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Digital transformation with agility: The emerging dynamic capability of complementary services

Transformação digital com agilidade: A emergente capacidade dinâmica de serviços complementares

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ABSTRACT

Purpose: This study aims to understand how organizations accelerate a digital transformation (DT) and leverage innovations in digital services in the *modus operandi* of dynamic capabilities (DC) development. DT provides an agile resource mobilization in relation to the operational flexibility and to the technological and informational capabilities.

Originality/value: This study contributes with a new theoretical-applied perspective on agility as a necessary competence for DC development, being investigated in an emerging country, in this case, Brazil. The development of DC that are suitable for DT becomes critical for capturing opportunities in the dynamic digital environment.

Design/methodology/approach: Forty companies in the Brazilian territory were investigated in order to explore the relation between DC and DT, focusing on agility and based on the logic of literal and theoretical replication of case studies. The theoretical framework was applied to investigate companies from three empirical fields (energy, automotive, and digital services), within the triangulation of secondary sources, management reports and internal documents.

Findings: The cases analyzed provide evidence that agility does not presuppose strong DC in sensing, as it depends on services' maturity. We highlight the mediation of the applied use of intangible resources and digitized assets that speed up the seizing and transformation of the business. In the context of digital assets in intensive environments, we propose that DT strategy may be used with analytical intelligence and agility by integrating technological processes.

Keywords: digital transformation, dynamic capabilities, complementary services, platforms, ecosystems

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RESUMO

Objetivo: O objetivo deste estudo é compreender como organizações agilizam a transformação digital (TD) e impulsionam inovações em serviços digitais no *modus operandi* do desenvolvimento de capacidades dinâmicas (CD). A TD propicia a mobilização de recursos ágeis relativos à flexibilidade operacional e às capacidades tecnológica e informacional.

Originalidade/valor: O estudo contribui ao apresentar uma nova perspectiva teórico-aplicada sobre a agilidade como uma competência necessária ao desenvolvimento de CD, sendo investigada em país emergente, no caso, o Brasil. O desenvolvimento de CD adequadas à TD torna-se crítico para a captura de oportunidades no dinâmico ambiente digital.

Design/metodologia/abordagem: Foram investigadas 40 empresas no território brasileiro no sentido de explorar a relação entre CD e a TD, com enfoque na agilidade e com base na lógica de replicação literal e teórica de estudos de casos. O *framework* teórico foi a base de validação do raciocínio aplicado em empresas de três campos empíricos (energia, automotivo e serviços digitais), com triangulação de fontes secundárias, relatórios gerenciais e documentos internos.

Resultados: Resultados evidenciam que, dentre os casos analisados, a agilidade não pressupõe CD fortes em *sensing*, pois depende da maturidade em servitização. Destacou-se a mediação do uso aplicado de recursos intangíveis e ativos digitizados, que atribuem velocidade ao *seizing* e à transformação do negócio. No contexto de ambientes intensivos em ativos digitais, propõe-se que a estratégia de TD seja realizada com inteligência analítica e agilidade na integração de processos tecnológicos.

Palavras-chave: transformação digital, capacidades dinâmicas, serviços complementares, plataformas, ecossistemas

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INTRODUCTION

Digital transformation (DT) is a relevant topic from a strategic perspective, not only for academic research but also for companies (Hanelt et al., 2021). Digital business strategy is characterized by taking advantage of digital resources to create differential value (Bharadwaj et al., 2013). Within transforming information into digital format, also known as *digitization,* possibilities arise to reconfigure resources by creating or innovating strategic operations in services. The intensive application of *digitalization* has become a critical factor for the organization to align or build strategies regarding differentiation possibilities in a new set of resources (Fischer et al., 2020).

The lived experiences during business relationships need to be validated for the market to value and "absorb" a strategic differential, particularly in the service business. It is necessary to perceive and prove the organization's dynamic capacity (DC) in a specifically recognized competence (Teece, 2007). In the context of DT, it is understood that DC is a strategic exercise of a set of organizational activities whose purpose is to deliver digital value in the evolution of sectors of society and economies (Shuen et al., 2014; Warner &Wäger, 2019).

DT provides new possibilities for network management, which allows cooperation among different actors based on the case of a greater flow of information and knowledge (Schallmo & Tidd, 2021). The intensive environments in digital assets propose that the DT strategy involves analytical intelligence and agility in integrating technological processes. Such context promotes contiguous digital capabilities for companies. The development of DCs suitable for DT becomes a critical factor in capturing opportunities created in this dynamic environment of the digital context (Mikalef et al., 2019).

DT also restructures organizational relationships and external environments. The advance in digitalization allows the search for information and the creation of knowledge based on data monitoring, for example, to promote a scientific understanding of consumer attitudes and behaviors (Braganza et al., 2017). Beyond that, digital services may play a leading role in value creation, from the intense association of complementary services with products or the complete transformation of products into services (Cenamor et al., 2017). This occurs in the so-called *servitization*, which is the hybrid business modeling of smart products linked to digital platforms.

This study aims to understand how companies streamline DT and drive innovations in digital services in the *modus operandi* of developing dynamic

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capabilities. To compete in the "fidigital" (hybridism between the physical and the digital), the development of unique capabilities allows strategic processes such as extensive data collection (Mikalef et al., 2019), intelligent analytical practices (Chen et al., 2012) or new business models (Schallmo et al., 2017).

In sum, this article aims to provide a vision of how the development of DT can support the value creation system of industry 4.0 (Erro-Garcés, 2021) and the digital transformation (Schallmo & Tidd, 2021), highlighting the Brazilian perspective. The offer of more intelligent and faster innovative digital services would be a counterpoint to mitigate uncertainties, as suggested by Pisano (2017). The mechanisms that reduce the decision gap between deep existing capabilities with complementary services or expand their repertoire of abilities into new domains of the digital economy are investigated from three representative Brazilian sectors (energy, automotive, and services).

THE AGILITY FOR PROMOTING STRATEGIC CAPABILITIES FROM DT PERFORMED BY PLATFORMS AND ECOSYSTEMS

Academia and the market point to the trend of a new physical and digital environment permeated by an intelligent environment (Organization for Economic Co-operation and Development – OECD, 2019; Erro-Garcés, 2021). In this new environment context, this study considers the concept of *agility* as the dynamic process of anticipating or adjusting to those trends and needs in digital services (Blaschke et al., 2019).

Agility comes from the ability to change processes quickly and efficiently, combining and reintegrating organizational resources without interrupting routine activities. It is noteworthy that DT requires the creative capacity to develop a delivery system characterized by flexibility and speed rather than simply reorganizing old value packages (Ali & Zalisham Jali, 2018). There are many perspectives and applications of this concept – DT – applying it to organizations with significant differences in definitions regarding the technology types and the nature of the transformation (Vial, 2019).

The conceptual research framework is presented in Figure 1, identifying DC in the agile DT perspective. Sensing capabilities are related to the identification, development, improvement, and evaluation of new technological opportunities, and these opportunities can be identified both internally and externally (Teece, 2007). Therefore, organizations manage their digital

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assets and seek to understand how products and services with digital intangible resources would increase their values.

Seizing capabilities are necessary for developing new products – smart or not – digitizing and adapting processes or offering new services that include digital categories (Warner & Wäger, 2019). It means mobilizing resources and developing the collective capacity to "make it happen" to guarantee the proposed strategic value.

Teece (2018) corroborates DC in the perspective of DT, proposing that enabling technologies play a decisive role in generating value. As data-driven and design-driven innovation make up the research and development (R&D) process to assign meanings to their transformations into information (Verganti, 2009), the role of big data and its analytical capacity is highlighted (Batko, 2017) as levers of organizational dynamism and agility.

The agility in decision-making to take advantage of opportunities (sensing) involves a data-oriented view. This requires intelligent information use that is already received in real-time and by the internet of things (IoT), people, and services. And, those data are in the cloud, which attributes more complexity to decision-making and uncertainties (Teece et al., 2016).

Preparing for the future, organizations need to develop new capabilities in two aspects (Weill & Woerner, 2015). The first concerns further learning about customers: 1. expanding the voice of the customer within the company using digital capabilities with information about consumer goals and events; 2. amplifying the voice of the customer within the company; and 3. emphasizing evidence-based decision-making and the development of an integrated multi-product channel, providing a good customer experience. The second, on the other hand, contemplates approximation actions with an ecosystem format: 1. make its consumers' first choice in its digitized space; 2. obtain excellence in building partnerships; 3. create service-enabled interfaces that others can use; and 4. treat efficiency and compliance as a competency (Weill &Woerner, 2015).

In emerging countries, such as Brazil, organizations require extended capabilities, as they demand a high level of organizational agility to improve their chances of survival, given the characteristics of their markets and the constant socioeconomic challenges (Erro-Garcés & Aranaz-Núñez, 2020).

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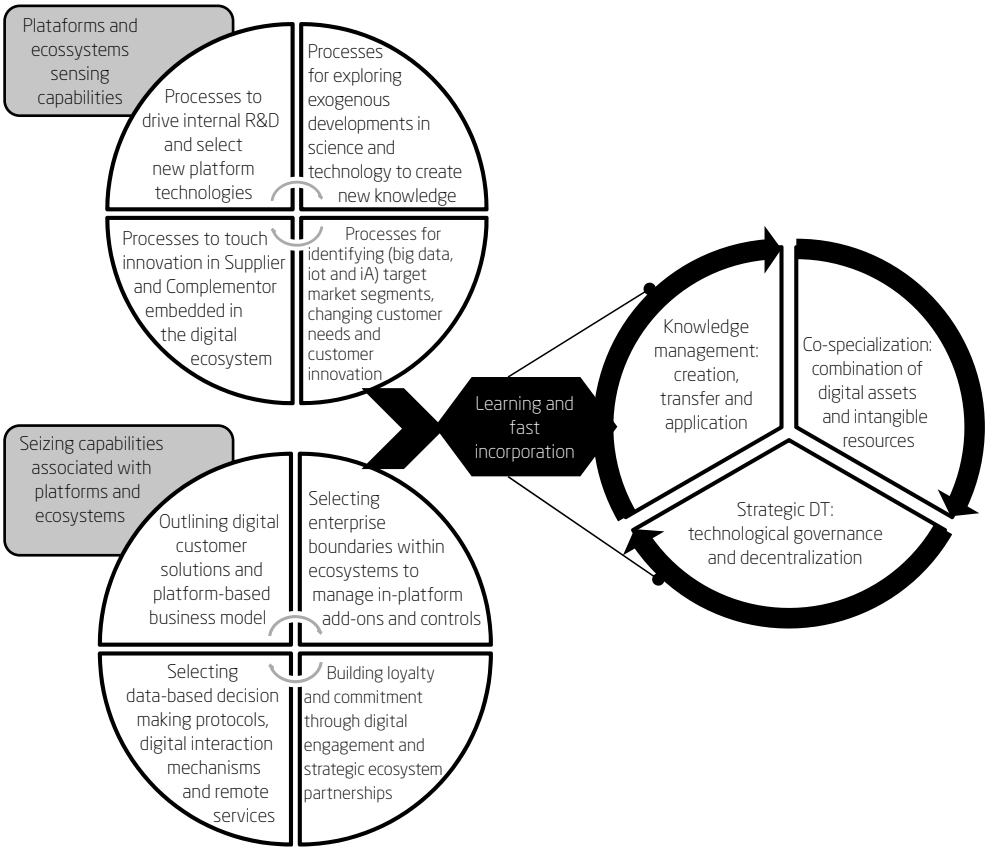
Figure 1

Dynamic capability in the perspective of agile digital transformation



Source: Adapted from Teece (2018), Ghobakhloo (2018), Helfat and Raubitschek (2018), and Erro-Garcés and Aranaz-Núñez (2020).

The evidence of the study is investigated by *sensing* and *seizing* the strategy mitigated by digital transformation, focusing on the gaps highlighted in the theoretical framework.

Development of digital sensing capabilities for knowledge creation

The adaptation of organizations to the reality of the 4.0 journey leads to the development of competencies and market differentials. The growth opportunities by DT of the main global organizations lead to the adoption of

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mechanisms to achieve better international performance and deployment of intelligent operations (production-service) systems (Ghobakhloo, 2018).

Specific relationships and commitment mechanisms stand out, allowing them to take advantage of the configuration of networks, which leads to learning and knowledge creation through data and business intelligence. Therefore, new knowledge is promoted by relationships of trust and results in the commercialization of the benefits of digitization and *servitization* (Cenamor et al., 2017). In emerging countries, both the co-specialization of assets and the execution of complementary businesses in partnerships are subterfuges to justify the implementation of the DT meta-process via digital strategic capabilities for developing *serviced* intangible resources (Teece, 2007).

The first type of mechanism is related to digital platforms, which play a central role in the value propositions of many companies, allowing the management of information and marketing benefits (Cenamor et al., 2017; Hollebeek, 2019). Consequently, big data, artificial intelligence (AI), and machine learning have become requirements for companies to participate in the competitive game in digital platform ecosystems (Vial, 2019).

The second type of mechanism is supported by ecosystems that lead to the exploitation (seizing) of opportunities, such as those driven by co-creation resources and shared with the development of costs (Blaschke et al., 2019). However, several types of ecosystems are mainly related to value capture (Helfat & Raubitschek, 2018). As a theoretical consequence, those ecosystem approaches describe the increasing interdependence and co-evolution of contemporary business and innovation products (Walrave et al., 2018).

Thus, the first proposition of the article is:

- Organizations can be effective learners and can accelerate the changes when they skillfully use the digital and analytical resources of digital platforms and ecosystems.

This specialized experience builds potential capabilities improving innovation and moving organizational motivation to pursue other new technologies (Ghobakhloo, 2018). On the other hand, experts characterize DT by some characteristics: customer orientation, mobility, speed, and data orientation (Akatkin et al., 2017) that are presented at the fundamental micro level attributing agility factors (Teece, 2018).

In addition, Erro-Garcés and Aranaz-Núñez (2020) analyzed articles on the readiness of industrial companies and economies. Most agree on the importance of assessing this availability as it affects challenges in both internal and external factors. These types of factors could be classified as micro-

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conditions (company strategy, intra-organizational communication, implemented technologies, employees, products/services, and innovation) and macro-conditions (the collaboration of institutions and the country's technological level), corroborating with Teece (2018).

Development of dynamic seizing capabilities for digital business transformation

Promoting large amounts of change in a short period, as assumed by Helfat and Winter (2011), presumes adopting platforms or joining ecosystems in the new economy. Fundamentally, the relationship between dynamic and operational capabilities affects strategies for either digital support or digital transformation (Nambisan et al., 2019). As dynamic capabilities foster organizational agility – for the detection and apprehension of approaches under intense uncertainty – contributions to innovation and competition in dynamic environments associated with DT stand out (Teece et al., 2016; Teece, 2018).

Thus, the second proposition of the article is:

- The influence of integration by agile resources is a critical factor for DT in organizations that are operating in the territory of Brazil and, in particular, when driven by the synergistic effects of using platforms and ecosystems.

Understanding DT from a strategic point of view reveals critical issues for raising awareness of industry 4.0 value creation systems (Ghobakhloo, 2018), as they can promote economically significant gradual changes (Erro-Garcés, 2021). These orchestrate dynamic changes based on solid and fast capabilities, given the interoperable/interchangeable nature of information and the collaborative/collective effect of mobilizing strategic actions (Helfat & Winter, 2011; Teece et al., 2016).

The increasing expansion of actor networks in this technological journey, beyond their temporal, organizational, and spatial limits, is crucial to account for the effect of value co-creation. For example, it is possible to cite the processes of information systems in multi-actor configurations (Blaschke et al., 2019) or the use of technology to radically improve the performance or reach the digital way in organizations (Westerman et al., 2011).

Therefore, dynamic capabilities involve facing future external and internal challenges and opportunities and determining what the company should do in the future. Capabilities ensure firm access to the resources needed to

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implement the appropriate organizational design (Teece, 2017). Enabling technologies (Ghobakhloo, 2018) also play an important role, as they can positively and significantly affect agility and competitive advantage (Teece, 2018).

An essential element for DT is resource orchestration. This capability is based on the modularization of platforms to identify resources and explore global opportunities (Nambisan et al., 2019). Platforms offer the integration of resources with existing services, connecting different actors through digital means. Therefore, orchestration must ensure the harmonious coordination of internal and external physical, human, and logistical elements (Teece, 2017).

This integrative resource orchestration capability goes beyond the simple information flow solution and involves the ability to articulate and manage resources promoting innovativeness (Fuchs et al., 2000). Organizational performance is associated with resource development, technologies for innovation, digitization, capabilities for environmental sensing, and integrative capabilities for ecosystem orchestration. In the spotlight, integrative competencies play a crucial role in enhancing the ability of platform leaders to capture value (Helfat & Raubitschekb, 2018). In a data-driven economy, analytics drive strategic actions and assign organizational governance via digital (Batko, 2017). In summary, knowledge from this orchestration presupposes being managed in a peculiar way, inherent to the DNA of the organization, seeking to recreate a new and ingenious agile management system (Miozzo et al., 2016).

METHODOLOGY

Qualitative research was conducted through the multiple-case study strategy to understand how companies streamline DT and drive innovations in digital services in the *modus operandi* of developing dynamic capabilities (Yin, 2016). Forty cases were selected in the logic of literal and theoretical replication to ensure consistency and diversity of scenarios and evidence for the research (Dubé & Paré, 2003). Companies in three Brazilian sectors (energy, automotive, and digital services) with an active presence of DT were conducted from different vectors of DT, different levels of dynamic capabilities, and different enabling technologies (see Figure 2). These multiple sectors support the criterion of maximum heterogeneity between cases (Merriam & Tisdell, 2015). Numerous cases contribute to external validity by taking advantage of different managerial perspectives and empirical contexts to build diversified evidence (Leonard-Barton, 1990). The unit of

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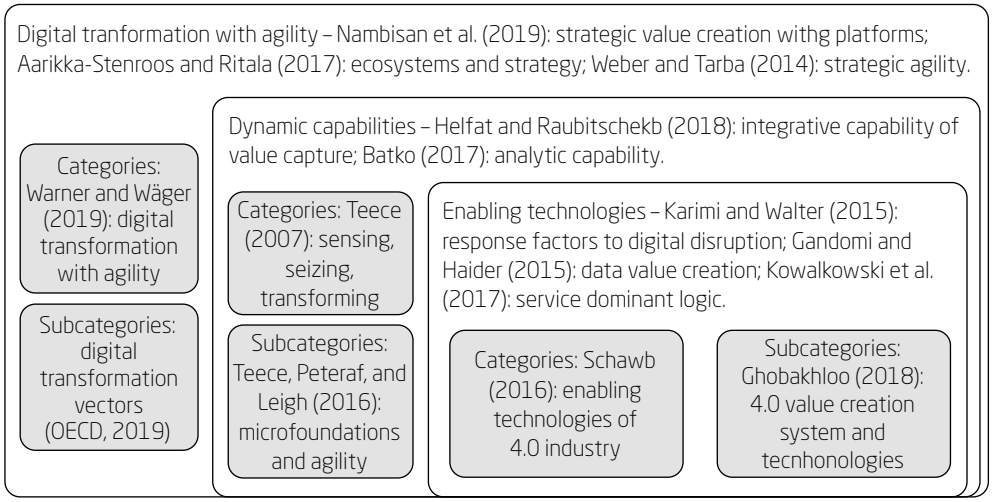
analysis was specified to capture the strategic dynamics of DT of each case analyzed, as comparisons between theory and cases allow for a more vigorous clarification construction process by understanding the effects of contextual variables (Urbinati et al., 2019).

Figure 2

Categorical breakdowns



Source: Elaborated by the authors.

The interviewed people were chosen to represent the company's vision and DT strategies. Each company selected a *c-level* informant (directors or executive managers) and linked to the DT process. The literature points out that the use of high-level informants is indicated for research regarding management and organizational strategy, as they can reliably inform the organization's values and strategic directions, contributing to the external validity of the results (Solarino & Aguinis, 2021). In some cases, given the complexity of the organizational structure, additional respondents were appointed. The interviews were carried out by telephone, teleconference, or in person. Each interview was recorded and transcribed. In cases where the recording was not authorized, notes were used to record the information acquired.

In addition to the semi-structured interviews, secondary sources were investigated, such as internal documents provided by the companies, and public information, obtained from institutional websites and specialized sources. Plurality contributes to study validity, in line with recommen-

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dations on diversifying data sources in case studies (Eisenhardt, 1989). Regarding the limited time available to the respondent executives, the indication was followed by elaborating semi-structured scripts, covering all relevant topics without restricting the conversation (Solarino & Aguinis, 2021). Appendix 1 presents the final inventory of data sources. In total, 40 companies were studied, and 59 interviews were carried out, totaling 62 hours and 35 minutes, composing a sound universe of 101,172 words in transcription. Also, 1,840 secondary documentary sources were analyzed.

An initial set of semi-structured questions (Appendix 2), based on the literature, was formulated to answer the research question in three main axes: the Digital Transformation one composed of eight questions; the Dynamic Capabilities pillars (sensing, seizing, knowledge management), consisting of 24 questions; and the third axis, ending the reasoning, with enabling technologies and platforms, containing 12 questions.

For data analysis, the analytical strategy was applied, identifying evidence that corresponded to the theoretical standards predicted by the literature. An analysis protocol with theoretical categories and conceptual criteria was developed to provide uniformity in data treatment (see Appendix 3).

DATA ANALYSIS AND DISCUSSIONS FROM THE INDUSTRIES PERSPECTIVE: AUTOMOTIVE, ENERGY, AND DIGITAL SERVICE

In the empirical context of the cases, it was possible to show that DC is associated with DT strategies based on digital technologies that enable innovation. In Appendix 4, the analyzed cases summarized strategies based on the digitization of processes followed by the offer of digital solutions (Table 1). DT processes associated with innovation were more evident in cases with well-established R&D structures.

The investigation focused on how organizations accelerate digital transformation (DT) and drive digital service innovations in developing dynamic capabilities. The cases were categorized in terms of the characteristics of the companies' capabilities by identifying opportunities (*sensing*), exploiting opportunities (*seizing*), and digital transformation associated with agility in these capabilities (see Appendix 5). Different groups combined strong evidence of skill in *sensing* and *seizing* with enabling and innovative use of DT. These were contrasted with groups of low innovativeness and agility, which use digital technologies to optimize processes.

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Table 1

Digital transformation strategies found

Digital transformation strategies	Number of cases
Process digitization	12
Digital bank model	1
Model of industry 4.0	4
Innovation model	4
Platform model	3
Singularity (unique offer of customized services or products)	4
IoT solution	4
Digital solutions	8
Total	40

Source: Elaborated by the authors.

Organizations that promote DT with agility are effective both in taking advantage of digital opportunities and in the skill of learning and dealing with the barriers found in emerging markets, such as Brazil. One example is digital connectivity. DT is strongly supported by mobile networks and technologies, whose national reality is quite different from developed markets. According to the industrial quality manager of E23, a Japanese automaker:

> We don't have 5G, we have a connectivity that is constantly interrupted, so we can't really deliver everything we design, that we think for our customer, this causes some frustration in the customer because it is giving an accessory that does not work.

Therefore, companies need to learn from the intrinsic characteristics of the environment in which they are competing and be effective in speeding up and applying digital resources to deliver innovations.

The orchestration of digital resources is evident as a necessary competence for agility in the delivery of value. In the analyzed cases, it was understood that the companies' ability to respond to the environment (seizing) was supported by their ability to use information resources to identify and take advantage of market opportunities.

Furthermore, the chief digital transformation officer at E27 points out that in his multinational "integrated, autonomous, intelligent systems do

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half the work for us, so we can respond much faster to our internal and external customers" corroborating the logic of technological value creation by Ghobakhloo (2018) and Erro-Garcés and Aranaz-Núñez, (2020) for players in emerging markets.

The skillful use of digital and analytical resources provides agility in generating and delivering value in the context of dynamic environments. The CEO of the company E1, a corporate start-up of aeronautical digital services, illustrates the importance of the analytical capacity of organizations for the generation of value from data:

> The generation of value, it is not within the borders of the company, right, it is it's out [...]. This is the challenge of this model carried out by technology and data [...]. We understand, well, it (technology) is not an end, it is a means.

Organizations must be agile in the DT to operate a data-driven value creation strategy. Adopting real-time executable methods that provide data for nimble decision-making is still a worrying challenge. Dealing with poor data infrastructure quality issues and ensuring data security requires technical and managerial deliverability in terms of speed and efficiency, availability, reduced latency, and tolerance to high densities of digital devices.

However, the energy and automotive industries foster innovation projects through strategic partnerships (Appendix 5) with other companies and science and technology institutions. When framed within global borders, some entities evidence the use of platforms as an exclusive stage of strategic digital transformation. It is noted that the decrease in communication and computing costs offers companies opportunities to increase their competitive advantage by applying innovative collaboration. This is evident with suppliers and complementary partnerships, notably with ecosystem effects in digital services. It is argued that these new services add value to the customer or act as a "stepping stone", a means of advancing towards reconfiguring resources for DT.

Analysis of the strategic impact of digital platforms

Triangulated data (Appendix 3) indicates that industrial logic is essential for the intelligent application of platforms. The investigated organizations reported strategic media use with particular emphasis on streamlining capabilities. The CEO of E27, from the RFID services sector, highlighted the

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effect of the customer experience as an opportunity for business development: "When we mapped this market and then made the architecture of the solution, it is a pillar to be flexible to the maximum in terms of integration and to make it highly customizable". However, the innovation director of another respondent, one of the most innovative in the national territory, highlights the challenges of offering value with personification:

> This possibility of monitoring the quality and operation of the equipment, from a distance, gives you a large scope number of services, new services are being offered, new parameters are applied or thought of, and new concerns too, such as safety, such as equipment safety, and the protection of industrial parks, also come to the fore.

The integration provided in the transference of knowledge across the borders of the digital environment implies the dynamic ability to perceive the level of agile decision-making, differing from the ordinary ones. About an agricultural vehicle manufacturer – winner of innovation awards: "Our differential lies in the intelligence of the data offered that our competitors are not able to have". This positioning implies offering agile services with a superior experience. The interviewer E15 gives evidence of decision-making agility in " […] generating a variety of topographic and yield maps to establish yield performance and comparing them to multi-year average maps to identify areas that deliver consistently high or low yields".

Analysis of the strategic contribution from analytical capabilities

The analysis of the 40 cases allowed us to identify a distinct set of companies that presented remarkable indicators in terms of their dynamic capabilities and agility, with particular emphasis on integration, contributing to Proposition 2. These entities are shaded at the bottom of Appendix 2.

Regarding the capacity for integration and development of dynamic capabilities, performances that are quite different among the cases studied stand out. Since this capacity for integration means skill in mobilizing tangible and intangible assets as a composition of unique DT resources, other cases highlight integrative capabilities (Helfat & Raubitschekb, 2018) associated with analytics (Batko, 2017) with an effect on agility.

The first case is a global manufacturer of generation equipment that showed that they created an

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> […] ecosystem that connects and integrates equipment and sensors, capable of collecting and storing data and transforming them into information that makes it possible to monitor, control, and automate operations… performing analysis in real-time, is the company's expertise applied in the development of more efficient technologies for the continuous growth of industry 4.0.

Finally, the most extensive reference in automation in the national territory confirms that "the data integrated systems end up connecting, ascending to Business Intelligence Systems and within these Dashboards Analytics are set up, in order to be able to metric results and monitor the progress of both ours and our customers' business".

Evidence in thirty cases indicates that developing dynamic DT capabilities implies new analytical skills from the executive and managerial levels, corroborating Proposition 1. The fluidity of data and the ability to collect them in abundance requires an analytical counterpart on the part of human resources. Agile action in the context of DT is heterogeneous as the cognition of decision makers. There is a critical element for digital innovation – as shown in Appendix 2 – which highlights both digital solutions (11 entities) and their impact on the business model, as well as the frequency of use of protocols (34 apply robust algorithms) and their decisions, unfolded with intelligence (with an emphasis on IoT/S in four entities).

The ability to orchestrate resources for DT demonstrated effects with lower transaction costs, optimization of business infrastructure, and increased sales. The cases have shown that the functional configuration of platforms allowed the simplification of work and the integration of processes. In the consumer market, companies reported that the platforms allowed greater connection with the customer, translating into relationship advantages and increased satisfaction. Digitized relationships allow a more remarkable ability to track performance metrics and obtain real-time analytics data during the consumption experience. Thus, in the inseparable logic of service provision and consumption, real-time attention allows dynamic and agile actions, adjusting to changes in the environment, consumer, or service process. This emphasizes companies that are strong in agile sensing, seizing, and transforming, all highlighted at the bottom of Appendix 2.

According to the consolidated data (Appendix 5), among the incumbents, the prioritization of DT is not always the origin factor for the development of dynamic capabilities, considering the criterion of transaction costs. Learning about the technological transition is more important than reconfiguring the business model, even if digital natives tend to make the organizational struc-

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turing nexuses of these more traditional entities obsolete. So, the effect is a mediator.

The mastery of skills associated with digital platforms also guarantees agility and the imposition of strategic barriers. The possibilities of new relationships, combined with technological capacity, the operational flexibility of organizational processes, and integrated technical systems, can make it difficult for new competitors to enter the market, especially when a dependency relationship among consumers is created with the platform offered.

Examples of this discussion can be seen in the automotive industry, where performance is related to 4.0 technologies. At the same time, in the energy chain, DT has a more significant influence on the strategic potential of its viability with strong technological governance, adapting the digital to remote operations. Both industries are associated with R&D projects (Table 2) on which digital services assign strategic solutions to the vulnerabilities listed above (breaking technological barriers quickly and adding value to the customer with innovative services). These solutions contributed to process efficiency and information agility. Reliability was also improved.

Table 2

Outstanding companies in R&D and innovation metrics

Entity	Employees	Patents	R&D	Projects
Aluminium	2,100	1,200	18489000	837
Generation and distribution equipments	293,000	3,750	1,269E+10	8,796
Manufacturer of rings and pistons	79,564	9,930	573800000	7,769
Compressor manufacturer	14,000	10,000	90000000	5,421
Tractor manufacturer	63,499	11,051	1061000	5,998
Interconnection supplier	80,000	15,000	475200000	7,235
Chassis supplier	14,300	1,000	250000000	178
Cockpit supplier	122,000	10,000	6416500	2,189
Yarn machine supplier	1,700	5,200	29756000	414
Oriental car assembler	136,134	1,100	901700000	123
Truck and bus assembler	22,500	7,600	1,431E+10	1,359
Home car assembler	164,000	10,000	6,165E+09	1,181
Sports vehicles	36,359	3,550	1,4E+09	27

Source: Elaborated by the authors.

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On the other hand, the orchestration of platform resources and ecosystems reveals new technological components to promote co-innovation, creativity, and cooperation, especially in the service chain. Among *stakeholders*, this allows a broader set of entities with more knowledge absorbed and heterogeneity for complementary innovations in digital services.

Among the cases analyzed, 14 entities attributed importance to IoT/S and AI as performance enablers, showing solution categories and models in *seizing* in Appendix 2. In these organizations, the use of analytics is crucial for *sensing*. As service organizations have a business model based on intangibility, the development of analytical capabilities occurs concomitantly with integrative ones. As consumption is not separated from its operation, real-time monitoring proves to be a critical success factor, like a company that has been operating its plants remotely for 15 years. We do this process in a super planned way, in a super safe, with all the necessary security in technical and operational terms, all monitoring systems and staff on standby if necessary".

Therefore, an effect on agility was identified as strategic value, technological capacity, and operational flexibility of organizational processes and information technology (IT) systems (Chen et al., 2014) as mediating factors (Zhou & Wu, 2010). Another example is a yarn supplier in the automotive industry that justifies that "manufacturing applications are viable and machine learning systems, artificial intelligence, make the interactions, to understand what is the best sequence to produce".

The company's ability to innovate positively impacts organizational agility when digitization and *digitization* are embedded in the business model. Entities with greater innovation capacity demonstrate a more remarkable ability to leverage their digital platforms to increase agility, such as streaming and telecommunications services.

General analysis of the cases

Although the construction of capabilities for DT is strongly evidenced, the cases analyzed pointed to a gap in the relationship with innovation. Agility in DT is not a prerogative of innovation. It was observed that the development of capacities was oriented towards the operational and execution domain of the DT and was dependent on decentralization (20 entities). A South American multinational manufacturing manager says that "currently, professional excellence has gained a management in each of the operations, in each of the countries that are bringing automation concepts, of

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industry 4.0 to start implementing". These entities started managing their own 4.0 ambiance and innovation projects aiming at different objectives (ranging from operational excellence and servitization to sustainability). Still, when multidivisional structured, entities showed a predisposition to budgetary freedom with a collaborative profile of innovation management that is very frequent in automobiles. E33 stands out, stating "The staff has innovated in the organizational structure so that it generates collaboration and generation of innovation in an agile, efficient and focused way". Among energy companies, sustainability is a vector for the development of decentralized projects focused in services, start-up structures, technology verticals and applied technology centers which may generate extra revenue by offering innovative and digital services.

Practices and routines for transforming data and information into creative and innovative solutions were only weakly observed where there is no decentralization. In general, there is no recurrent practice of knowledge management performed in a way that knowledge is transferred among the involved and connected actors. This indicates that using *dashboards* and real-time monitoring platforms does not guarantee the synergistic effect on innovation projects and the creation of new products. This explains the difficulty of these entities in adhering to the practice of open innovation because they have not learned to deal with the risks and uncertainties of this innovation procedure.

There is no applied research in new domains in the analyzed environments. This is a gap for future investigations. Another example of capabilities that need to be developed concerns using artificial intelligence. While AI refers to the ability of a system to correctly interpret, learn and use external data, achieving specific goals and tasks through flexible adaptation is a critical success factor for DT and the readiness of the business model for digital operation. Except for automotive innovation projects based on autonomous vehicles (cars driven by intelligent systems without drivers) and eVTOLs (a combination of a flying car and an electric helicopter), the potential of AI has been little explored.

The energy industry has demonstrated above-average supply chain orchestration capabilities. It is possible that the regulation of the sector, which establishes minimum levels of investment in research and development, has contributed to the *seizing capabilities*. It was observed that different actors and companies in the energy generation and distribution system have a high technological capacity in their processes, products, and services. As a result, many machines, equipment, and systems have increased the scope

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and functionality of energy service due to partnerships in the innovation chain, with the advantage of reasonable costs and excellent reliability of operations.

The service industry also observed the integration of the supply chain as an element of DT. However, unlike energy companies, the most significant impact of these capabilities occurred in the reconfiguration of business models, depending on the end customer. Greater *sensing capacity* suggests an advantage in using information sources from the platforms for project intelligence, with intense personalization in electronic channels and customer relationships. The service in digital channels is a sideboard of strategic information. The elimination of intermediaries and the participation of industries directly in the retail market was also an example of the construction of new capacities to operationalize a digital strategy, of direct relationship between industry and consumer.

A truck assembler corroborates this statement, noting that

> DT comes to the outputs for all channels [...] we had to modernize and have sales channels. Since the free market that we have, I don't think so many applications have been created to provide services.

This relationship is also characterized by the offer of complementary services, as a way of differentiation or even as an additional source of revenue.

Overall, users' IT knowledge and experience is a significant enabler of manufacturing digitization, as they can facilitate the implementation of advanced and more effective technologies by reducing the degree of uncertainty. Table 3 provides evidence that enabling technologies to anticipate vulnerabilities and, as indicated in Table 1, result in benefits by capturing and retaining opportunities for business evolution. In this decision-making logic, agility is an essential component and is associated with the potential of this anticipation by IT capacity (Ravichandran, 2018).

Secondary data revealed a link between platforms and financial performance (Tabela 3). Monetization issues are being overcome due to the focus on user experience, as customers perceive value creation. Among the entities, when decision-making is guided by data and intelligence (11 entities that have digital or complementary platforms in the business), all digital services are related to marketing communication in an integrated way. And social media allow vertical digital integration, targeting a multifaceted platform complexity.

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Table 3

Financial performance and seizing indicators

Entity	ROE (2020)	ROE (2019)	EBITDA (2020)	EBITDA (2019)
Compressor manufacturer	9,5%	5,8%	$ 1.884.000.000,00	$ 1.814.000.000,00
Manufacturer of generation eq.	18,3%	20,2%	R$ 981.000.000,00	R$ 664.000.000,00
Tractor manufacturer	11,5%	14,0%	€ 258.754,00	€ 190.117,00
Cockpit supplier	3,2%	20,0%	R$ 1.678.800.000,00	R$ 2.404.300.000,00
Supplier of wires machines	19,2%	5,0%	€ 1.125.400.000,00	€ 2.403.500.000,00
Power generation	22,2%	31,0%	R$ 4.500.000.000,00	R$ 2.430.000.000,00
Digital innovation platform	2,7%	3,2%	R$ 45.000,00	R$ 79.000,00
Food security	11,8%	15,0%	$ 88.745.000,00	$ 69.456.000,00
Streaming service	28,2%	28,5%	$ 15.508.000.000,00	$ 11.924.000.000,00
Telecommunications	3,0%	1,3%	R$ 240.400.000,00	R$ 246.800.000,00
Sports vehicles	7,4%	25,1%	€ 2.987.000.000,00	€ 4.944.000.000,00

Source: Elaborated by the authors.

However, the *seizing capabilities* indicated the development of business models with a unique offering, exclusive and intelligent products, and services with a customized experience in four entities. A director of new streaming services products highlights that

> […] the way in which competitive difference is maintained has a lot to do with the ability to analyze customer data and use it to your advantage [...] what you see in your login is different from all other logins, they have like more than 20 covers for the same movie selected according to your user profile.

The previously highlighted digital solutions return with evidence of seizing and strengthening the importance of platforms for transforming and using the internet of things/services in business modeling with average frequency.

Consequently, it is noted that DT can be defined as a driver of know-how, and in addition, the patent development process and protection are associated (Table 2). On the other hand, integrating digital services on platforms

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showed moderate evidence concerning relevant cases in the dynamics of DT (Appendix 5). In the performance analysis, it is observed that organizations that enhance the culture for DT were better for implementing changes, as they could face better barriers to developing dynamic capability. A prominent external factor was associated with the mobility achieved by digitalization with less impact on the environment, on which digital services are responsible for capturing these investments justified by their carbon neutrality (Appendix 6).

FINAL REMARKS

This article investigated organizations in the automotive, energy, and digital services sectors to understand how to accelerate digital transformation and drive innovations in digital services in the *modus operandi* of dynamic capability development. Two theoretical propositions (Table 4) were elaborated to guide the reflection on the emphasized theme.

As for the first theoretical proposition – organizations can be effective learners and can accelerate the changes when they skillfully use the digital and analytical resources of digital platforms and ecosystems –, the relevance of learning associated with the applied use of 4.0-based technologies, as the strategic way of promoting an agile digital transformation. Its application in business operations offers differentiation and business opportunities to compete globally (Chen et al., 2019). The application of large-volume data analysis techniques presupposes that it is considered a precedent source of knowledge management.

Regarding the second theoretical proposition –the influence of integration by agile resources is a critical factor for DT in organizations which are operating in the territory of Brazil and, in particular, when driven by the synergistic effects using platforms and ecosystems –, it was observed that the technological advancement of industry 4.0 and digital transformation allows the creation of specific capabilities, which are considered critical for the effectiveness of service platforms. Among these capabilities, the most observed was the ability to be agile, revealing itself as a specific competitive factor when it becomes a dynamic capability. Industry 4.0 policies and reduced transaction costs can expedite benefits for firms and subsidiaries. This transaction cost reduction can be achieved by orchestrating platforms and ecosystems relating and integrating multiple levels of knowledge sources.

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Table 4

Evidences consolidation per proposition

Proposition	Description	Enterviews (mentioned cases)	Internal documents (citations)	Public data (citations)
P1	Automotive	9	32	133
	Energy	6	17	90
	Services	15	13	58
	Incidence	30 from 40	62 from 66	281 from 333
	Representativeness	75%	94%	84%
P2	Automotive	9	9	12
	Energy	5	9	5
	Service	7	12	7
	Incidence	21 from 40	30 from 32	24 from 24
	Representativeness	53%	94%	100%

Source: Elaborated by the authors.

Platforms and ecosystems are associated with creating value to obtain sustained competitive advantages through knowledge creation by their interactions in the practices and routines established in the *sensing* and *seizing* of opportunities. It also reinforces the assumption that organizations' dynamic capabilities can be complementary, which can improve these innovative ways of creating value.

Regarding this investigated complementarity, evidence contributed to deepening the relationship between digital governance and dynamic capability with organizational agility. Elements that promote partnerships in developing projects with suppliers and complementary businesses for digital management were explored. Digital acceleration mechanisms were identified to understand which routines and development systems of each subcategory of dynamic capabilities were solidified by digital technologies, with an emphasis on *the digitization* of processes – *digitization* for a new business model with *servitization singularities*. The sub-categorization raised elements in the field to identify factors associated with organizational agility in digital seizing.

However, complementary assets can arise from the exchange between market scanning, externalizing other sources of knowledge, and decreasing

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information asymmetry. Artificial intelligence adds to more complex and assertive decision-making. An essential theoretical contribution can realize long-term benefits in innovation within new markets and new consumer needs by exploring behavioral patterns abstracted from machine learning hypotheses.

Among the analyzed cases, agility does not presuppose strong dynamic capabilities in *sensing*, as it depends on maturity in *servitization*. It is related to the mediation of the applied use of intangible resources and digitized assets that speed up the mobilization and transformation of the business. It is suggested to understand how they are involved in new domains in the analyzed environments as a particular gap for future investigations.

Limits of research and future studies

It is noteworthy that analysis and discussions are referred to a particular context, limited to the chosen cases, and other different categories could be added to explore new approaches in the research on strategic capabilities. Thus, generalization can be investigated quantitatively.

Service companies do not exhibit organizational behavior like product manufacturers or sellers. Intangibility can reveal creatively developed complementary assets. In this sense, new research strategies are explored, including, for example, the creative economy or public services, in which new contexts can lead to the construction of competitive elements. It is also proposed, in future works, to examine the investigation of digital knowledge assets with coordination of economic activities across national borders.

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APPENDIX 1

Characterization of data sources

Entity	Description	Synchronous interactions	Responsible for digital transformation	Primary data	Secondary data	
				Transcription duration	Documents (total)	Public documents (total)
E1	Brazilian transnational conglomerate	1	CEO of corporate start-up	1h30min - 2,045 words	5	45
E2	Spin off of American multinational	1	Operations Manager	1h2min - 1,222 words	5	39
E3	Global bank	1	Manager (DT)	1h5min - 1,345 words	8	34
E4	Global digital bank	1	Manager (DT)	58 min - 1,200 words	12	24
E5	South American multinational	1	President	57 min - 1,113 words	1	6
E6	German multinational	1	Chief Operating Officer	57 min - 1,117 words	4	28
E7	Applied technology company	2	Consultant specialist	1h2min - 1,193 words	4	18
E8	Applied technology company	2	Consultant specialist	1h3min - 1,147 words	5	13
E9	German multinational	1	Operations Manager	59 min - 1,306 words	8	28
E10	American multinational	3	Industrial Engineering Manager	3h7min - 9,328 words	13	48
E11	Japanese multinational	2	R&D and Manufacturing Managers	2h3min - 2,496 words	7	38
E12	Brazilian multinational	1	Director of Innovation	1h2min - 1,089 words	10	28
E13	Chilean multinational	1	Industrial Operations Manager	1h12min - 1,423 words	14	29

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Characterization of data sources (continuation)

Entity	Description	Synchronous interactions	Responsible for digital transformation	Primary data	Secondary data	
				Transcription duration	Documents (total)	Public documents (total)
E14	American multinational	2	Improvement and Innovation Managers	2h12min - 2,267 words	12	31
E15	Italian multinational	2	HR and DT Directors	2h3min - 2,522 words	12	28
E16	American multinational	1	Industrial Engineering Manager	3h7min - 9,328 words	14	23
E17	American multinational	2	Operations Manager	2h2min - 2,118 words	13	32
E18	German global family business	2	Industrial Project Manager	2h7min - 6,722 words	3	38
E19	French multinational	2	Chief Operating Officer	2h22 min - 1,822 words	8	39
E20	German multinational	1	Industrial Commercial Manager	58 min - 1,209 words	2	14
E21	National mixed economic holding	1	Digital Transformation Director and Operations Supervisor	1h45min - 3,800 words	28	123
E22	Entity without profitable funs	1	President of Institute	1h12min - 1,422 words	29	68
E23	Japanese multinational	1	General Manager of Quality	59 min - 1,321 words	5	27
E24	German multinational	1	Digital Services Officer	1h4min - 1,339 words	22	45
E25	American multinational	1	Digital Transformation Officer	1h15min - 1,507 words	12	47
E26	South American theme park	2	Director of Innovation	1h49min - 1,792 words	2	27
E27	Specialized digital services company	1	Chief Executive Officer	1h12min - 1,377 words	2	23

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Characterization of data sources (conclusion)

Entity	Description	Synchronous interactions	Responsible for digital transformation	Primary data	Secondary data	
				Transcription duration	Documents (total)	Public documents (total)
E28	Digital innovation ecosystem	2	Chief Ecosystem Officer and Operations Manager	2h37min - 8,000 words	4	38
E29	American multinational	1	Director of Innovation	1h4min - 1,439 words	12	62
E30	Private power generator	2	DT Director	2h11min - 2,423 words	28	73
E31	Private renewable energy generator	2	HR and DT Managers	2h38min - 3,128 words	37	52
E32	Empresa familiar francesa	3	Vice president of Digital Services	3h8min - 8,600 words	12	57
E33	U.S. global technology company	1	New Product Director	1h7min - 1,067 words	4	16
E34	Applied technology company	2	Partner	1h34min - 1,537 words	2	10
E35	Specialized digital services company	1	Project Manager	59min - 973 words	4	22
E36	Spin off digital services	2	Chief Executive Officer	1h52min - 1,893 words	4	22
E37	Applied technology company	1	Director of Digital Services	1h5min - 1,287 words	5	21
E38	Start-up of digital services	1	Chief Executive Officer	59 min - 1,019 words	3	18
E39	National family business	2	Director of Innovation	2h5min - 4,013 words	18	56
E40	German multinational	1	Digital Transformation Officer	58min - 1,223 words	18	39

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APPENDIX 2

Semi-structured interview protocol

Digital transformation	1. Describe what the company's digital transformation journey has been like. 2. Have the actions been worked on at the strategic level and in the business model? a) Was it conducted in a market-imposed manner? b) In case of branches, was there a pilot project/pilot plant with replicable models? c) Is there a specific sector dealing with this issue in the company? 3. Describe how the company's reaction was during the pandemic (critical event and decision-making skills). How has scanning helped this process? 4. What is the reason for adopting these strategic actions in the digital flow? 5. What is the role of digital platforms as a strategic resource? Is the company embedded in an ecosystem? 6. What are the perceived benefits and limitations of this process of change in the company? What is the role of leadership in this journey? 7. Which routines were impacted by digitization? 8. Which performance metrics have benefited the most from TD?
Dynamic capabilities (sensing, seizing, and transforming)	9. Describe the company's innovation process. 10. What are the innovation management processes in the company? 11. Is there a department responsible for innovation? How are routines in this sense? a) Does the company invest in R&D/C&T? b) Are there partnerships with other institutions (e.g. start-ups, universities and NGOs)? 12. What is the participation of employees (external or not), suppliers and customers in innovation projects? 13. In relation to intellectual property: does the company already have a patent or application process? 14. How the company's product/service development processes are conducted. 15. How was the impact of TD, I4.0 on the company's innovations? Which performance metrics contributed the most? 16. How does the recovered data contribute to the generation of knowledge and insights for innovation projects? 17. Describe the day-to-day regarding innovation in the company: a) Routines and tools applied b) Development environment c) Launch and monitoring of performance

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Semi-structured interview protocol (conclusion)

Enabling technologies and platforms/ ecosystems	I4.0 Enabling technologies 18. Describe the adoption of industry 4.0 enabling technologies on this digital transformation journey. 19. What enabling technologies do you already adopt? What is the criterion for these choices? a) Big data b) Iot c) IA/ML d) Cloud e) Cyber security f) Robots g) Integration h) Other 20. What are they pretensions to adopt? How these projects are made feasible? 21. What are the future goals and plans for the creation of a 4.0 system? 22. How have information security been performed in the company? a) How has data protection law affected the company's operations? b) How dependent on cloud storage is? c) How is the degree of digital integration of the company? 23. Were company employees prepared for technological change? What skills and competences have been/should be developed? 24. What is the relationship between the adoption of technology and the company's customers/suppliers? 25. How was the impact or recovery of investments by the company? How is it possible to carry out projects on time? 26. Benefits considered in the adoption of I4.0. Platforms and ecosystems 27. Describe your relationship with digital platforms and ecosystems. 28. What is the contribution of the platform's resource to the company's performance and innovation? 29. What are the actors of the adopted ecosystem? 30. What is the company's relationship with start-ups and spin offs? 31. In case of existence of a matrix how are the information of the platforms and innovation projects in this type of digital environment being worked?

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APPENDIX 3

Standards protocol for data analysis

Categories (nodes)	Subcategories (subnodes)	Node analysis criteria for subnodes
SS – Sensing (Teece, 2007): to identify scanning, learning and interpretation activities that allow access to information and knowledge that can create opportunities. This identification of opportunities involves the search in different technology markets in order to understand a latent demand, the evolution of a sector and a market and competitors and suppliers in that market.	Demonstrate the existence of processes to target internal R&D and select new technologies.	STRONG: to present evidence of the four subprocesses; AVERAGE/STRONG: present evidence in at least three subprocesses; AVERAGE: present evidence in at least two subprocesses; WEAK: present evidence in at least two subprocesses.
	Demonstrate the existence of processes to explore developments in exogenous science and technology.	
	Demonstrate the existence of processes to touch innovation in Supplier and Complementary Business.	
	Demonstrate the existence of processes to identify target market segments, changes in customer needs and customer innovation driven by TD.	
SZ – Seizing (Teece, 2007): for the understanding of the company's responsiveness to the environment, culminating in investments in opportunities discovered by sensing and improving business model that meets the needs of customers and that provides the organization to capture value.	Demonstrate the design of the Customer Solution and the Business Model for digital in the value offer, breakdown of servitude, digitization and digitization of processes.	
	Selection of decision-making protocols based on digital technology and I4.0.	
	Demonstrate the selection of corporate boundaries to manage add-ons and control platforms, with phase in digitization.	
	Demonstrate the construction of loyalty and commitment through the development of routine actions of a digital nature.	

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Standards protocol for data analysis (conclusion)

Categories (nodes)	Subcategories (subnodes)	Node analysis criteria for subnodes
TD – Digital Transforming (Teece, 2007): to understand and classify how (factors formed by processes, positions and trajectories) and because (effects) organizations are distinct in decision making and obtain results that seem similar, although they deal with very different internal processes. They contribute to performance when the organization understands the environment and future needs, making impartial and timely investment decisions within an appropriate business model designed, promoting learning, restructuring systems that no longer work and implementing good governance.	Decentralization and Quasi Decomposition in the face of service and response to changes, adoption of technologies and degree of centralization of the decision-making process.	STRONG: to present evidence of the four subprocesses; AVERAGE/STRONG: present evidence in at least three subprocesses; AVERAGE: present evidence in at least two subprocesses; WEAK: present evidence in at least two subprocesses.
	Governance that includes processes of integration of external know-how, learning, sharing and integration of knowledge.	
	Co-expertise in analyzing why organizations develop and use a specialized and co-specialized combination of assets.	
	Knowledge management that organizes the main policies, processes and management and technological tools, for a better understanding of the processes of generation, identification, validation, dissemination, sharing, protection and use of knowledge to generate results.	
Agility (Weber &Tarba, 2014), is understood as actions carried out in a changing environment – non-routine and irregular – fast and unpredictable, quickly adapting successfully to this disruptive environment in order to invest in resources to maintain high levels of flexibility.	SSA – Demonstrate the existence of generative sensing, abductive reasoning and meaning creation, use of scenario planning and the "purchase" of real options (Teece et al, 2016).	PRESENT: present at least one evidence in the subnode between the category and the subcategory (agility capabilities).
	SZA – Demonstrate the existence of the preservation of agility, including flexible sourcing arrangements (vertical integration), opening space "in the organization itself, reengineering hierarchies linked to rules and" adopting open innovation processes (Teece et al, 2016).	
	TDA – Identify the continuous process of using new digital technologies in everyday organizational life, which recognizes agility as the central mechanism for the strategic renewal of an organization's business model, collaborative approach and culture (Warner & Wäger, 2019).	

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APPENDIX 4

Entities and theoretical saturation

Entity	Sensing (SS) strength	Agile SS	Solution and model (DT)	Seizing (SZ) strength	Agile SZ	Strategic governance	Knowledge management	Digital tranformation (DT) strength	Agile TD
Brazilian bank	Strong	No	Process digitalization	Average to strong	No	Present	Absent	Average	No
Manufacturer of electric harnesses	Strong	No	Innovation model	Average	No	Absent	Learning	Average to strong	No
Manufacturer of hygiene and cleaning products	Strong	No	Process digitalization	Average	No	Absent	Learning	Average	No
Electrical systems manufacturer	Strong	No	Innovation model	Average	No	Absent	Learning	Average to strong	No
Production of automotive banks	Strong	No	I4.0 model	Average	No	Absent	Learning	Average to strong	No
Truck and bus assembler	Strong	Yes	Process digitalization	Average to strong	No	Absent	Learning	Average	No
Interconnection supplier	Strong	Yes	Process digitalization	Average	No	Absent	Learning	Average to strong	No
Aluminium	Strong	Yes	IoT solution	Average to strong	No	Absent	Integration	Average to strong	No
Generation and distribution equipment	Strong	Yes	I4 model	Strong	Yes	Absent	Protection	Average to strong	Yes
Manufacturer of rings and pistons	Strong	Yes	IoT solution	Strong	Yes	Absent	Protection	Average	No
Tractor manufacturer	Strong	Yes	IoT solution	Strong	Yes	Absent	Protection	Average to strong	Yes
Supplier of wire processing machines	Strong	Yes	Digital solutions	Strong	Yes	Present	Protection	Average to strong	Yes

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Entities and theoretical saturation (continuation)

Entity	Sensing (SS) strength	Agile SS	Solution and model (DT)	Seizing (SZ) strength	Agile SZ	Strategic governance	Knowledge management	Digital tranformation (DT) strength	Agile TD
Home car assembler	Strong	Yes	I4.0 model	Strong	Yes	Absent	Protection	Average	No
Public power generation	Strong	No	Digital solutions	Strong	Yes	Present	Know-how	Average to strong	No
Private power generation	Strong	No	Innovation model	Strong	Yes	Present	Know-how	Average to strong	No
Private power generation	Strong	No	Innovation model	Strong	Yes	Present	Know-how	Average to strong	No
Robotics and automation services	Strong	No	IoT solution	Strong	Yes	Absent	Know-how	Average	No
Global digital services platform	Strong	No	Platform model	Strong	Yes	Absent	Know-how	Average	No
Global video and educational services platform	Strong	No	Singularity	Strong	Yes	Absent	Know-how	Average to strong	No
National automation services	Strong	No	Process digitalization	Strong	Yes	Absent	Know-how	Average	No
Global digital innovation ecosystem	Strong	No	Platform model	Strong	Yes	Present	Know-how	Strong	Yes
Aerospace – global platform	Strong	No	Platform model	Average to strong	No	Present	Know-how	Strong	Yes
National gamification services	Weak	No	Process digitalization	Average to strong	No	Absent	Know-how	Weak	No
RFID digital services	Average	No	Process digitalization	Average to strong	No	Absent	Know-how	Weak	No
Supplier of electrical cables	Average	No	Process digitalization	Average	No	Absent	Know-how	Weak	No

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Entities and theoretical saturation **(conclusion)**

Entity	Sensing (SS) strength	Agile SS	Solution and model (DT)	Seizing (SZ) strength	Agile SZ	Strategic governance	Knowledge management	Digital tranformation (DT) strength	Agile TD
Chassis supplier	Average to strong	No	Process digitalization	Average	No	Absent	Know-how	Weak	No
National reference in DT	Weak	No	Digital solutions	Average to strong	No	Absent	Know-how	Weak	No
Oriental car maker	Average to strong	No	Process digitalization	Weak	No	Absent	Know-how	Weak	No
National theme park	Average to strong	No	Process digitalization	Average to strong	No	Absent	Know-how	Weak	No
Digital bank	Average	No	Digital bank model	Average to strong	No	Present	Know-how	Weak	No
International equipment distributor	Average to strong	Yes	Process digitalization	Average to strong	Yes	Absent	Know-how	Weak	Yes
National reference in energy transition	Weak	No	Absent	Weak	No	Absent	Know-how	Weak	No
National industry reference 4.0	Weak	No	Absent	Weak	No	Absent	Know-how	Weak	No
Telecommunication service	Strong	No	Singularity	Strong	Yes	Present	Know-how	Strong	Yes
Sports vehicles	Strong	Yes	Singularity	Strong	Yes	Present	Know-how	Strong	Yes
Food security	Strong	No	Digital solutions	Strong	Yes	Present	Know-how	Strong	Yes
Global streaming platform	Strong	No	Singularity	Strong	Yes	Present	Know-how	Strong	Yes
Power generation equipment manufacturer	Strong	No	Digital solutions	Strong	Yes	Present	Know-how	Strong	Yes
Cockpit supplier	Strong	Yes	Digital solutions	Strong	Yes	Present	Protection	Strong	Yes
Compressor manufacturer	Strong	Yes	Digital solutions	Strong	Yes	Present	Protection	Strong	Yes

APPENDIX 5

Data triangulation of analyzed entities

Entity	R&D	C&T process	Supplier and complementary innovation	Change identification	Sensing (SS) strength	Agile SS	Solution and model (digital transformation)	Add-ons and control platforms	Protocols and decision
Brazilian bank	Present	Present	Present	Present	Strong	No	Process digitalization	Digital platform	Present
Manufacturer of electric harnesses	Present	Present	Present	Present	Strong	No	Innovation model	Complements	Present
Manufacturer of hygiene and cleaning products	Present	Present	Present	Present	Strong	No	Process digitalization	Complements	Absent
Electrical systems manufacturer	Present	Present	Present	Present	Strong	No	Innovation model	Complements	Present
Production of automotive banks	Present	Present	Present	Present	Strong	No	I4.0 model	Complements	Present
Truck and bus assembler	Present	Present	Present	Present	Strong	Yes	Process digitalization	Digital Platform	Present
Interconnection supplier	Present	Present	Present	Present	Strong	Yes	Process digitalization	Complements	Present
Aluminium	Present	Present	Present	Present	Strong	Yes	IoT solution	Digital platform	Present
Generation and distribution equipment	Present	Present	Present	Present	Strong	Yes	I4.0 model	Both	Present
Manufacturer of rings and pistons	Present	Present	Present	Present	Strong	Yes	IoT solution	Both	Present
Tractor manufacturer	Present	Present	Present	Present	Strong	Yes	IoT solution	Both	Present

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Data triangulation of analyzed entities (continuation)

Entity	R&D	C&T process	Supplier and complementary innovation	Change identification	Sensing (SS) strength	Agile SS	Solution and model (digital transformation)	Add-ons and control platforms	Protocols and decision
Supplier of wire processing machines	Present	Present	Present	Present	Strong	Yes	Digital solutions	Both	Present
Home car assembler	Present	Present	Present	Present	Strong	Yes	I4.0 model	Both	Present
Public power generation	Present	Present	Present	Present	Strong	No	Digital solutions	Both	Present
Private power generation	Present	Present	Present	Present	Strong	No	Innovation model	Both	Present
Private power generation	Present	Present	Present	Present	Strong	No	Innovation model	Both	Present
Robotics and automation services	Present	Present	Present	Present	Strong	No	IoT solution	Both	Present
Global digital services platform	Present	Absent	Absent	Present	Strong	No	Platform model	Both	Present
Global video and educational services platform	Present	Absent	Absent	Present	Strong	No	Singularity	Both	Present
National automation services	Absent	Present	Present	Present	Strong	No	Process digitalization	Both	Present
Global digital innovation ecosystem	Absent	Absent	Absent	Present	Strong	No	Platform model	Both	Present
Aerospace – global platform	Present	Present	Present	Present	Strong	No	Platform model	Digital platform	Present
National gamification services	Absent	Absent	Absent	Present	Weak	No	Process digitalization	Digital platform	Present

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Data triangulation of analyzed entities (continuation)

Entity	R&D	C&T process	Supplier and complementary innovation	Change identification	Sensing (SS) strength	Agile SS	Solution and model (digital transformation)	Add-ons and control platforms	Protocols and decision
RFID digital services	Present	Absent	Absent	Present	Average	No	Process digitalization	Digital platform	Present
Supplier of electrical cables	Present	Absent	Absent	Present	Average	No	Process digitalization	Complements	Absent
Chassis supplier	Present	Present	Absent	Present	Average to strong	No	Process digitalization	Complements	Absent
National reference in DT	Present	Absent	Present	Present	Weak	No	Digital solutions	Digital platform	Present
Oriental car maker	Present	Present	Absent	Present	Average to strong	No	Process digitalization	Absent	Absent
National theme park	Present	Absent	Present	Present	Average to strong	No	Process digitalization	Digital platform	Present
Digital bank	Present	Absent	Absent	Present	Average	No	Digital bank model	Digital platform	Present
International equipment distributor	Absent	Present	Present	Present	Average to strong	Yes	Process digitalization	Digital platform	Present
National reference in energy transition	Present	Absent	Absent	Present	Weak	No	Absent	Absent	Absent
National industry reference 4.0	Present	Present	Absent	Present	Weak	No	Absent	Absent	Absent
Telecommunication service	Present	Present	Present	Present	Strong	No	Singularity	Both	Present
Sports vehicles	Present	Present	Present	Present	Strong	Yes	Singularity	Both	Present

(continue)

Data triangulation of analyzed entities **(continuation)**

Entity	R&D	C&T process	Supplier and complementary innovation	Change identification	Sensing (SS) strength	Agile SS	Solution and model (digital transformation)	Add-ons and control platforms	Protocols and decision
Food security	Present	Present	Present	Present	Strong	No	Digital solutions	Both	Present
Global streaming platform	Present	Present	Present	Present	Strong	No	Singularity	Both	Present
Power generation equipment manufacturer	Present	Present	Present	Present	Strong	No	Digital solutions	Both	Present
Cockpit supplier	Present	Present	Present	Present	Strong	Yes	Digital solutions	Both	Present
Compressor manufacturer	Present	Present	Present	Present	Strong	Yes	Digital solutions	Both	Present

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Data triangulation of analyzed entities (continuation)

Entity	Loyalty and commitment	Seizing (SZ) strength	Agile SZ	Decentralization and quasi decomposition	Co-specialization	Strategic governance	Knowledge management	DT strength	Agile DT
Brazilian bank	Present	Average to strong	No	Absent	Present	Present	Absent	Average	No
Manufacturer of electric harnesses	Present	Average	No	Present	Present	Absent	Learning	Average to strong	No
Manufacturer of hygiene and cleaning products	Present	Average	No	Absent	Present	Absent	Learning	Average	No
Electrical systems manufacturer	Present	Average	No	Present	Present	Absent	Learning	Average to strong	No
Production of automotive banks	Present	Average	No	Present	Present	Absent	Learning	Average to strong	No
Truck and bus assembler	Absent	Average to strong	No	Absent	Present	Absent	Learning	Average	No
Interconnection supplier	Present	Average	No	Present	Present	Absent	Learning	Average to strong	No
Aluminium	Present	Average to strong	No	Present	Present	Absent	Integration	Average to strong	No
Generation and distribution equipment	Present	Strong	Yes	Present	Present	Absent	Protection	Average to strong	Yes
Manufacturer of rings and pistons	Present	Strong	Yes	Absent	Present	Absent	Protection	Average	No
Tractor manufacturer	Present	Strong	Yes	Present	Present	Absent	Protection	Average to strong	Yes

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Data triangulation of analyzed entities (continuation)

Entity	Loyalty and commitment	Seizing (SZ) strength	Agile SZ	Decentralization and quasi decomposition	Co-specialization	Strategic governance	Knowledge management	DT strength	Agile DT
Supplier of wire processing Machines	Present	Strong	Yes	Absent	Present	Present	Protection	Average to strong	Yes
Home car assembler	Present	Strong	Yes	Absent	Present	Absent	Protection	Average	No
Public power generation	Present	Strong	Yes	Absent	Present	Present	Know-how	Average to strong	No
Private power generation	Present	Strong	Yes	Absent	Present	Present	Know-how	Average to strong	No
Private power generation	Present	Strong	Yes	Absent	Present	Present	Know-how	Average to strong	No
Robotics and automation services	Present	Strong	Yes	Absent	Present	Absent	Know-how	Average	No
Global digital services platform	Present	Strong	Yes	Present	Present	Absent	Know-how	Average	No
Global video and educational services platform	Present	Strong	Yes	Present	Present	Absent	Know-how	Average to strong	No
National automation services	Absent	Strong	Yes	Absent	Present	Absent	Know-how	Average	No
Global digital innovation ecosystem	Present	Strong	Yes	Present	Present	Present	Know-how	Strong	Yes
Aerospace – global platform	Present	Average to strong	No	Present	Present	Present	Know-how	Strong	Yes

(continue)

Data triangulation of analyzed entities (continuation)

Entity	Loyalty and commitment	Seizing (SZ) strength	Agile SZ	Decentralization and quasi decomposition	Co-specialization	Strategic governance	Knowledge management	DT strength	Agile DT
National gamification services	Present	Average to strong	No	Absent	Present	Absent	Know-how	Weak	No
RFID digital services	Present	Average to strong	No	Present	Present	Absent	Know-how	Weak	No
Supplier of electrical cables	Absent	Average	No	Absent	Present	Absent	Know-how	Weak	No
Chassis supplier	Absent	Average	No	Absent	Present	Absent	Know-how	Weak	No
National reference in DT	Present	Average to strong	No	Absent	Present	Absent	Know-how	Weak	No
Oriental car maker	Present	Weak	No	Absent	Present	Absent	Know-how	Weak	No
National theme park	Present	Average to strong	No	Absent	Present	Absent	Know-how	Weak	No
Digital bank	Present	Average to strong	No	Absent	Present	Present	Know-how	Weak	No
International equipment distributor	Present	Average to strong	Yes	Present	Present	Absent	Know-how	Weak	Yes
National reference in energy transition	Absent	Weak	No	Absent	Absent	Absent	Know-how	Weak	No
National industry reference 4.0	Absent	Weak	No	Absent	Absent	Absent	Know-how	Weak	No
Telecommunication service	Present	Strong	Yes	Present	Present	Present	Know-how	Strong	Yes

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Data triangulation of analyzed entities **(conclusion)**

Entity	Loyalty and commitment	Seizing (SZ) strength	Agile SZ	Decentralization and quasi decomposition	Co-specialization	Strategic governance	Knowledge management	DT strength	Agile DT
Sports vehicles	Present	Strong	Yes	Present	Present	Present	Know-how	Strong	Yes
Food security	Present	Strong	Yes	Present	Present	Present	Know-how	Strong	Yes
Global streaming platform	Present	Strong	Yes	Present	Present	Present	Know-how	Strong	Yes
Power generation equipment manufacturer	Present	Strong	Yes	Present	Present	Present	Know-how	Strong	Yes
Cockpit supplier	Present	Strong	Yes	Present	Present	Present	Protection	Strong	Yes
Compressor manufacturer	Present	Strong	Yes	Present	Present	Present	Protection	Strong	Yes

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