_GS	67%	0,118
S_JS	61%	0,184
S_C	60%	0,219
S_VAP	58%	0,157
T_N	54%	0,190
IM_S	54%	0,119
SC_S	54%	0,196
3S_SF	49%	0,207
CC_I	47%	0,225
IA_M	46%	0,341
IM_MI	46%	0,180
S_AC	37%	0,201
SA_F	31%	0,161

Source: research data

We also analyzed the average degree of digital transformation among companies in the same industry. Table 5 shows the results. The companies' characterization considered the sectors shown in the structured questionnaire used for the interview. Respondents informed the sector of activity of the companies they represented. The sectors are civil construction (CC), consulting (C), education (ED), consumer electronics (EC), energy (E), finance (F), manufacturing industry (IM), machinery and equipment industry (IME), health (SA), services (S), software (SO), technology (T), third sector (3S) and transport and automotive (TA).

Considering the data collected in each sector, we observed that the sector that reached the highest general average was the manufacturing industry, with an average digital transformation of 77%, followed by companies in the technology sector with 71% and civil construction with 68%. The sector with the lowest average index of digital transformation was the service sector with 66%. We did not consider sectors in which there were fewer than three respondent companies. For example, education, health, and the third sector had only two responding companies. In addition, the energy, financial, machinery industry, and automotive transport sectors had only one respondent.

**Table 5**

The average degree of digital transformation by sector

Sector	Medium DT
Manufacturing industry	77%
Technology	71%
Construction	68%
Services	66%

Source: research data

We also examined the average degrees of digital transformation by economic classification (based on revenue). Table 6 describes them.

Among companies in the sample, eight declared themselves as large, ten as medium, ten as small, and eight as microenterprises. The average indexes and standard deviations we found were large companies 74% with a 0.21873 standard deviation, medium companies 81% with a 0.14462 standard deviation, small companies 62% with a 0.20509 standard deviation and micro companies 62% with a 0.23416 standard deviation.

**Table 6**

The companies' average digital transformation degree by economic classification

Size	Companies	Quantity of companies	Medium DT	Standard deviation
Micro enterprise	S_VAP; S_TL; S_JS; 3S_SF; S_S; CC_I; ED_P; SA_F;	8	62%	0,234
Small companies	T_N; SA_ODF; S_TM; 3S_F; IM_S; S_AC; S_SC; IM_MI; T_C; F_GS;	10	62%	0,205
Medium companies	E_NG; CC_B; IMM_BLA; ED_CVL; IM_A; IM_GL; TA_T; IM_K; S_M; S_D;	10	81%	0,145
Large companies	IM_C; CV_H; IM_M; IM_HSA; S_C; T_MU; IM_B; IM_S;	8	74%	0,219

Source: research data

The third analysis sought to verify the average digital transformation indexes according to companies' number of employees. Data is in Table 7. Classified in terms of the number of employees, results found were sixteen companies have up to 19 employees, and the average degree of digital transformation was 70% (standard deviation 0.19342); four companies reported to have between 20 and 99 employees, and the average degree of transformation was 56% (deviation of 0.2748); nine companies have between 100 and 499 employees, with 74% of average digital transformation (standard deviation 0.2112); seven companies reported to have more than 500 employees and their average digital transformation degree was 74% (standard deviation 0.20434).

**Table 7**

The companies' average digital transformation degree by the number of employees

Quantity of employees	Companies	Quantity of companies	Medium DT	Standard deviation
Up to 19	E_NG, S_VAP, ADEP, IM_GL, S_TL, S_JS, 3S_SF, SA_ODF, S_S, S_TM, 3S_F, CC_I, IM_S, F_GS, S_SC, ED_P	16	70%	0,193
Between 20 and 99	T_N; IM_K; SA_F; IM_MI;	4	56%	0,275

Between 100 and 499	CC_B; IMM_BLA; ED_CVL; IM_HSA; S_C; TA_T; S_AC; S_D; S_M;	9	74%	0,211
Up to 500	IM_C; CV_H; IM_M; T_C; T_MU; IM_B; IM_S;	7	74%	0,204

Source: research data

As previously mentioned, this research used a convenience sample. Therefore, we incorporated data from companies outside Bragança Paulista municipality, and there were cities where we collected only one response. However, three of the seven municipalities in the sample had more than three companies responding. The municipalities were Bragança Paulista e Itatiba, with ten companies, and Campinas, with four companies (Table 8).

Except for Jundiaí, which had two responding companies, all other cities had only one. The cities were Pinhalzinho, Amparo, Valinhos, Vargem, Louveira, Morungaba, Atibaia and Joanópolis.

**Table 8**

The companies' average digital transformation degree by localization

Localization	Companies	Quantity of companies	Medium DT	Standard deviation
Itatiba	IMM_BLA; T_N; IM_M; S_S; IM_HSA; S_TM; CC_I; S_C; TA_T;	9	69%	0,243
Bragança	S_VAP; IM_A; S_TL; S_AC; 3S_F; IM_S; ED_P; F_GS, IM_S;	9	69%	0,181
Campinas	CV_H; S_M; SA_F; S_SC;	4	56%	0,232

Source: research data

The application of the questionnaire also made it possible to analyze the companies' perceptions of their digital transformation degree. This situation meant answering whether they believed they were close or far from complete transformation. To enrich the analysis, we correlated the companies' self-assessments with the degree of transformation they achieved in Table 9. The results suggest that companies still need to understand how digital transformation occurs internally.

Examples of such situations were companies that obtained a good digital transformation index but considered themselves “far” or “very far” from achieving digital transformation. ED\_P and E\_NG are examples of it, as they said to be “very far” and “far” from digital transformation but reached indexes of 81% and 80%, respectively.

**Table 9**  
Companies’ Perception of Digital Transformation Development

Companies	Companies’ perception of DT development	IRTD index
ED_CVL	Close	77%
S_TL	Close	85%
SA_ODF	Close	85%
IM_HSA	Close	91%
S_C	Close	60%
TA_T	Close	72%
IM_K	Close	92%
S_D	Close	89%
T_C	Close	76%
IM_S	Close	82%
3S_F	Close	79%
IMM_BLA	Very close	92%
IM_C	Very close	88%
IM_GL	Very close	94%
F_GS	Very close	67%
IA_M	Very close	46%
3S_SF	Very close	49%
SA_F	Very close	31%
IM_B	Far	73%
E_NG	Far	80%
CC_B	Far	77%
S_VAP	Far	58%
T_N	Far	54%
IM_A	Far	73%
CC_HM	Far	70%
S_S	Far	78%
CC_I	Far	47%
S_AC	Far	37%
S_M	Far	68%
IM_MI	Far	46%

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T_MU	Far	82%
IM_S	Far	54%
S_SC	Far	54%
S_JS	Far	61%
S_TM	Far	69%
ED_P	Very far	81%

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Source: research data

As the digital transformation, the industry 4.0 subject has been frequently approached in scientific publications, leading the industry to be considered one of the most digitally transformed sectors. Aiming to innovate and have productive competitiveness, in many situations industry has more capital to invest and ease in implementing new technologies and operational methods. So, despite the digital transformation already being discussed in other sectors such as agriculture, education, finance, and healthcare, the industry still appears the most in related publications and practical applications.

The lack of similar studies shows that digital transformation analysis is an emerging topic and presents how an analysis of various sectors and locations can contribute to understanding the topic and its actual development in Brazil.

## 5. CONCLUDING REMARKS

From the analyzed data, we realized that although large companies have greater chances to push investments in new technologies and application of innovative tools, the medium-sized interviewed companies had a greater degree of digital transformation, with a lower standard deviation. We believe this situation may be a consequence of the type and focus of these companies' investments, despite their sector. Instigated by data, the hypothesis is that medium-sized companies invest in standard solutions and, therefore, have access to the same tools and strategies, which can be cheaper but poorly adapted to their reality.

It is still a common understanding that digital transformation happens through technology implementation, missing its actual meaning that technology has to integrate itself into agents' reality involved in productive activities. This situation hampers the effective advance of digital transformation. Without everyone understanding the importance of DT and the ease it can bring, they will hardly have a competitive or effective difference in their processes.

Driving the understanding of digital transformation beyond simple technology applications can be the real challenge for companies that seek to transform themselves digitally.

The pandemic context has accelerated the digital transformation in companies obligating them to face their risk aversion. However, this acceleration seems a safe and necessary point, avoiding investments that may not be justified in a volatile scenario. As companies reached a comfortable resolution of their problems, they stepped on the brakes once continuing the acceleration in such an unstable context could increase risk and problems rather than solve them.

The analysis made possible by the ICTD contributed a lot to clarify what digital transformation is. However, it is still difficult to define it, especially when considering each company's competitive uniqueness and that leveraging this strength is also this transformation role.

As a final consideration, it is important to emphasize that the companies' effective digital transformation depends not only on the managerial model adopted by their leaders but also on the availability of technological and communication infrastructure, the preparation and availability of skilled labor adapted to digital environments and operations, and more encouraging macroeconomic scenarios, especially for small and medium-sized companies.

## REFERENCES

- Borges, F. R. (2021). *Transformação Digital: um guia prático para liderar empresas que se reinventam*. Barueri: Atlas.
- Botelho, M. C. (2020). A proteção de dados pessoais enquanto direito fundamental: considerações sobre a lei geral de proteção de dados pessoais. *Argumenta Journal Law*. n. 32 p. 191-207 jan/jun
- Ferreira, A. B. de H. (2004). *Novo dicionário Aurélio da língua portuguesa*. 3.ed. Curitiba: Positivo.
- Kane, G. C.; Palmer, D.; Phillips, A. N.; Kiron, D.; Buckeley, N. (2015). *Strategy, not technology, drives digital transformation*. [s.l.]: Deloitte University Press. [https://www2.deloitte.com/content/dam/Deloitte/fr/Documents/strategy/dup\\_strategy-not-technology-drives-digital-transformation.pdf](https://www2.deloitte.com/content/dam/Deloitte/fr/Documents/strategy/dup_strategy-not-technology-drives-digital-transformation.pdf).
- Koeleman, J., Ribeirinho, M. J., Rockhill, D., Sjödin, E., Strube, G. (2019). *Decoding digital transformation in construction*. McKinsey & Company Reports, <https://www.mckinsey.com/~/media/McKinsey/Industries/Capital%20Projects%20and%20Infrastructure/Our%20Insights/Decoding%20digital%20transformation%20in%20construction/Decoding-digital-transformation-in-construction-vF.pdf>.

- Mendonça, F. M.; Zaidan, F. H. (2019). Ontologias para organização da informação em processos de transformação digital. Em questão. v. 25, n. 1, p. 295-320,. [https://doi: 10.19132/1808-5245251.295-320](https://doi.org/10.19132/1808-5245251.295-320)
- Oliveira, R. R.; Oliveira, R. R.; Ziviani, F. (2021). Processo de inovação no contexto de transformação digital: framework para gestão da inovação. Perspectivas em Gestão & Conhecimento. João Pessoa, v. 11, n. 3, p. 2-15, set./dez.
- Pacheco, R. C. S.; Santos, N. Wahrhaftig, R. (2020). Transformação digital na Educação Superior: modos e impactos na universidade. Dossiê: A universidade como agente de desenvolvimento cultural, social e econômico. Revista NUPEM. v. 12, n. 27.
- Peixoto, E. et al. (2020). *Transformação Digital nas Organizações em Tempos de Pandemia*: em um cenário de tantas mudanças em tão pouco tempo, o que mudou na maturidade digital e quais os impactos da transformação nas organizações. Recife: CESAR REPORTS, 2020. <https://materiais.cesar.org.br/report-ictd2020>.
- Perides, M. P.; Vasconcellos, E.; Vasconcellos, L. *A gestão de mudanças em projetos de transformação digital*: estudo de caso em uma organização financeira. Revista de Gestão e Projetos (GeP), 11(1), 54-73. <https://doi.org/10.5585/gep.v11i1.16087>
- Rabelo, A. (2019). Transformação Digital: o que é e quais os seus impactos na sociedade. Rock content. <https://rockcontent.com/blog/transformacao-digital/>.
- Rogers, D. L. (2017). Transformação digital: Repensando o seu negócio para a era digital. Belo Horizonte: Autêntica Business.
- Senna, D.; Ribeiro, J. (2021). A gestão do conhecimento na transformação digital para a Indústria 4.0: tecnologias digitais e suas aplicações em setores econômicos. Exacta. 2021. <https://doi.org/10.5585/exactaep.2021.18918>
- Shi, L.; Mai, Y.; Wu, Y. J. (2022). Digital Transformation: A Bibliometric Analysis. Journal of Organizational and End User Computing. N. 34 (7).
- Silva, L. F. dos S. (2019). A transformação digital e a sua relação com a reestruturação dos processos de negócio no Sebrae/RN. 108f.: il.
- Vergara, S. C. (2016). Projetos e Relatórios de Pesquisa em Administração. 16 ed. São Paulo: Atlas.
- Vial, G. (2019). Understanding digital transformation: A review and a research agenda. Journal of Strategic Information Systems. V.28, p.118–144