Digital Innovation through LGPD Compliance: Transforming Business Models and Infrastructure in Brazilian Companies

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This study explores how compliance with Brazil's General Data Protection Law (LGPD) acts as a catalyst for digital innovation in two major companies. Using Dynamic Capabilities and Business Model frameworks, the research examines how the companies transformed their digital infrastructures to manage personal data effectively. The findings reveal that legal compliance drove technological upgrades, including new systems for data pre-processing and governance, fostering operational efficiency. This study highlights how regulatory requirements can trigger innovation, aligning infrastructure with business needs. The results suggest that compliance can enhance competitive advantage, encouraging future exploration of similar impacts across other industries and smaller companies.

Keywords: LGPD; Digital Innovation; Digital Infrastructure; Data Privacy; Brazil.

1. Introduction

New digital technologies are innovating in several areas of companies, industrial or commercial, allowing manual processes and routines to be automated and new functions to be created intelligently for decision-making.

These new requests for the use of technologies come from various stakeholders, whether internal or external, such as government, suppliers, market, and customers, and need their own Digital Infrastructure. In this article, we analyzed what the LGPD (General Data Protection Law, in Portuguese) required of digital infrastructure for the preparation of data for its implementation required by the Digital Infrastructure to prepare data for its implementation.

According to Tilson et al. (2010), Digital Infrastructure is a shared, infinite, heterogeneous, open, and evolving socio-technical system that includes the installed base of infrastructure resources and their user, operational and design communities.

For Berawi et al. [2020], the use of digitalization provides new ways for companies to create added value for business and the modernization of companies, combining digital technologies, physical resources and the creativity of individuals, is an essential step in the innovative transformation of businesses that can constitute a competitive advantage and a Digital Innovation.

Digital Innovation (DI) is challenging both theories and practices in organizational research, and scholars are calling for more research on this. DI management research can be classified under innovation management research, which revolves around organizations. Therefore, the central issue of DI management is still the interaction between DI and organization (Xie et al., 2020). In this context, the research question of this project is Can digital infrastructures to meet the LGPD be considered a digital innovation?

The purpose of this article is to present how two large Brazilian companies had to prepare their digital infrastructures to meet the LGPD in data preparation and why this represents a digital innovation.

To analyze the companies, we adopted the Business Model and Dynamic Capabilities as theoretical lenses to verify how an organization will be able to quickly implement, evaluate and refine new and revised business models due to a new legal requirement like the LGPD.

This article consists of this introduction as an initial section, in section 2- Literature Review, the main theories and concepts used are presented, in section 3- Methodology the methodological procedures used are presented, in Section 4- Results and

Analyzes contains the results of analyzes of the two companies and the last section 5 - Conclusions complete with considerations about the study.

2. Literature Review

In this section we present an overview of the main sections covered in this study such as Digital Innovation, Digital Infrastructure, LGPD and Business Model and Dynamic Capabilities.

2.1 Digital Innovation

Bogers et al. (2022) consider that Digital Innovation is changing the way products and services are developed, produced, and used. For example, innovations using digital technologies allow for the "sharing" of inputs or resources such as cars, tools, and accommodation. These innovations are revolutionizing traditional markets, including media and entertainment, car rental and sales, hotels and hospitality, and even temporary employment.

Xie et al. (2020) in the article "Digital Innovation in Organizational Research: A Systematic Review" define two points of view how Digital Innovation has been classified in the academic literature, the first classification sees it as the use of digital technology/IT in a wide range of innovations and the second classification sees it as a kind of recombination of physical components and digital, as seen in Table 1.

Table 1 *Definitions of Digital Innovation and Two Classifications*

Classifications	Definitions of Digital Innovation
Use of digital technology/IT for innovations	Nambisan et al. (2017): "the creation of (and consequent change in) market offerings, business processes or models that result from the use of digital technology." Saldanha et al. (2017) and Fichman et al. (2014): "broadly defined as a product, process or business model that is perceived as new, requires some changes by adopters and is incorporated or enabled by IT". Shibeika & Harty (2015): "the technologies and associated digital work practices used for the management and delivery of projects under construction".
Recombination of physical and digital components	Yoo et al. (2010): "the realization of new combinations of digital and physical components to produce new products". Huang et al. (2017): "the recombination of digital components in a layered modular architecture to create a new use value for users or potential users of a service". Henfridsson et al. (2018): "the result of activities by which a set of digital resources is recombined in both design and use through connections between value spaces".

Source: *Xie et al. (2020).*

According to Nambisan et al. (2017) digital innovation is the use of digital technology during the innovation process and can be used to describe, in whole or in part, the result of innovation.

Other definition of Nambisan et al. (2017) is Digital Innovation as the creation of (and consequent change in) market offerings, business processes or models that result from the use of digital technology. This definition of Digital Innovation includes a range of innovation outcomes such as new products, platforms, and services, as well as customer experiences and value pathways. Another factor in this definition is a wide range of digital tools and infrastructure such as additive manufacturing and data analytics to make innovation possible. And finally, the definition includes the possibility that the results can be disseminated, assimilated, or tailored to specific contexts of use, as typically experienced with digital platforms.

The impact of Digital Innovations penetrates all aspects of human life beyond organized economic activities, requires the collaboration of academics in areas such as humanities, law, education, and journalism. This expanded perspective towards Digital Innovation research will emphasize not only the social, organizational and management studies that are typically concerned with innovation research, but also all the other fields/disciplines not previously mentioned above, as we seek to advance an understanding more realistic and coherent of the numerous implications of digital innovation on economic, social, behavioral, political, legal, technological, scientific, moral, ethical and scientific issues (Nambisan et al., 2017).

Put another way, in Digital Innovation, digital technologies and associated digitization processes form an innate part of the new idea and/or its development, diffusion or assimilation (Nambisan et al., 2017).

2.2 Digital Infrastructure

The Digital Infrastructure is ingrained in many areas of society, supporting the operations of organizations and entire sectors, and providing the basis for several new services (Rodon & Eaton, 2021). The Digital Infrastructure has undergone reformulations, previously with ICTs, the concept of infrastructure was formed by servers, peripherals, networks, and software, and today with digital technologies, the Digital Infrastructure is composed of digital platforms.

The diffusion of innovation during the Fourth Industrial Revolution (Industry 4.0) reshaped the economic system and brought about structural changes in different economic sectors. These innovations become the basis of society's new Digital Infrastructure (Berawi et al., 2020).

The emergence of a wide range of digital technologies and the ever-expanding digital infrastructures they comprise – including mobile and wearable computing, social media, blockchain, virtual and augmented reality, cloud computing services, data analytics and machine learning, robotics, Internet of Things, and 3D printing – is radically reshaping the nature, process, and outcomes of innovation (Nambisan et al., 2017).

Digital Infrastructure can be defined as the basic information technology and organizational structures, as well as the related services and facilities necessary for the functioning of an industrial or commercial company. These infrastructures can be defined as global, national, regional, industrial, or corporate infrastructure depending on the entity being supported or enabled (Tilson et al., 2010).

According to Ghazawneh (2019), service providers increasingly depend on and use the Digital Infrastructure and tools provided by digital platforms to transform their services and develop digital services that meet the needs of heterogeneous end users.

Ndubuisi et al. (2021) show a strong positive effect of Digital Infrastructure on service sector employment and reveal that the service sector employment effect of Digital Infrastructure depends on a country's institutional and economic conditions. They cite as an example the positive effect of Digital Infrastructure on employment in the services sector increases as institutional quality increases, while poor macroeconomic conditions (measured by the inflation rate) diminish effect of it on employment in the services sector.

2.3 General Law for the Protection of Personal Data (LGPD) in Brazil

Law no. 13,709/2018 or the General Law for the Protection of Personal Data, known as the LGPD, was enacted by the 14th of August 2018 and brings together a series of control items to ensure compliance with the foreseen guarantees whose ballast is based on the protection of human rights concerning personal data (Pinheiro, 2020).

The LGPD provides for the processing of personal data, including in digital media, by a natural person or by a public or private legal entity, with the aim of protecting the fundamental rights of freedom and privacy and the free development of the personality of the natural person (Brasil, 2018).

According to Pinheiro (2020), Law n. 13,709/2018 is divided into 10 Chapters, with 65 articles. Comparatively, it is smaller than its European reference (GDPR), which has 11 Chapters, with 99 articles.

Some terms and concepts, and terminologies brought by the law are fundamental and must be object of harmonization in documents, with special attention to policies, rules, procedures, and contracts (Pinheiro, 2020). Table 2 presents some of these terms and concepts:

Table 2 *LGPD Terms and Concepts*

Term or Concept	Description
Holder	Person to whom the personal data that are subject to some processing refer.
Data treatment	Any operation conducted with any type of handling of personal data: collection, production, reception, classification, use, access, reproduction, transmission, distribution, processing, archiving, storage, editing, elimination, evaluation or control of information, modification, communication, transfer, diffusion, or extraction.
Personal data	All information related to an identified or identifiable person, not limited, therefore, to name, surname, nickname, age, residential or electronic address, and may include location data, license plates, shopping profiles, Internet Protocol (IP) number, academic data, purchase history, among others. Always related to a living natural person.
Sensitive personal data	Data that are related to the characteristics of the individual's personality and personal choices, such as racial or ethnic origin, religious conviction, political opinion, membership of a union or organization of a religious, philosophical or political nature, data referring to health or life sexual, genetic or biometric data, when linked to a natural person.
Anonymized data	These are data relating to a holder who cannot be identified, considering the use of reasonable technical means available at the time of processing.
Anonymization	Use of reasonable technical means available at the time of processing, through which data loses the possibility of association, directly or indirectly, with an individual.
Consent	Free, informed, and unequivocal statement by which the holder agrees with the processing of its personal data for a specific purpose. It is not the only reason that authorizes the processing of data, but only one of the hypotheses.
Treating agents	The controller that receives the personal data of the holders through consent or in cases of exception, and the operator that conducts some processing of personal data motivated by contract or legal obligation.
In charge	Natural person, indicated by the subsidiary, who acts as a communication channel between the controller and the holders and the national authority.
International data transfer	Transfer of personal data to a foreign country or international organization of which the country is a member.

Source: *Pinheiro (2020)*

According to Pinheiro (2020) the LGPD is a principled legislation, that is, it brings a list of principles that need to be met. The best way to analyze the law is by verifying the conformity of the control items, that is, if the control is not present, applied and implemented, then the principle is not met.

In this way, some terms or concepts in Table 1 must comply with the law, for example, the company will have to know where all personal and sensitive data of customers are stored without having implemented the LGPD, being a mandatory pre-processing for comply with legislation.

2.4 Business Model and Dynamic Capabilities

According to Teece (2018), a business model describes an architecture of how a company creates and delivers value to customers and the mechanisms employed to capture a portion of that value. It is a combined set of elements covering cost, revenue, and profit streams. Table 3 presents the business model components found in a study by Alegre & Berbegal-Mirabent (2016).

Table 3. *Business Model Components*

Author	Business model components
Hamel & Ruben (2000)	Basic strategy, strategic resources, customer interface, and value network
Gordijn & Akkermans (2001)	Value, value port, actor, value activity, value exchange, value object, and profitability calculation
Chesbrough & Rosenbloom (2002)	Value proposition, market segment, value chain structure, cost and profit structure, company position within the context of value network, and competitive strategy
Hedman & Kalling (2003)	Customers, competitors, offer, organization activities and resources, supply of inputs and production, and longitudinal process component
Osterwalder et al. (2005)	Value proposition, distribution channel, customer relationships, partner network, and revenue model
Shafer et al. (2005)	Strategic choices, value creation, value capture, and value network
Amit & Zott (2001)	Design elements (content, structure, and governance) and design themes (novelty, lock-in, complementarities, and efficiency)
Casadesus-Masanell & Ricart (2010)	Policy choices, asset options, and governance options
Yunus et al. (2010)	Value proposition (stakeholders and product/service), social profit equation (social profit and environmental profit), value constellation (internal value chain and external value chain), and economic profit equation (sales revenue, costs, and capital employed)
Osterwalder & Pigneur (2010)	Customer segments, value propositions, channels, customer relationships, revenue streams, key resources, key activities, key partnerships, and cost structure

Source: *Alegre & Berbegal-Mirabent (2016)*

The design and operation of a business model depends on the capabilities of the company. The design, improvement, implementation, and transformation of business models are the result of advanced (dynamic) capabilities (Teece, 2018). As mentioned, dynamic capabilities include the detection, capture, and transformation needed to design and implement business models (Teece, 2018).

According to Teece (2018), business models are enabled by dynamic resources in the sense that a dynamically capable organization will be able to quickly implement, evaluate and refine new and revised business models. Successful implementation relies on management architecture design, asset orchestration, and learning functions, which are key dynamic capabilities.

Once in place, a business model shapes strategy as it constrains some actions and facilitates others. By determining costs and profitability, a business model impacts the very viability of a strategy. In case of a conflict between the strategy and the business model, it is up to top management to determine which of the two should change (Teece, 2018).

Dynamic capabilities are the capacity to recognize and evaluate new business opportunities, to form new customers, to build and improve the business model, and to make a profit. They can assist companies in enhancing their habitual abilities by altering and combining resources and directing their habitual abilities toward the partners' habitual abilities (Wang & Photchanachan, 2021).

Dynamic capabilities and strategy combine to create and refine a defensible business model that guides the transformation organizational. Ideally, this leads to an adequate level of profits to allow the company to sustain and enhance its capabilities and resources (Teece, 2018).

Teece (2018) presents the dynamic capabilities framework, a multidisciplinary model of the firm with dynamic capabilities at its core, reflects this interdependence. A simplified version of the framework, omitting feedback channels such as between organization design and dynamic capabilities, is shown in Figure 1 (Teece, 2018).
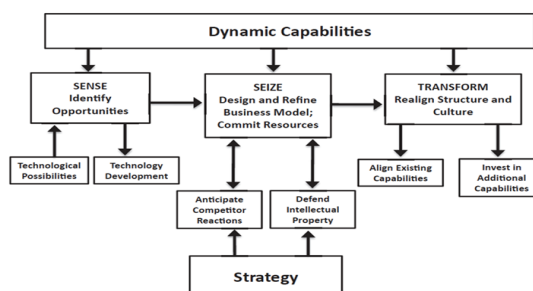

Figure 1 *Simplified Schematic of Dynamic Capabilities, Business Models and Strategy. Source: Teece (2018)*

By combining the practice of dynamic capability with a strategy that creates and refines a defensible business model that guides the organization's change, this would ideally lead to enough profit to improve the capabilities and enjoy benefits, see Figure 2 (Wang & Photchanachan, 2021).
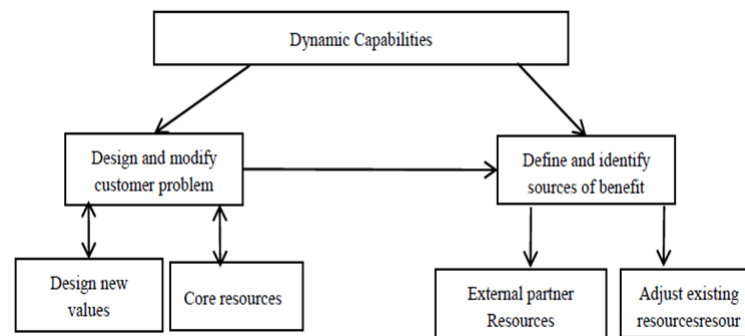

Figure 2. dynamic capabilities and business model built. Source: (Wang & Photchanachan, 2021)

The partnership between business model and Dynamic Capabilities, business model is facilitated by Dynamic Capabilities, which is demonstrated by a dynamic capable organization that can quickly implement, test, and improve a new business model. Its success is based on a comprehensive design of the management architecture, an integrated resource for regulation, and the capacity for learning, which are all considered paramount to dynamic capabilities. Conversely, dynamic capability is also reliant on organizational flexibility that is derived from the business model, and the choice of business model has a significant effect on the degree of organizational flexibility (Wang & Photchanachan, 2021).

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3. Methodology

The research methods used were the bibliographic research to build the theoretical framework with the themes Digital Innovation, Digital Infrastructure and LGPD, and the multiple case study to analyze two large Brazilian companies, which we will call Alpha and Beta, which had to prepare their Digital Infrastructures to meet the LGPD in data preparation.

The research instrument was a script of interviews with open and closed questions and professionals who participated in the implementation of LGPD in companies were interviewed.

The strategy of this research project was the study of multiple cases (Yin, 2015). Conducting this research from this perspective allowed considering the different organizational phenomena in a dynamic way from the perspective of movement, change and temporal evolution (Langley, 2007).

The company Alpha is a large company in the Brazilian financial area, with headquarters in São Paulo and branches in all states and the company Beta is a large Brazilian company in the metal industry with a presence throughout the country.

The following employees from each company were interviewed: A senior manager and a project manager from the IT area of the company Alfa and a junior manager from the security area and a senior developer from the company Beta, all involved with the implementation of the LGPD in their respective organizations.

4. Results and Discussions

The models by Teece (2018) and Wang & Photchanachan (2021) used to evaluate dynamic capabilities and business models have the same theoretical foundation and the indicators are similar, with few indicators changing. We adopted both models as a way of analyzing companies to obtain more details about them.

The research presented as results the digital infrastructures of the Alpha and Beta companies for the preparation of data for the LGPD, the data information such as amount of source of researched data, amount of researched data, types of data (structured and unstructured), amount by data types, total execution time, and details of digital infrastructure, the sequential steps can be seen in Fig. 1, the general LGPD description in Table 1, and the main concepts of de business model in Table 2.

The model by Wang & Photchanachan (2021) presents the initial step of "designing and modifying the customer problem" focusing on designing new value and key resources. On the other hand, Teece's model (2018) initially presents steps such as sense (identify opportunities) and seize (design and refine business model). Comparing the two models, the initial stage of Wang & Photchanachan (2021) corresponds to the sense and seize stages of Teece (2018). In this way, the following indicators were adopted:

4.1 Sense.

Identify opportunities - The mandatory implementation of the LGPD in Alpha and Beta companies due to the enactment of Law n. 13,709/2018 and the need to process customers' personal and sensitive data, warned the responsible teams that they would need computational pre-processing to initially search and identify all occurrences of personal and sensitive data in the companies' systems and storage. Another point that was raised was that depending on the type of data (structured and unstructured) it would require a different pre-processing and would have a different execution time.

Design new value – Companies responded that due to the imposition of the LGPD, as it is a law, the location of personal data in all data storage systems, whether structured or unstructured, will allow a new way of treating the privacy of this data in compliance with the requirements of LGPD, compliance, security and IT governance and fully organized and secure.

Technological possibilities – Both companies had their own ICT teams to carry out the pre-processing, but the computational resources needed to run these new tasks and the development of programs or systems to discover the data would require investments and time to prepare the new Digital Infrastructures, the solutions could be to acquire the entire infrastructure of servers and storage or to contract the platforms or software as services (PaaS or SaaS) and in the case of the program/system for searching personal and sensitive data, the options would be to develop with a team own or hire a market solution.

Technological development - So, Alpha and Beta decided to acquire the digital infrastructures to be installed on their own premises, as they would have better control and as access to data on other servers would require intensive use of networks, the network structures of the headquarters are larger and more efficient for these cases. In the case of programs/systems, the companies decided to hire Delta's system to prospect personal and sensitive data, as this would reduce the times to start pre-processing.

4.2 Seize.

Design and refine business model – The LGPD did not alter or change the business models of Alpha and Beta companies, but its non-implementation may cause legal problems such as the following penalties, and the application criteria must observe some requirements, especially that of proportionality: I – warning, indicating the deadline for adopting corrective measures; II – a simple fine of up to 2% (two percent) of the billing of the private legal entity, group or conglomerate in Brazil in its last fiscal year, excluding taxes, limited in total to R$ 50,000,000.00 (fifty million reais) for infringement; III – daily fine, subject to the total limit referred to in item II; IV – publication of the infraction after its occurrence has been duly investigated and confirmed; V – blocking of the personal data to which the infraction refers until its regularization; VI – deletion of the personal data to which the infraction refers.

Commit resource and Core Resources – Respondents from Alpha and Beta companies pointed out that most of the resources were used to perform pre-processing and illustrated with the following results (Table 4).

Table 4. *Results*

	Alpha	Beta
Amount of source of researched data	1	3 (source A, Source B and Source C)
Total of data in Terabytes	1 Tb	Source A = 13 Tb Source B = 10 Tb Source C = 1.8 Tb
Type of data	Unstructured data	Unstructured Data (Source A and Source B) Structured data (Source C)
Total execution time	50 hours	Source A = 3 months Source B = 2 months Source C = 72 hours
Type of operation	scan	scan

Source: *Research Data*

Respondents pointed out that some operational precautions had to be taken to obtain the best performance as the scan servers were installed in the same datacenters as the scanned file and database servers to reduce network latency and the servers cannot be turned off or interrupted because if the scan process stops, it will have to start again from the beginning.

In the final step, the model by Wang & Photchanachan (2021) brings "Define and identify sources of benefits" based on "resources from external partners" and "adjust existing resources" and the model by Teece (2018) presents Transform (Realign structure and culture) with a focus on aligning existing capacity and investment in additional capital. Based on the models, we define the following indicators:

4.3 Transform.

Realign structured and culture – Respondents felt that the LGPD required both approaches, that is, the alignment (or adaptation) of existing capabilities and the investment in additional capabilities.

The main investments were made in the digital infrastructure, which required new servers, acquisition of licenses from the company Delta for the scanning systems and human resources to operationalize the pre-processing procedures. Alpha and Beta companies did not provide the investments made but provided the server configurations for pre-processing. These settings do not include structured and unstructured data servers.

- Alpha company server: 8 CPUs, 32Gbytes of RAM and 1 Terabytes of disks and quantity = 1
- Beta company server: 8 CPUs, 16Gbytes of RAM and 500 Mbytes of disks and quantities = 3

5. Conclusions

In this article we use the Business Model and Dynamic Capabilities as theoretical lenses to verify how companies were able to quickly implement, evaluate and refine their business models due to a new legal requirement such as the LGPD and what digital infrastructures were necessary to a pre-installation stage for the LGPD.

Digital Infrastructure is an integrated environment where all the elements must communicate to achieve synergy. Companies must embrace digital transformation by acquiring not just part but as many as elements of Digital Infrastructure to succeed in today's complex business environment in going into the future.

This global view reinforces the results and analyzes presented in the research, and lead to the conclusion that new digital technologies increasingly require their own and autonomous Digital Infrastructures to prepare the required scenarios such as the LGPD, as the existing digital infrastructures meet the daily needs of companies and do not are prepared for the new requirements.

The Business Model of Innovation primarily builds on transforming existing resources to exploit the firm's competitive position. Dynamic capabilities are highly relevant to the environmental changes caused by digital transformations, and digital Business Model of Innovation are essential for thriving amidst the ongoing transformations. Thereby, we extend the Business Model of Innovation typology by Foss and Saebi (2017) with the perspective of how diverse types of Business Model of Innovation emerge and find one new type unique to the digital context, in this case, the LGPD implementation, see Böttcher et al. (2022).

Therefore, these new Digital Infrastructures can be considered Digital Innovations, as according to Nambisan et al. (2017), Digital Innovation is the use of digital technology during the innovation process and can be used to describe, in whole or in part, the result of innovation, which in this case is the preparation of data to implement the LGPD.

The limitations of this study are that we only used two large companies, we suggest repeating the research with smaller companies and a larger number of samples.

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