BRAZILIAN DIGITAL TRANSFORMATION STRATEGY

E-Digital

Brasília, 2018

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PRESENTATION

An agenda for the digital society of the future.

The Brazilian Digital Transformation Strategy (E-Digital) is an initiative by the federal government, coordinated by the Ministry of Science, Technology, Innovation and Communications (MCTIC). An Inter-Ministerial Working Group composed by nine government bodies developed this public policy after seven months of meetings, evaluations and experts and public consultations. Additionally, representatives of over thirty entities of the federal government interacted with that core group throughout the process.

The resulting document also reflects the broad engagement of the private sector, the scientific and academic community and civil society through many stages of the elaboration process. Such actors had significant participation in seminars and workshops, and also at the public consultation of the draft document, which received thousands of contributions. This led to a comprehensive review and to improvements to the draft version, now consolidated into an official public policy document.

The rapid changes in the economy and society effected by the digital environment impose new challenges to the government's tasks and responsibilities. This policy proposes strategic actions focused on the role of the government as an enabler of the digital transformation in the economy's productive sectors, as an important contributor for capacity-building in this new era, as well as a service provider and guarantor of rights.

Each thematic axis which composes the E-Digital is explored in detail, according to four dimensions: a broad diagnosis of the current challenges, a vision of the desirable future, a set of strategic actions that bring us closer to that vision, and, when applicable, a set of indicators and metrics to monitor progress in the achievement of the goals.

This strategy ought to be regarded as a "living" policy, designed to be constantly monitored, evaluated and adjusted, as the rhythm of global digital transformation tends to accelerate.

Perhaps the most important aspect, however, is to embrace digital transformation as an opportunity for the entire nation to take a leap forward. Digital technologies provide the tools for a profound transformation in government actions, in competitiveness and productivity in the private sector, and in empowerment and inclusion in society, so that everyone can develop economy and socially, and thrive in quality of life.

INTRODUCTION

Harness the full potential of digital technologies in order to increase productivity, competitiveness, and income and employment levels throughout the country, building a free, just and prosperous society for all.

Digital technologies are increasingly present in everyone's life: at home, at work, in schools, media and in social relations. Our national economy must transform with dynamism, competitiveness and inclusion, embedding digitalization in processes, values and knowledge, so that Brazil can completely explore the digital revolution and reap the benefits that the information and knowledge society can offer.

The economy of the future will be digital. All Brazilians must have a part in it. One cannot conceive of a modern and dynamic economy that does not offer equal opportunities in all regions of the country.

Digital technologies have appeared as a new vital center of modern economies, and leading countries have positioned themselves strategically on this issue. On the international stage, countries seek to leverage their core competencies and advantages while filling important gaps to maximize the benefits of the digital economy. According to their strengths, some countries seek leadership in specific and promising sectors, such as robotics, artificial intelligence, high-precision manufacturing or financial digital innovations; while others tune their regulatory framework so that the market can seize the full potential of digital technologies. Priorities for digitalization initiatives include strengthening competitiveness in digital business, digitization of public services, creation of skilled jobs in the new economy, and better and more advanced education for the population.

The Brazilian case is no different: Brazil's advantages must be leveraged to overcome challenges and promote the digitization process. Despite a significant competitive advantage in a number of areas, such as agribusiness, and its large, diverse economy with a globally significant consumer market, Brazil still has major challenges to face.

An important focus of the Brazilian Strategy for Digital Transformation is to propose strategic actions under the perspective of Sustainable Development Goals[1] (SDGs) of the 2030 Agenda of the United Nations.

There are 17 Sustainable Development Goals with a total of 169 targets – one of which has specific indicators related to information and communication technologies[2]. Actually, digital transformation

[1] See the UN Sustainable Development Goals at https://www.un.org/sustainabledevelopment/sustainable-development-goals/, access on 09/04/2018.

[2] Objective 9, Target c: "Significantly increase access to information and communications technology and strive to provide universal and affordable access to the Internet in least developed countries by 2020".

may influence, direct or indirectly, many of the goals and objectives of the SDGs:

- **Goal 1 – No Poverty:** financially include the poorer population by combining mobile devices with Internet access, mobile payments and new financial instruments in the digital environment.

- **Goal 2 – Zero Hunger:** Internet of things may increase agricultural productivity, reducing production loss in the field and during transport and distribution.

- **Goal 3 – Good Health and Well-Being:** use of mobile terminals with access to medical databases and electronic records. Internet of Thins technology, with monitoring and remote diagnosis.

- **Goal 4 – Quality Education:** use of computers with access to digital content, distance learning, teacher training and professional qualification.

- **Goal 9 – Industry, Innovation and Infrastructure:** expansion of Internet and communication infrastructure for industry and R&D.

- **Goal 13 – Climate Action**: implement combined sensor networks with access to the Internet, enabling swift action to prevent and mitigate natural disasters.

In order to assess the contribution of digital transformation to Brazil's global competitiveness, this strategy takes into account some indicators and metrics that provide international comparison, most notably those compiled by specialized agencies of the United Nations, which include:

- Infrastructure: ITU ICT Development Index (IDI)

- Cybersecurity: ITU Global Cybersecurity Index (GCI)

- E-commerce: UNCTAD B2C E-commerce Index

- Electronic Government: UN E-Government Development Index (EGDI)

The World Economic Forum annually compiles the Global Competitiveness Index (GCI)[3]. This index compares the economy of 137 countries, and defines competitiveness as a set of institutions, policies and other factors that determine the level of productivity, seeking to reflect the level of prosperity that every country can achieve. The GCI index combines 114 indicators, aiming to capture and incorporate statistical data from various international organizations.

Currently, Brazil ranks 80th among the countries listed on the GCI. This ranking is below the country's potential. The current rank affects the level of attractiveness for new investments and the Brazilian image on the international scene, harming its social and economic development. The goal of this strategy is to raise significantly Brazil's rank over the next five years. Progress on this and other

[3] Available on: http://www.weforum.org/reports/the-global-competitiveness-report-2016-2017-1, access on 06/07/2017.

indicators will closely reflect the level of success of the Brazilian economy, including the digital economy.

A recent study[4] points out that the digital economy accounted for approximately 22% of the Brazilian GDP in 2016, and may reach 25.1% of GDP in 2021. It also points out that an optimal digital strategy can bring an additional estimated 5.7% increase in GDP (equivalent to US$115 billion) for a given year. Another study[5] indicates that the global digital economy is expected to grow at a rate 2.5 times higher than the growth of the global economy in other sectors over the next few years. The global digital economy should amount to US$23 trillion in 2025.

Society is undergoing profound technological changes, and although this is a means of advancement, inevitably they affect some more than others. The role of the Brazilian Digital Transformation Strategy is precisely to coordinate various public policies to ensure broad adoption of digital technologies and a productive transition for the different sectors of the economy, while building a more prosperous, free and fair society.

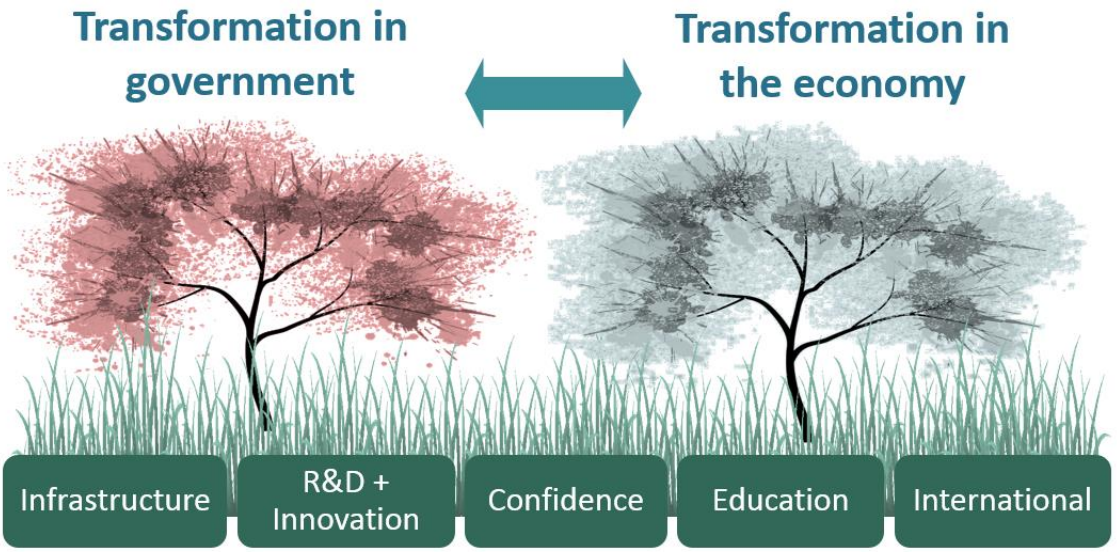
Digitalization opens new opportunities in many ways. Today it is possible to imagine equal access to educational resources, with no distinction whatsoever by geographic location, income, race, gender, and other factors. Automation, data analysis and algorithm improvement in decision making offer significant gains. Health care may be more accessible, cheaper and of higher quality for everyone due to digital technologies. Meanwhile, new concerns on privacy and rights protection arise with the quick spread of information and the expanding economic value of its use.

Such innovations involve creating and updating an appropriate regulatory framework, to ensure harnessing the full potential of digital technology. They also require the establishment of a governance framework for the digital strategy, coordinating existing institutional mechanisms and ensuring priority in implementation, monitoring and evaluation of several initiatives.

The Brazilian Digital Transformation Strategy, similarly to the digital strategies of other countries, focuses on a period of four years (2018-2021). The strategy aims to coordinate different governmental initiatives on digital issues within a coherent framework, in order to further the digitalization process of production, promote education and training for the digital environment, and enable economic growth.

[4] See Accenture: "Digital Disruption: The Growth Multiplier", available on https://www.accenture.com/us-en/insight-digital-disruption-growth-multiplier. Accessed on 14/09/2017.

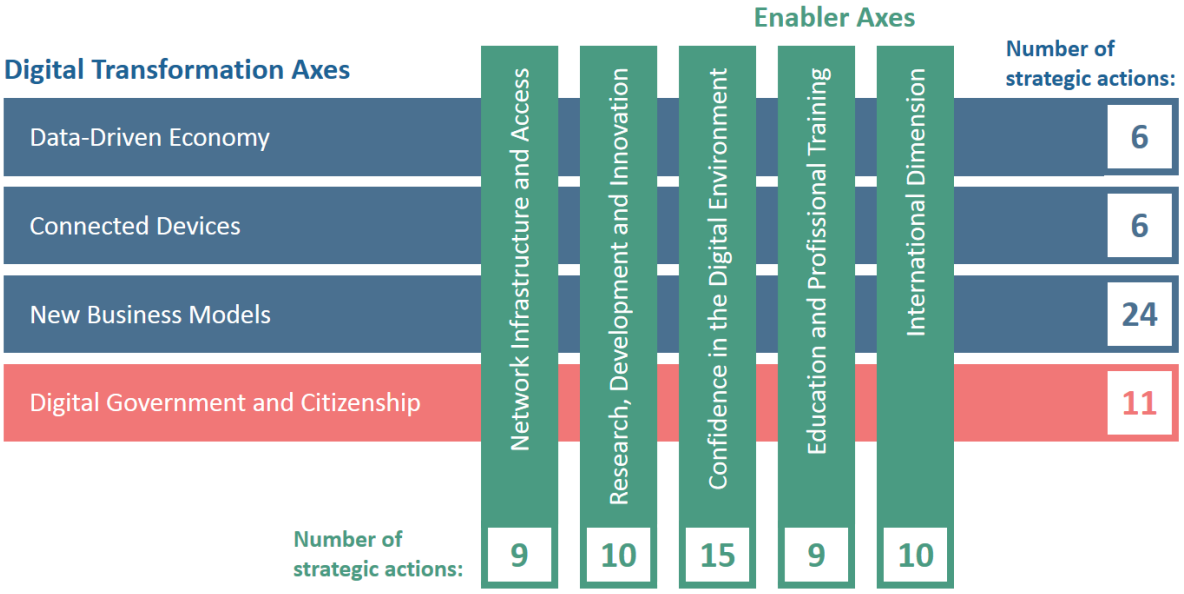
[5] See Oxford Economics: "Digital Spillover - Measuring the true impact of the digital economy", available on http://www.huawei.com/minisite/gci/en/digital-spillover/files/gci_digital_spillover.pdf, access on 06/09/2017.



The relationship between government and private sector in the economy provide the framework for the approach adopted in the E-Digital strategy, which comprises a set of thematic axes, as illustrated in the figure below:

These axes provide an integrated approach to digitalization, and to the role of government in this process. The complexity of the digitalization process is greater, due to additional crosscutting elements and mutual influences among these axes. The strategic actions that are proposed take into account such interdependences in the context of a common strategic vision.

E-Digital comprises two blocks of thematic axes: enablers of the digital transformation, and those of the digital transformation *per se*.



The **enablers** include initiatives aiming to create an environment conducive of the digital transformation of the Brazilian economy. Such initiatives include infrastructure and access to information and communication technologies; activities in research, development and innovation; development of an appropriate regulatory environment; rules and norms that promote trust in the digital environment; educational and professional skills for the digital economy; and international presence of Brazil.

This enabling environment provides the setting for a number of initiatives of digital transformation, both in government and in the private sector. In this context, specific actions relate directly to the process of **digital transformation**:

- Digital transformation of the economy (data-driven economy, connected devices, new business models), and
- Digital transformation of government (citizenship in the digital world and efficiency on provision of government services).

Many challenges lie ahead of implementing these initiatives. Therefore, from its inception the development of this Strategy has sought synergy and the involvement of different actors and stakeholders, with an aim to explore the full potential of digital technologies in providing equitable growth throughout Brazil.

METHODOLOGICAL APPROACH

The activities related to the development of the first Brazilian Digital Transformation Strategy began on 17 February 2017, with the publishing of Ordinance MCTIC No. 842/2017. An Inter-Ministerial Working Group (IWG) was established and tasked with preparing a base-document of the Strategy, ready for submission to public consultation.

This Working Group set up subgroups divided according to the main thematic axes of the Brazilian Digital Transformation Strategy. Five subgroups (SG) were established: i) SG Infrastructure; II) SG Citizenship and Digital Government; III) SG Research, Development and Innovation; IV) SG Trust and Security in the Digital Environment v) SG Digital Economy. The IWG reviewed and approved the results of each subgroup.

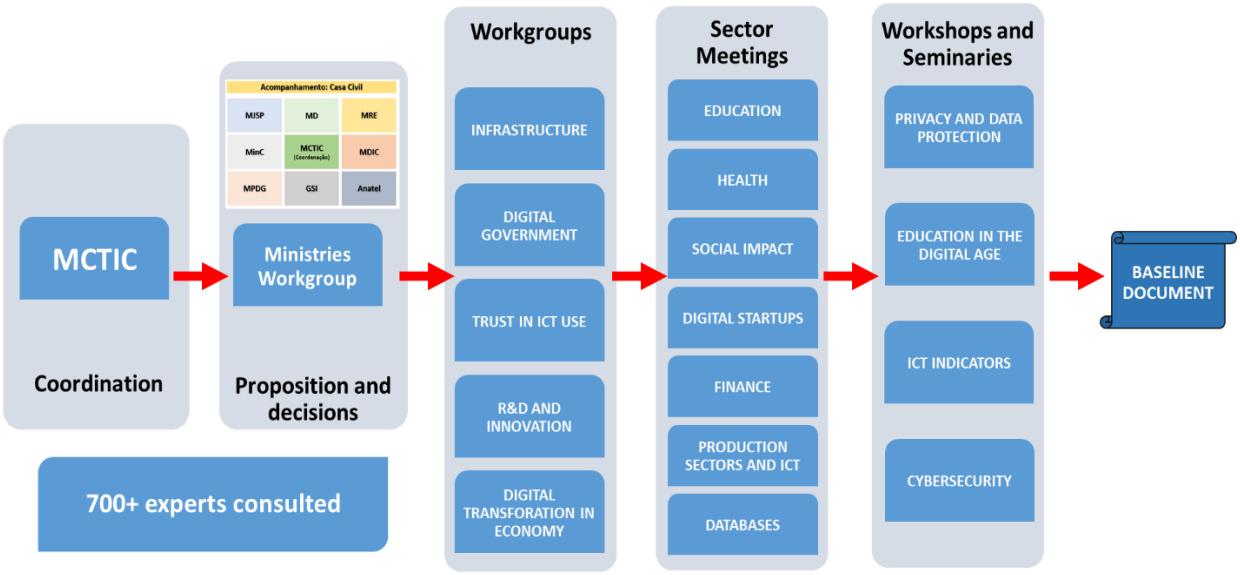
The IWG held nine meetings held, as well as 25 meetings of the subgroups for presentation and discussion of the related topics. The work of the subgroups involved intense interaction with participating agencies and entities, providing an exchange of knowledge and ideas, as well as the coordination of Government initiatives in the digital economy.

In addition, the IWG sponsored a preliminary Consultation focused on a group of 130 experts in Government, academia and the private sector. This online consultation, conducted with the support of the center of Strategic Studies and management (CGEE), aimed at identifying relevant topics for a digital transformation strategy for the country, as well as to indicate priority strategic actions.

A series of meetings provided further engagement of representatives of the private sector, non-governmental entities and government agencies. These events, known as "Sectoral Meetings", covered the following topics: education; ICT in health; application service providers and the ICT industry; social impacts of the digital transformation; banks, fintechs and venture capitalists; among others.

Finally, four major workshops and seminars were held: Privacy and Data Protection, March 2017; Education in the Digital Age, May 2017; ICT indicators and metrics, May 2017; Cyber Security, June 2017). All of these events actively engaged representatives of civil society, academia, the private sector and Government.

The chart below illustrates the process of building the draft Brazilian Digital Transformation Strategy (E-Digital), from February to June 2017.



In order to organize and provide a standard format for the conclusions of each subgroup, the participants of the IWG defined a common standard for presentations, containing the following elements for each topic covered in the Brazilian Digital Transformation Strategy:

- Diagnosis: current status and challenges;
- Vision: desired future scenario;
- Strategy: actions to get form current status to vision;
- Indicators: metrics to track progress on strategic actions.

The conclusions of this process provided the basis for the first version of this document, submitted to public consultation from August 1st 2017 to September 20th 2017. This online consultation via Internet was conducted on a dedicated digital platform provided by CGEE. Over 2,000 participants accessed the platform. Among these, more than 700 individuals and organization offered suggestions and contributions. These included representatives of Government (at the Federal, State and Municipal levels), the productive sector (companies and associations), the scientific and academic community (universities, institutes and schools) and civil society (associations, entities, NGOs and citizens).

Based on the contributions received during the public consultation process, the IWG conducted a review with improvements to the draft version. This final consolidated version, accompanied by draft normative instrument, is ready for submission to the consideration of the President of the Republic, based on the recommendation of the economic and Social Development Council (CDES).

THEMATIC AXES – ENABLERS

A. Infrastructure and Access to Information and Communication Technologies

Increasing the access of all Brazilians to the Internet and digital technologies, with quality service and economy.

Telecommunications emerged as the main driver of economic and social development in a global scenario of intense growth and demand for knowledge. Telecommunications services connect and power various sectors of the economy, contributing to social development and attracting large amounts of national and foreign investments. Such services also generate multiple job opportunities in many industries.

In a country with gigantic territorial dimensions such as Brazil, the need for Internet network expansion imposes continuous challenges for broadening the telecommunications infrastructure.

Area (km^2): 8,358,140

Population (millions of habitants)	206.1
Proportion of urban population	85%
Proportion of population living in urban areas with over 1 million habitants.	22%

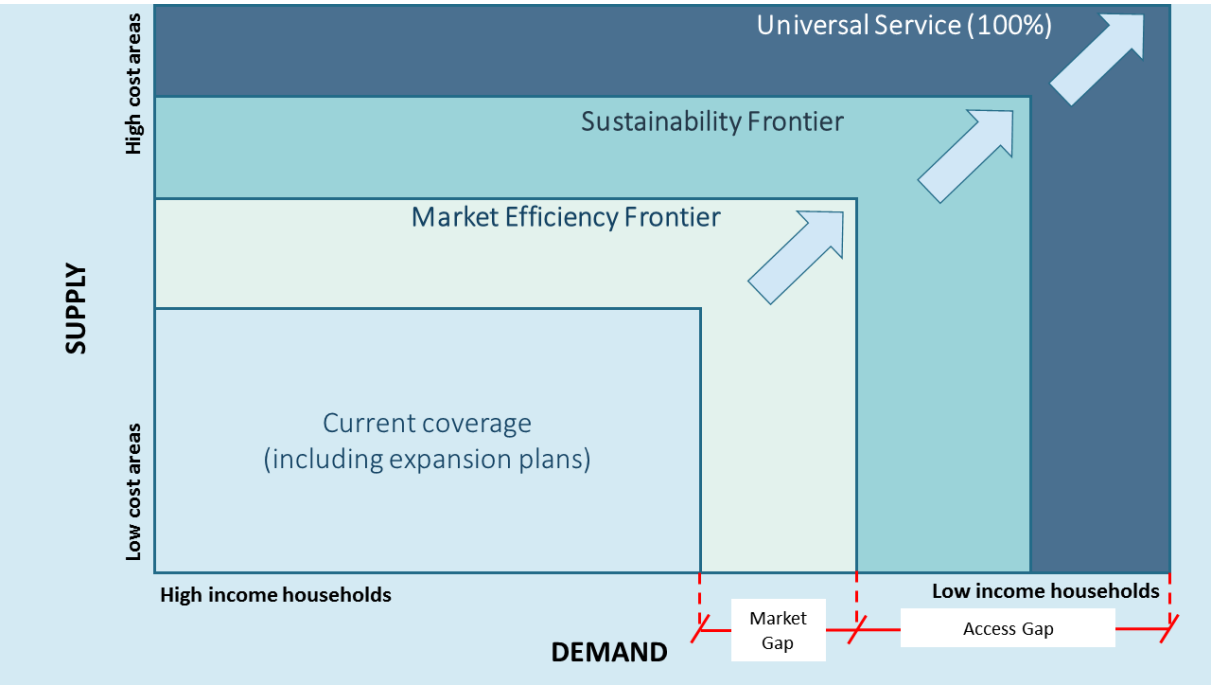
There is wide room to increase the provision of terrestrial telecommunications infrastructure in Brazil through market solutions, in order to expand the availability of broadband Internet access with efficiency and economy. Many public policies and government agencies, as well as new and updated regulations for telecommunications, aim to improve the provision of such services.

Two separate studies of the World Bank on the infrastructure expansion of telecom and Internet in

developing countries (2002[6] and 2010[7]) point out the main difficulties for universalization of access. According to these studies, areas of infrastructure coverage deficit ("access gap"), combining high cost and low income population, persist in such countries, even when market-driven enlargement happens in economically more viable areas (thereby reducing the "market gap").

The following figure illustrates the opportunities for supply expansion to meet the demand for telecommunications services – in this case, Internet broadband networks. Expansion must occur initially by increasing supply through market players, meeting the suppressed demand (represented by the "market efficiency frontier"). Nevertheless, there is also a further segment where the service offer may be possible by the combination of market action and complementary induction mechanisms (the so-called "sustainability frontier"). Finally, portions of unattended territory and population will persist; demand in those areas can only be addressed by a service with universalization characteristics.

FIGURE 1: MARKET GAP AND ACCESS GAP MODEL



Source: World Bank, "Telecommunications and information services for the poor – toward a strategy for universal access", 2002.

In further remote areas, network solutions via satellite are often required either for access (to connect the population to the Internet) or for data transport (to connect those areas to national backbones). In

[6] NAVAS-SABATER, J., et al**. Telecommunications and information services for the poor - toward a strategy for universal access**, World Bank, 2002, available on http://documents.worldbank.org/curated/en/496311468739312956/Telecommunications-and-information-services-for-the-poor-toward-a-strategy-for-universal-access, access on 30/06/2017.

[7] MUENTE-KUNIGAMI, A. and NAVAS-SABATER, J., **Options to Increase Access to Telecommunications Services in Rural and Low-Income Areas**, World Bank, 2010, available on http://documents.worldbank.org/curated/en/277671468330886996/Options-to-increase-access-to-telecommunications-services-in-rural-and-low-income-areas, access on 30/06/2017.

such cases, public policies ensuring Internet access to government institutions and facilities – administrative, educational, health care, public security and the armed forces – are specially relevant.

Once the access infrastructure is locally available, either by satellite or other technology, it opens up the possibility of establishing various business models for Internet services to the general public. Education also plays a big part: as children and young people have contact with the technology in educational activities, service offering broadens also to their families, who can access digital government services, digital shopping services, leisure and culture.

Diagnosis

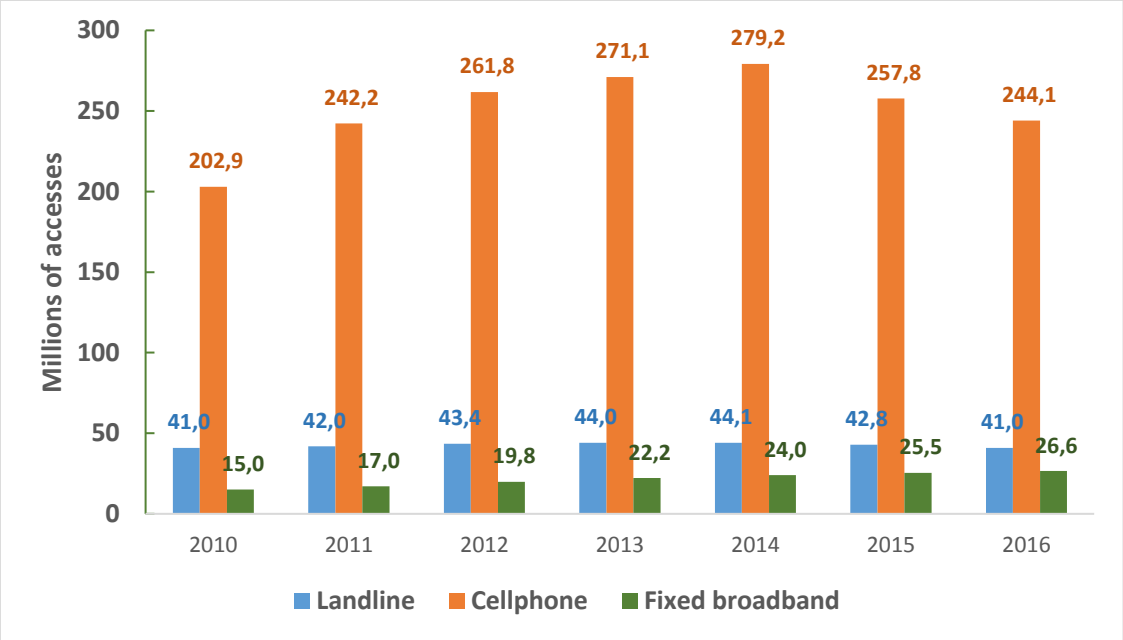
Our population is mostly urban and concentrated – 86% of Brazilians live in 58% of the municipalities[8] – which facilitated the fast increase of Internet access for a large part of the population in the past few years. One determining factor of that transformation was the rapid evolution of mobile technology, with the continuous expansion of 3G networks (which today attends the majority of the population)[9] and 4G[10], and the availability of low-cost mobile devices.

Fixed broadband access is present in 40% of households[11], but is increasing at slower rates in recent years. Due to the immense territory, with remote, secluded areas and development challenges, the task of offering Internet access to all must be in the focus of a connectivity public policy.

The National Telecommunications Agency (Anatel) generates monthly information on the number of accesses in current telecom service providers. The consolidated data shows a growth on access numbers for the following Internet services: fixed broadband connections (identified in the chart below as SCM) and cellphone connections (with the acronym SMP). The regular landline telephone connections (identified as STFC) kept steady for the past seven years.

[8] [9] [10] [11] Data from the National Telecommunication Agency (Anatel).

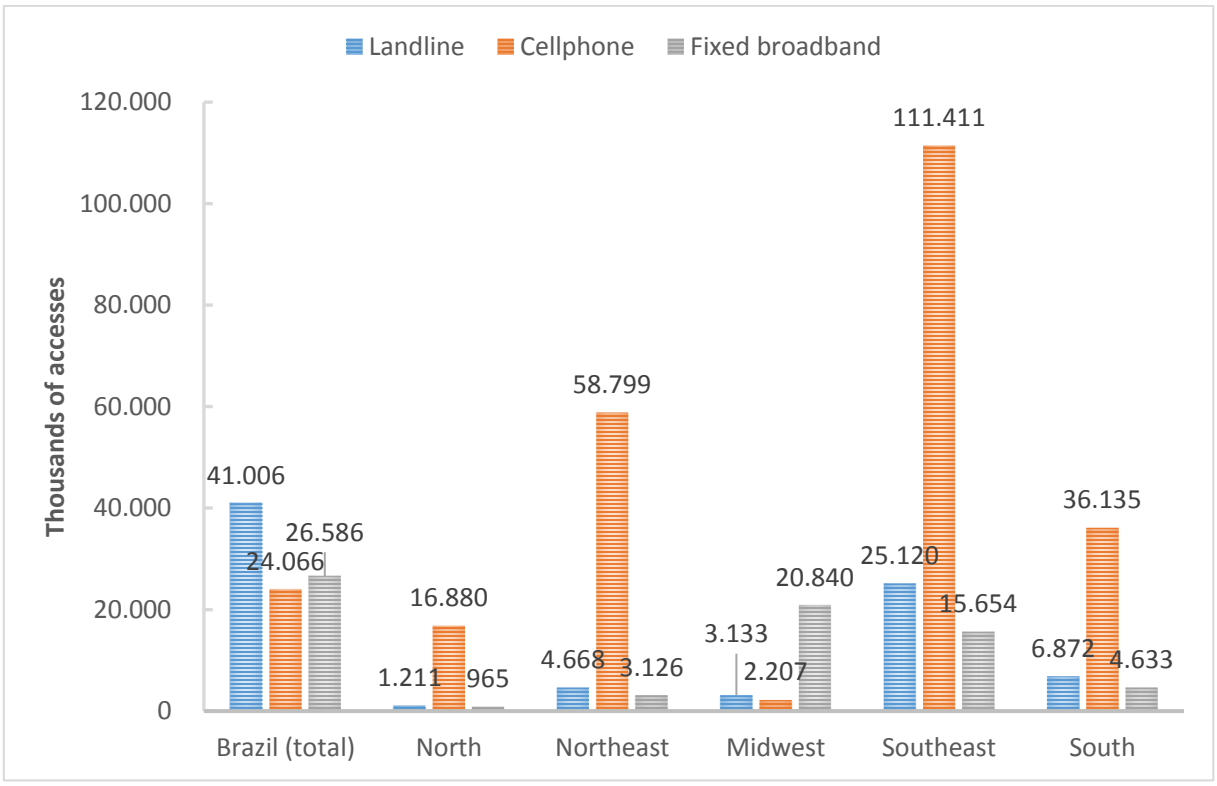
FIGURE 2: EVOLUTION OF ACCESS BY TYPE OF SERVICE (MILLIONS OF ACCESSES)



Source: extracted from the QMS, SGMU, JCL and SMP systems (Anatel).

Despite the consistent growth on access, the largest portion is concentrated on Southeast Brazil:

FIGURE 3: ACCESSES BY TYPE OF SERVICE AND REGION IN 2016 (THOUSANDS OF ACCESSES)



Source: QMS systems, SGMU, JCL and SMP (Dec/2016).

A study recently conducted by Anatel showed that 48.2 percent of municipalities had fiber optics backhaul in 2015. In 2016, that amount has increased to 57.9%, which represents 3,225 municipalities connected with fiber. The resident population in those municipalities with fiber backhaul was 86% of total Brazilian population in 2016.

According to the ICT Households Survey 2016 (formulated by Cetic.br, a branch organization of the Brazilian Internet Steering Committee – CGI.br), 107.9 million people used the Internet in a three months period. The percentage of households with Internet access varies from 40 to 64%, depending on the region –half of Brazilian households, on average, have Internet access.

A major vector for digital inclusion, however, is the cellphone. Mobile access to the Internet is already higher than through computers: in 2014, 76% of Internet users accessed via mobile, compared to 80% who used the computer. In 2016, the use of the cellphone to access the Internet rose to 94%, while the access by computer dropped to 49%. In lower income classes, the rate of Internet access exclusively by cellphones is even higher.

There are 239 million active accesses on mobile telecom in Brazil, with a teledensity of 120 lines per 100 habitants. Cellphones are the main Internet connection device for 89% of Brazilians.

Inclusion is also more intense among the younger population: 86% of people aged 16 to 24 have accessed the Internet, regardless of income. Of those Internet users, 98% used the cellphone for access. The Cetic.br report also reveals that 98% of broadband access is installed in municipalities with fiber optic backhaul in 2016.

In the Brazilian scenario, the network infrastructure for the provision of personal mobile service (mobile telephony, including mobile access to the Internet) is marked by the presence of four major economic groups, which concentrate 98.1% of accesses: Telefónica, Claro, Oi and Tim.

The 4G technology is present in 2,852 municipalities (51% of the total), already covering approximately 86% of the population. Using 3G technology, Internet access reaches 98.6% of the population by attending 91 percent of Brazilian cities, since the country's population is concentrated in urban centers. The evident challenge, then, is to meet rural and small urban areas further away from major urbanized centers.

FIGURE 4: MUNICIPALITIES WITH FIBER OPTIC BACKHAUL (IN BLUE)

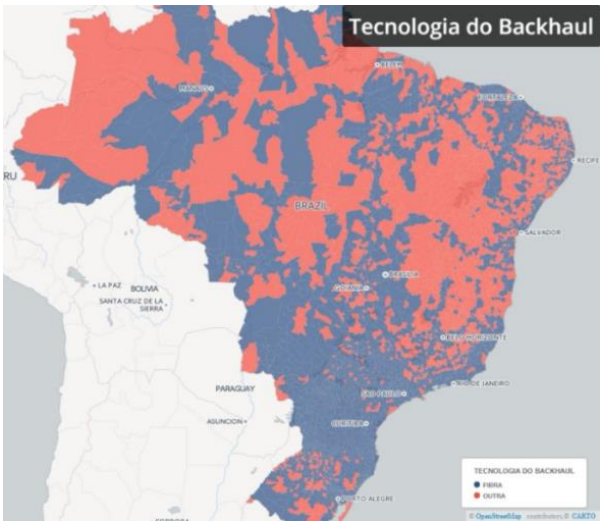


FIGURE 5: MUNICIPAL NON-HEAD DISTRICTS WITHOUT BTS

In Brazil, most municipalities are divided into districts, and the district with the largest urban population and which holds the seat of municipal government is the “head-district”. Districts other than head-districts – usually large areas of rural occupation – configure a peculiar challenge to territorial coverage. The service providers have no regulatory obligation to offer coverage to such districts, which may represent vast areas of scarcely populated territory with little or no infrastructure, particularly in the North and Midwest.

There are 4,717 districts which are not head-districts in Brazil. Of those districts, 2,012 do not have an base transceiver station (BTS) installed. The districts without mobile-network BTS, however, represent only 11% of the total population living in non-head-districts.

Hence, Brazil presents a dual challenge in developing broadband networks. In one hand, it is necessary to expand the transport networks infrastructure in fiber optics, in order to direct the data flow into the national backbones. In other hand, it is fundamental to extend the fixed and mobile access networks. The response to these challenges should result in an increased capacity of transport networks, backhauls and access infrastructure in urban centers (adopting fiber networks), and also in greater network penetration across the country, in order to provide connectivity to sparsely populated areas, with multiple fixed and mobile network technologies, rural areas, roads, etc. The following images illustrate the magnitude of these challenges.

FIGURE 6: BRAZIL – POPULATION DENSITY

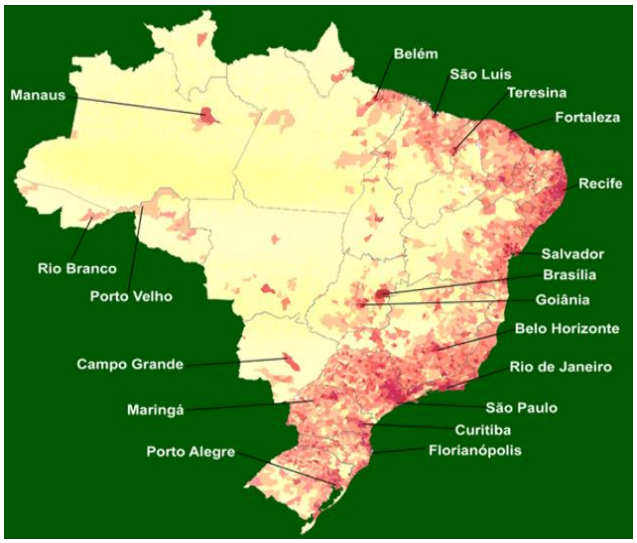
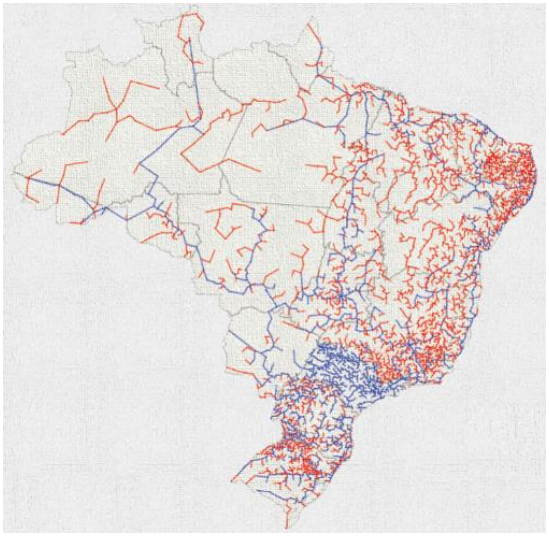


FIGURE 7: BRAZIL – DATA TRANSMISSION NETWORKS



Currently, there are a few possible significant contributions by the telecom operators to expand network and data access through fixed and mobile broadband. One of them is the financial reserves associated with "adjustment agreements" (known by the acronym TAC[12]), which are contractual penalties against telecom companies converted into investment obligations. Another opportunity is the surplus balance resulting from the adaptation of public telecom concession framework under the context of the General Telecommunications Act[13], which establishes investment goals for network and broadband access. In this subject, a public consultation on the proposed Decree[14], revising the telecom policy, was launched on MCTIC's initiative. The proposal points out three priorities for investment on networks: (1) expand the terrestrial transport networks, (2) increase coverage of mobile broadband networks, and (3) expand the scope of fixed broadband access.

Another possibility to quickly expand mobile broadband networks is to accelerate the implementation process of 4G networks using the 700 MHz band, nominally in those municipalities where this band is already free and do not have to be previously released by broadcast services on the transition to digital

[12] Resolution about TACs available at http://www.anatel.gov.br/legislacao/resolucoes/2013/680-resolucao-629 (in Portuguese).

[13] Available on https://www25.senado.leg.br/web/atividade/materias/-/materia/127688, access on 30/06/2017. http://www.cgee.org.br/prospeccao/exercicio/delphi/doc/170/decretoPoliticaTelecomunicacoes.pdf, access on 26/10/2017.

[14] On October 18, 2017, MCTIC had launched a public consultation on the decree proposal aiming to review the telecommunication policy: www.mctic.gov.br/mctic/opencms/salaImprensa/noticias/arquivos/2017/10/Revisao_das_politicas_de_telecomunicacoes_marca_uma_nova_etapa_para_o_setor_diz_ministro.html. Full text of the proposal is at http://www.cgee.org.br/prospeccao/exercicio/delphi/doc/170/decretoPoliticaTelecomunicacoes.pdf, access on 26/10/2017 (links in Portuguese).

TV[15]. In practice, this amounts to over 3,000 municipalities throughout the country, urban and rural areas included, able to benefit from mobile 4G service, given the excellent conditions for propagation, coverage, and the high-capacity for data transmission of the 700 MHz band.

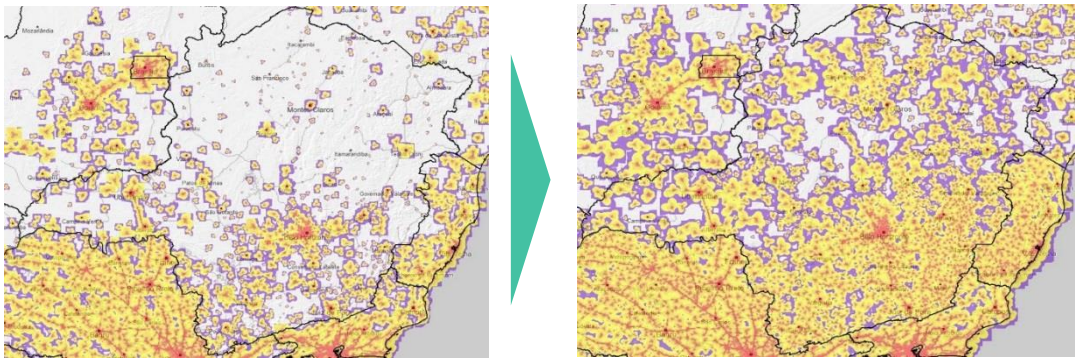
The Telecommunication Services Universalization Fund (FUST) is also noteworthy on this subject. A couple of bills are under discussion at the House of Representatives[16] and the Senate[17] to modify the legislation applicable to this fund, whose goal is to effectively use the resources to expand broadband infrastructure.

Moreover, Anatel is currently analyzing the possibility to revise the radio-frequency pricing model[18]. The proposal aims to channel those resources to investments in the expansion of the telecom network.

Some state governments have developed effective programs to encourage infrastructure installation in regions with sparse population and less coverage. States such as Minas Gerais and Ceará have implemented similar tax incentives policies for the deployment of base transceiver stations with 3G connection in municipal districts without coverage, achieving very positive results. Similar initiatives can be encouraged in other states as a way to expand coverage using mobile technology.

FIGURE 8: STATE POLICIES FOR BTS INSTALLATION AND THEIR RESULTS IN MOBILE COVERAGE FROM 2014 TO 2016 (IN YELLOW)

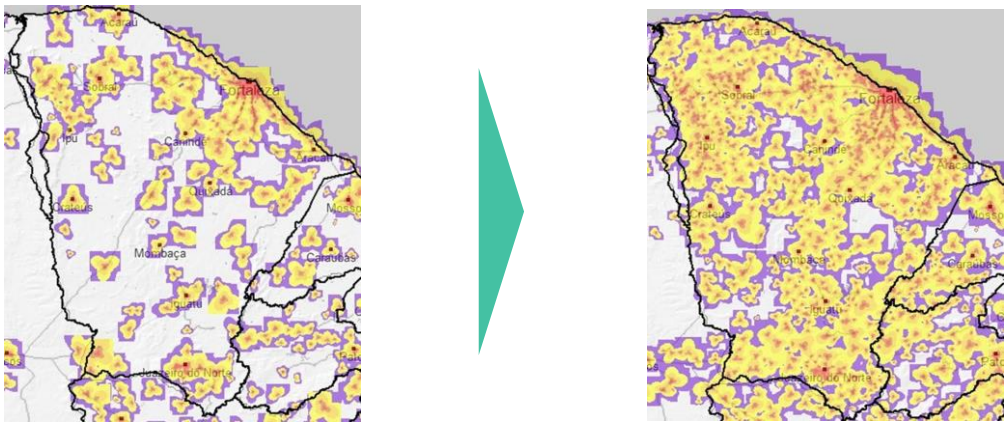
MINAS GERAIS



2014 **2016**

[15] Data on the digital TV transition process is available on http://www.sejadigital.com.br/site/gired?1499088076, access on 30/06/2017.
[16] Data on the House of Representatives Bill n. 6,413/2016 is available on http://www.camara.gov.br/proposicoesWeb/fichadetramitacao?idProposicao=2115521, access on 12/09/2017 (in Portuguese).
[17] Data on the Senate Bill n. 125/2017 are available on http://www25.senado.leg.br/web/atividade/materias/-/materia/128943, access on 30/06/2017 (in Portuguese).
[18] Public Consultation n. 7, opened from March 23 May 7, 2017.

CEARÁ



2014 **2016**

5G Technology

The fifth-generation technology for mobile telephony (5G) is currently in standardization process at the International Telecommunication Union (ITU). At the end of 2015, ITU published its 5G outlook, gathering the main features/functionality that should be present on systems using this technology, including very high speeds (up to 20 Gbps), low latency (up to 1 millisecond) and a large number of connected devices.

In 2019, ITU will promote the next World Radio Conference (WRC-19), when the spectrum bands to be used by 5G should be globally defined and harmonized. It shall be a landmark for a large-scale 5G technology implementation in telecom networks, possibly starting on 2020, although some countries are already planning pilot projects to begin on 2018-2019.

Brazil has engaged in research and development initiatives at the current stage of 5G technology. Good examples of R&D projects are the Radiocommunication Reference Center (RRC) of the National Institute of Telecommunications (Inatel), and the partnership between Ericsson and the Federal University of Ceará (UFC).

The international cooperation on research and development in 5G has various actors funding educational agreements, such as the Brazil-EU Strategic Cooperation in 5G, signed in 2016. At the same time, Brazil has been engaged in multilateral fora for discussion of this issue, approaching multiple world organizations dedicated to 5G standardization, harmonization and definitions: 5GIA (Europe), 5GForum (Korea), 5GAmericas (USA), IMT-2020 (China) and 5GMF (Japan).

The next steps include:

- establishment of a *roadmap* of development and deployment of 5G technology in Brazil, in partnership with the private sector;
- use of R&D funding sources, such as Funttel (Telecommunication Technology Development Fund) and FNDCT (Science and Technology National Development Fund);
- strengthening of the dialogue between government and private sector through the industrial association "5G Brazil".

Reaching remote regions and connecting communities further away from the major telecommunications infrastructures are the goals of major public initiatives. The Connected Amazon

Project19, for example, deploys telecom cables in riverbeds of the Amazon basin to form a backbone of fiber optics for remote areas of the country's Northern region.

The project is innovative in both technology and governance. In the technological aspect, actions are implemented in such a way to tackle budget limitations with technological solutions that are developed and commercialized in Brazil.

One of the most notable aspects of the Connected Amazon Project is its governance and sustainability models of cooperative work. The initial project costs are shared between public authorities, both Federal and state, which demand broadband infrastructure in Northern municipalities. In the following phase, after such infrastructure and data transport capacity is available in municipalities, local data and access providers can implement viable and a sustainable business models to offer telecommunications services and Internet access to the resident population.

State-level incentives for installing cell towers with 3G connectivity are an effective alternative to increase infrastructure coverage.

In 2017, it was launched the Geostationary Defense and Strategic Communications Satellite (SGDC)[20] in order to cover areas yet unattended by terrestrial broadband infrastructure, and to provide communication resources to meet strategic and defense needs.

Another project currently in development is the Brazil-Europe submarine cable[21], which will assist the distribution of international data traffic with improved quality of the connection, decreased latency, enhanced connection with major research centers in Europe, and reduced traffic cost.

The traffic exchange points (IXP or- *Internet Exchange Points*) are an important element of data transmission networks architecture in Brazil. IXPs allow direct interconnection between networks (autonomous systems, or AS) which constitute the Internet in Brazil. The country already has 28 points operated by IX.br[22] and located in metropolitan regions with the largest Internet traffic, allowing rationalization of costs, better performance, quality and efficiency in the Internet operation. Future expansion IXPs coverage in Brazil may contribute to strengthen and broaden the Internet infrastructure in the country, besides allowing the attraction of investments for local hosting of content

[19] Available on www.amazoniaconectada.eb.mil.br/pt/, access on 06/09/2017.
[20] MCTIC news release on: www.mcti.gov.br/noticia/-/asset_publisher/epbV0pr6eIS0/content/satelite-geoestacionario-vai-cumprir-importante-papel-social-no-brasil-diz-ministro, access on 06/07/2017.
[21] More information about this project can be found at the Brazilian Association of Technology Research Institutions (ABIPTI) website, at: http://www.agenciacti.com.br/index.php?option=com_content&view=article&id=10565%3Acabo-submarino-que-conecta-brasil-e-espanha-estara-concluido-em-2019&catid=1%3Alatest-news&Itemid=190. Access on 05/07/2017.
[22] Details about this initiative from the Brazilian Internet Steering Committee (CGI.br) can be found at http://ix.br/localidades/novasmap.

(notably CDN – Content Delivery Networks servers)[23].

IXPs also benefits competitiveness, as they converge small, medium and large-sized service providers into neutral hubs of data transport. It is worth mentioning that the IXP of São Paulo is already one of the five largest in operation globally, both in volume of traffic and the number of participants.

On the issue of the expansion of Internet networks, it is necessary to emphasize the relevance of the use of unlicensed spectrum. A recent study[24] with a 2021 projection points out that 60 percent of Internet traffic in Brazil should be provided by wifi networks (including those present in private and public environments).

In recent years has widely adopted by small service providers in Brazil to offer Internet access infrastructure with Wi-Fi networks. The adoption of Wi-Fi networks, as well as others who use unlicensed spectrum, can boost goals of this strategy. In this sense, Anatel has updated and simplified regulation[25] providing specific services.

At the same time, the offer of free wifi connection in heavily frequented public places (hospitals, bus terminals and airports, for example) has been used as a tool for providing public services and information, as well as a mechanism of digital inclusion. Some initiatives have similar effects on public internet access, such as the Broadband in Schools Program.

Finally, it is worth mentioning the MCTIC's Smart Cities Program for the deployment of fiber-optic network infrastructure. One of the goals of such networks aim is to connect government agencies, provide public Internet access points, and encourage partnerships between local public authorities and private institutions to provide sustainability the project. The public consultation of the project's draft decree was recently launched by MCTIC.

[23] See http://www.adlittle.com/downloads/tx_adlreports/ADL_LibertyGlobal_2014_FutureOfTheInternet.pdf, access on 29/09/2017.
[24] The study from Cisco VNI 2017 can be found at http://www.cisco.com/c/m/en_us/solutions/service-provider/vni-forecast-highlights.html.
[25] See Anatel Resolution n. 680/2017, available on www.anatel.gov.br/legislacao/resolucoes/2017/936-resolucao-680, access on 11/10/2017.

Challenges for digital inclusion

The challenges of digital inclusion in Brazil were object of a report by the Brazilian Federal Court of Audit (TCU), entitled *Public Policy for Digital Inclusion* (2015). The report contemplates the actions beginning in the year 2000, and it highlights the creation, in 2002 of the E-Government and Services to Citizens Program (GESAC). GESAC is under shared responsibility among different ministries, with the purpose to provide internet connections, mainly satellite, to telecentres, schools and government agencies located in remote and international border regions.

Other projects also mentioned in this report include the Digital Inclusion Program, the Connected Citizen Project, the One Computer per Student Project and the Telecentros.br Program. Other highlights are the Broadband for Schools Program (PBLE), the National Broadband Program (PNBL), and the special tax rule of the National Telecommunication Broadband Network Implementation Program (REPNBL).

The most financially important PNBL action mentioned at the report is the launching of the Geostationary Defense and Strategic Communications Satellite (SGDC). Additionally, the TCU report makes reference to the international negotiations for the construction of a new submarine cable connecting Brazil and Europe, which will expand traffic capacity between the two continents, reduce transmission costs and make data transmission safer.

In addition, the TCU report points out the lack of digital literacy of part of the population, as well as little formal literacy, as barriers to full digital inclusion of Brazilian society.

Finally, the TCU report draws a diagnosis for public policy management, stressing the coordination and articulation difficulties in different government levels: between federal government agencies somehow related to digital inclusion, and between the federal government and the many State and municipal bodies.

Vision

It is essential to design a clear investment plan, with short, medium and long-term goals, to achieve a the future in which:

- All Brazilian municipalities are supplied with high-capacity transport networks;
- All municipalities have mobile broadband service, both in their municipal head and non-head districts;
- Most of the Brazilian population covered with fixed broadband access, with the expansion of optical fiber access networks;
- Broadband infrastructure reaches remote and isolated areas, providing the population with efficient connectivity and allowing the digitalization of communications and services;
- Widespread presence of wifi networks in highly-frequented public places, in order to provide public services and digital inclusion opportunities.

- Integration of research, education, health and institutions by high-speed networks, which include connectivity, data processing and storage, as to encourage the scientific and technological exchange for the benefit of the society at large, especially in remote regions;

Strategic Actions

In order to achieve the intended objectives, a series of actions are required to combine funding sources for the telecommunications industry, meet service needs, update rules and regulations, and implement specific public policy. The proposal of this Strategy is to establish a plan for short, medium and long-terms actions, and to implement mechanisms to fulfill the following priorities:

- Connect 22,000 public schools, both urban and rural, with high-speed broadband, either with terrestrial or satellite network, within the framework of the Connected Education Program.

- Enable the use of funds from different sources for the construction of data transmission and broadband networks.

    - Such sources include the financial reserves associated with the Conduct Adjustment Terms – TAC (TACs are "adjustment agreements" which convert penalties into investment commitments) with the telecom companies; and also the balance resulted from adaptations in the service concession model, as stated by the General Telecommunications Law, which establishes investment goals on broadband networks.

- Set priorities to define new investment obligations to build mobile broadband networks, and incorporate such obligations into bidding notices for radio frequencies.

- Speed up the 4G implementation process using the 700 MHz band, especially in those municipalities which do not depend on releasing that radio band for the transition to digital TV.

- Encourage state governments to implement tax relief policies focusing the extension of coverage of mobile networks, as some states have already performed.

- Adapt the legislation concerning the Telecommunications Universalization Fund (FUST), in order to enable its application in broadband expansion, both in urban areas and in rural and remote regions.

- Strengthen the participation of research and development centers in multilateral fora whose mandate include the definition of international standards and frequency bands for the fifth generation mobile telephony (5G).

- Promote infrastructure building (including connectivity, data processing and storage features) to integrate research, education, health, and security institutions with high-speed networks

(including the expansion of the Giga Project[26]), encouraging scientific and technological exchange for the benefit of the society at large, particularly in remote regions;

- Perform long-term investments and coordinate initiatives on data communications infrastructure (known as *national critical infrastructure*), computing (e.g. high-performance computing) and data storage, with the purpose of meeting the needs of cyberinfrastructure for large science and technology projects; supporting RD&I projects in those areas; and strengthening cooperation with digital-intensive businesses.

Indicators

In order to track and measure the performance and efficiency of the proposed actions committed, the following indicators are recommended: (1) density of fixed Internet services, (2) percentage of mobile phone coverage (detailed into 3G and 4G technologies), and (3) backhaul coverage (detailed into fiber optic and other high-capacity technologies, for example, Radio IP). Such data can be extracted from Anatel databases[27], as well as the sector researches carried out by the Center for Regional Studies of the Information Society (Cetic.br)[28].

It is also important to consider indicators which allow international comparison: for instance, the ICT Development Index (IDI)[29], a global performance index developed by ITU which compiles a set of indicators for ICT access and effective use of ICT skills.

Regarding digital inclusion, the Economist Intelligence Unit (EIU) has developed an international indicator for "inclusive Internet", based on four dimensions: availability, accessibility, relevance and readiness. In the EIU ranking Inclusive Internet (2017)[30], 75 countries are evaluated; Brazil currently ranks at the 18th position.

[26] Details about Project Giga can be found at http://memoria.rnp.br/pd/giga/ and also http://www.giga.org.br/, access on 12/09/2017.
[27] Available on http://www.anatel.gov.br/dados/, access on 05/07/2017.
[28] Available on http://cetic.br/, access on 05/07/2017.
[29] Available on http://www.itu.int/net4/ITU-D/idi/2016/, access on 05/07/2017.
[30] EIU Inclusive Internet Rankings available on https://theinclusiveinternet.eiu.com/explore/countries/performance, access on 14/09/2017.

B. Research, Development and Innovation

Stimulating the development of new technologies through the increase of scientific and technological output, aiming to solve the most important national challenges.

Information and communication technologies (ICT) are today's economic and social drivers. Investment in Research, Development and Innovation (R&D+I) in this sector is key to ensure that a country participates in the global value chains, promotes jobs, increases income levels and economic activity, and provides its citizens with access to information and knowledge generated globally. Given that the digital industry is a very dynamic sector, it is indispensable to invest in R&D+I in order to keep competitiveness and to take full advantage of the knowledge generated by new technologies in the digital economy.

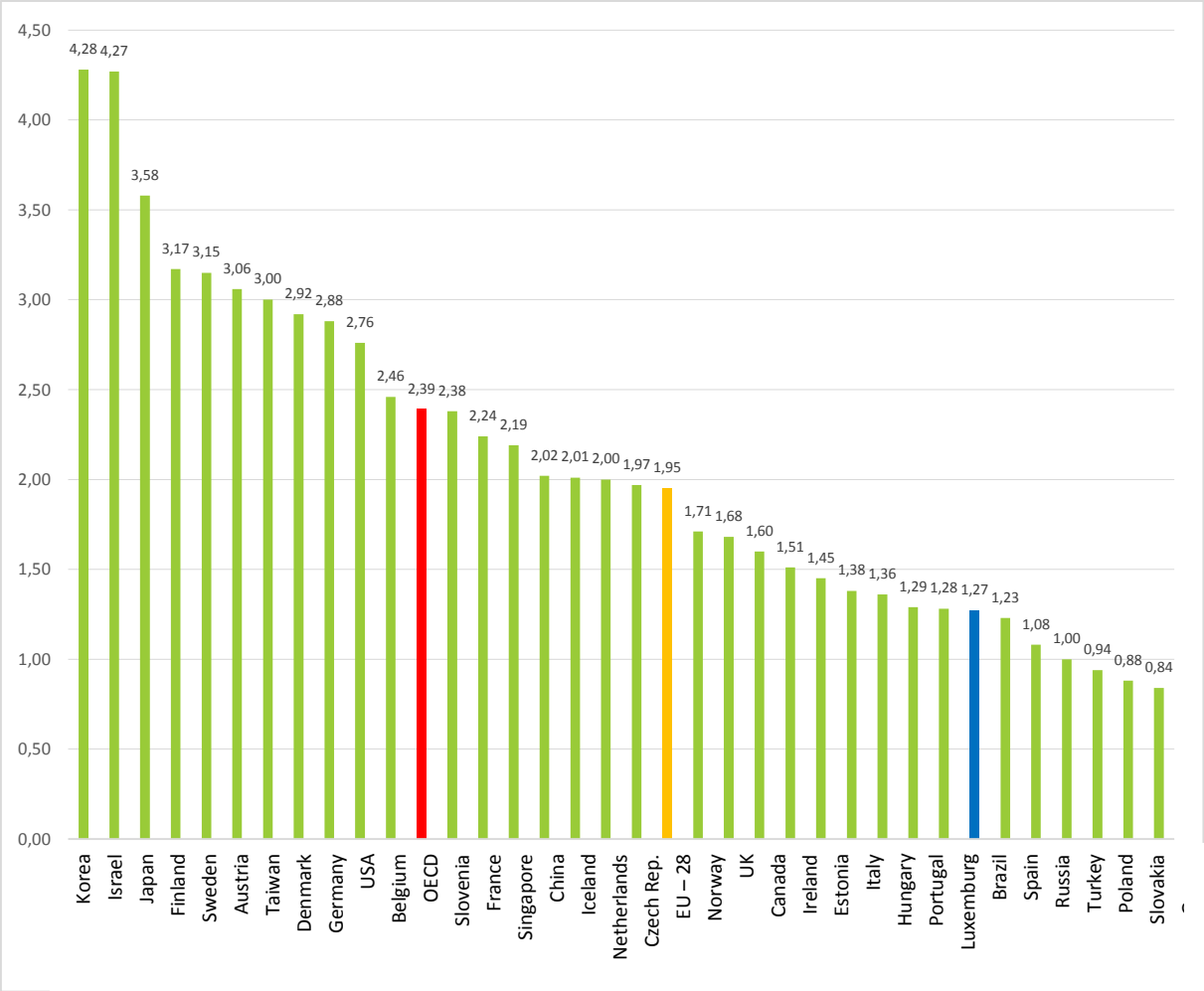
For a country such as Brazil, the R&D+I sector is vital to support domestic development and increase presence in the global economy. As a growth enabler, R&D+I is an essential element of a national development strategy. Brazil should rely on recent successes to establish an R&D+I policy for the 21st century, which is aligned with advances in industry, agriculture and other strategic sectors, and able to fully benefit from the potential of digital technologies.

The Brazilian initiatives in R&D+I should seek an active role in the world scenario for digital technologies, advancing in scientific production, technological development, and innovation international rankings, particularly in the ICT sector. Furthermore, policies should focus on addressing national issues with digital technologies, increasing productivity, and economic and social development.

Diagnosis

The R&D investment level in Brazil as a proportion of GDP, although close to some European countries, remains much lower than in leading countries worldwide. Figure 9 shows that this indicator in Brazil is 1.27%, the average in the European Union is 1.95%, and 2.39% for OECD countries. Leading countries typically score this indicator above 3.5%, such as the Republic of Korea (4.28%), Israel (4.27%) and Japan (3.58%).

FIGURE 9: TOTAL INVESTMENT IN R&D, OECD AND BRAZIL (% GDP)

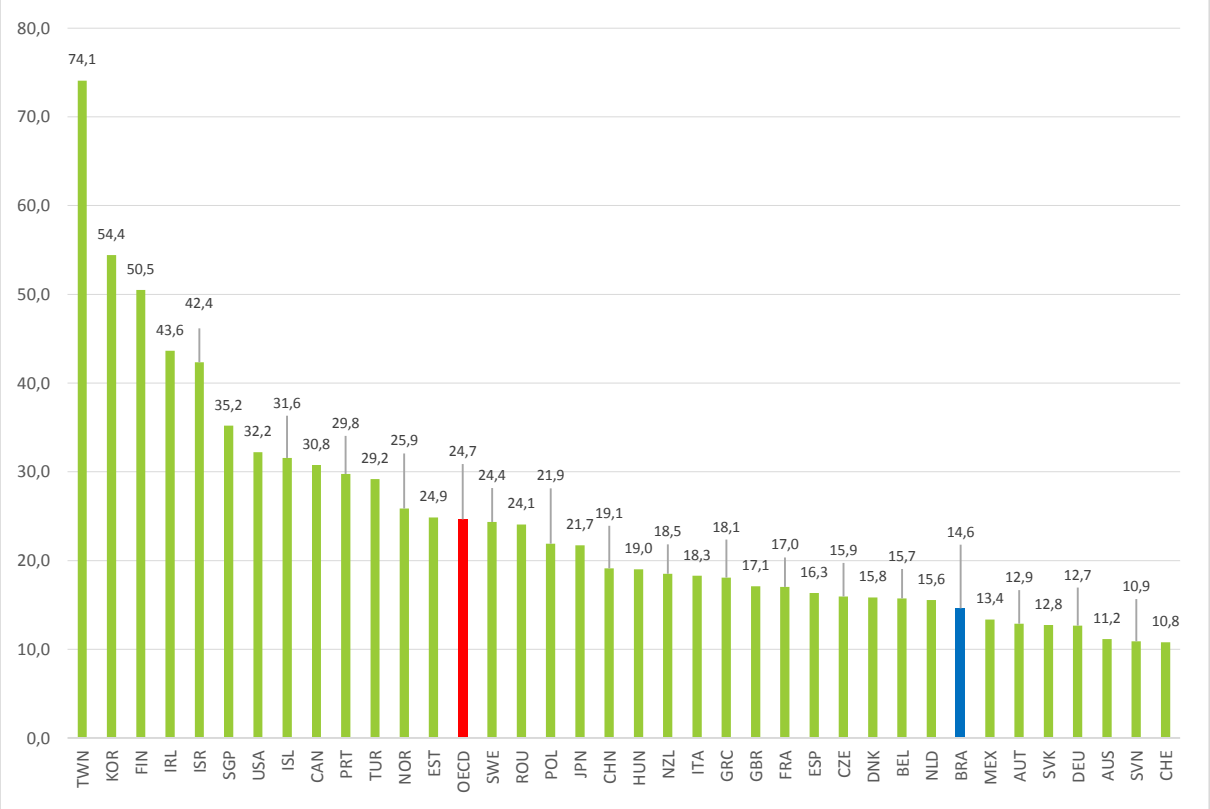


Source: OECD, MCTIC Indicators[31].

Companies in the ICT sector represent 14.6% of the total investment in R&D by companies in Brazil. The average for this indicator in OECD member countries is 24.7%, whereas in world leader countries this indicator is above 50%, as in Taiwan (71%), Republic of Korea (54.4%) and Finland (50.5%).

[31] Available at: https://data.oecd.org/rd/gross-domestic-spending-on-r-d.htm. MCTI Indicators: www.mct.gov.br/index.php/content/view/29144/Brasil_Dispendio_nacional_em_pesquisa_e_desenvolvimento_P_D_em_valores_correntes_em_relacao_ao_total_de_P_D_e_ao_produto_interno_bruto_PIB_por_setor_institucional.html. Access on 06/07/2017.

FIGURE 10: R&D EXPENDITURE OF COMPANIES IN THE ICT SECTOR, OECD AND BRAZIL
(% OF TOTAL COMPANIES EXPENDITURE IN R&D)

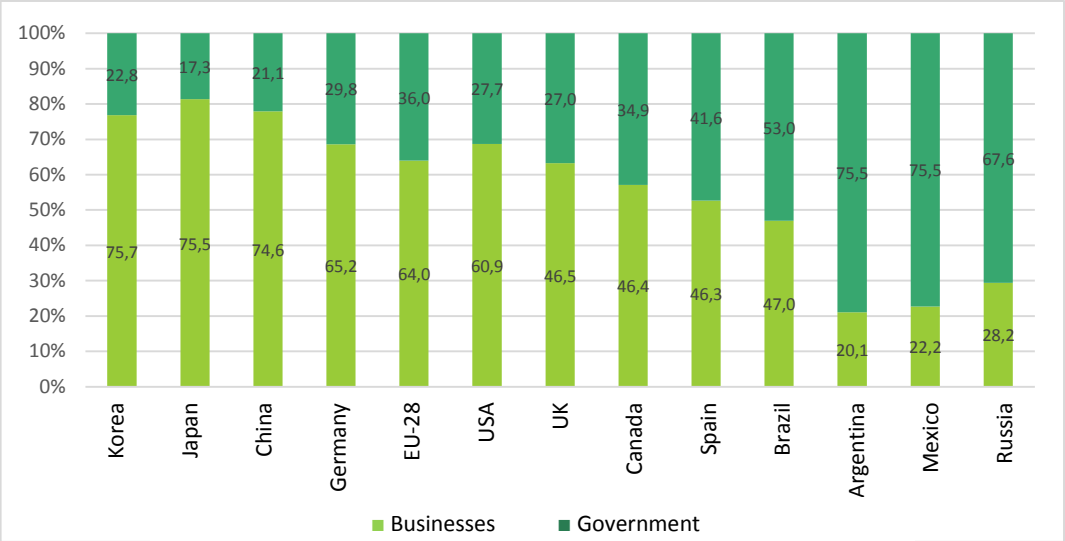


Source: OECD Key ICT Indicators[32]. PINTEC/IBGE (2014).

When comparing private and government investments in R&D, it is noted that the majority of investments in Brazil comes from the government: 53% of the total investment is public, compared to 47% from companies (see Figure 11). The situation of most European countries is substantially different, where R&D expenditures by companies represent, on average, 64% of the total. Such numbers are above 70% in other countries, as in the Republic of Korea (75.7%), Japan (75.5%) and China (74.6%).

[32] Available at: http://www.oecd.org/internet/broadband/oecdkeyictindicators.htm (Viewed on 06/07/2017). Note: for Czech Republic, Denmark, Estonia, Finland, France, Germany, Hungary, Israel, Italy, Netherlands, Norway, Poland, Portugal, Romania, Slovenia, Spain, Switzerland and United Kingdom, data is of 2012. For Australia, Austria, Belgium, Greece, Iceland, Ireland, Mexico, New Zealand, Singapore and USA, data is of 2011. The "Serviços de TIC não alocados" (Unallocated Services) section in the original study refer to ICT industries in Divisions 61 to 63.

FIGURE 11: INVESTMENTS BY BUSINESSES AND GOVERNMENTS IN R&D, SELECTED COUNTRIES (%)



Source: Community Innovation Survey (2015). MCTI indicators. [33]

With regard to innovation, according to data from PINTEC/IBGE) for 2014[34], the innovation rate of companies in the ICT sector in Brazil (40%) is greater than the average rate for companies in all other sectors (36%). Among ICT companies, the average innovation rate in industry is 65%, compared to 35% in companies in the service sector[35].

The role of government incentives to promote innovation in ICT companies was quite effective. According to results from PINTEC (2014), 40% of innovative companies in Brazil had accessed at least one governmental innovation support program (average of 40% in ICT industries and 35% in services).

Over half the investment in R&D+I in Brazil comes from public funds.

[33] Available at: http://ec.europa.eu/eurostat/statistics-explained/index.php/Europe_2020_indicators_-_R%26D_and_innovation, access on 06/07/2017. Note: Some of the percentages presented do not add up to 100% as only the most relevant sectors were considered, both in government and in companies. Sectors not included: higher education, not-for-profit and foreign institutions. Data from 2013, except for Brazil (2014).

[34] Available at: www.pintec.ibge.gov.br/index.php?option=com_content&view=category&layout=blog&id=30&Itemid=46, access on 09/10/2017.

[35] Equivalence between national classification of economic activities (CNAE/IBGE) and international classification – ISIC (*International Standard Industrial Classification*) of the United Nations, with the ICT sector divided in the segments of industry and services. Activities in the ICT industry include the manufacture of: electronic components (2610); IT equipment and peripherals (2620); communication equipment (2630); audio and/or video reception, recording, reproduction and amplification equipment (2640); and magnetic and optical media (2680). Services in ICT include the sectors of telecommunications (61); IT services (62); data processing, internet hosting and other related services (631). Cf. https://unstats.un.org/unsd/publication/seriesM/seriesm_4rev4e.pdf, viewed on 09/10/2017.

Currently available government innovation support instruments include the *Lei de Informática*[36] (510 companies accessed this instrument in 2014), and *Lei do Bem*[37], (1.206 companies accessed this instrument, of which 15% in the ICT sector). Additionally, other innovation instruments include the BNDES financing program for machines and equipment acquisition (FINAME); credit lines made available through FINEP/BNDES (e.g., INOVA EMPRESA) and several State Research Support Foundations (FAPs); research and development scholarships provided by the National Science and Technology Research Council (CNPq) and CAPES; and programs focused on the interaction between companies and research facilities, such as EMBRAPII and SIBRATEC.

> Instruments that promote investment in R&D+I can be better coordinated and geared towards the solution of specific national challenges.

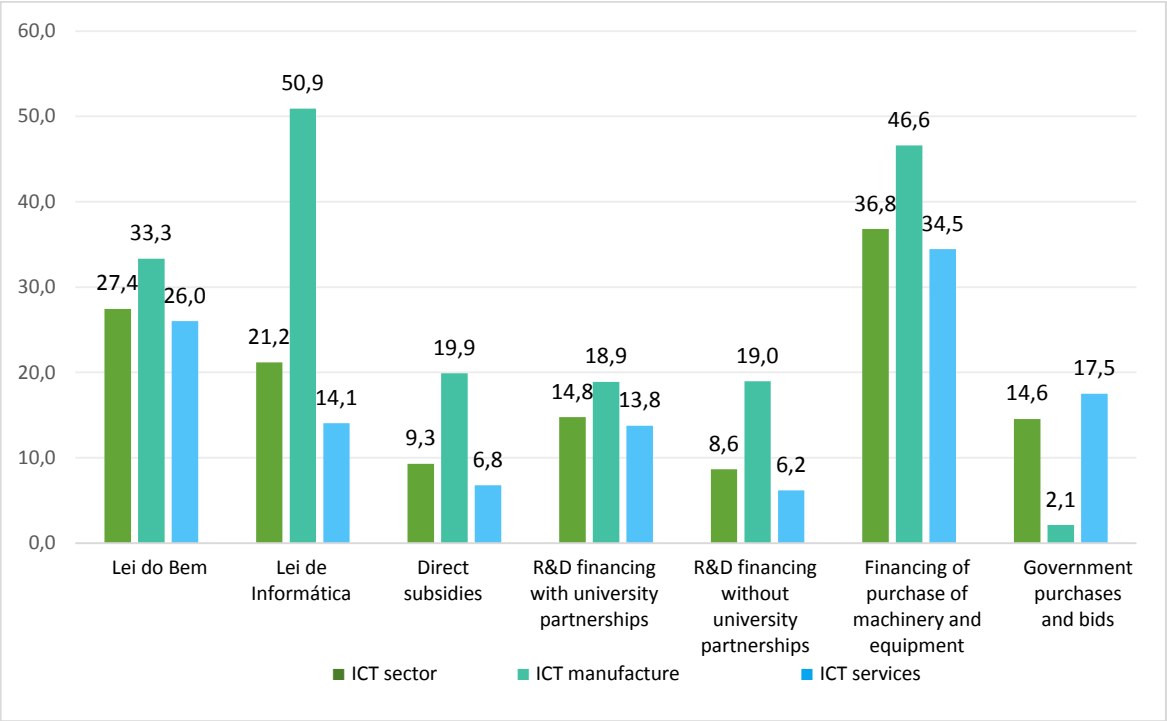
Data from PINTEC (years 2012 to 2014) show that the most accessed government innovation support instrument in the ICT sector was the financing program for machines and equipment acquisition (37% of innovative companies utilized this instrument), followed by R&D incentives of the *Lei do Bem* (27%).

Within the ICT industry, the more utilized instrument was *Lei de Informática* (51% of innovating businesses), followed by financing program for machines and equipment acquisition (47%). In ICT services, financing for the purchase of machines and equipment (34%) and Lei do Bem (26%) were the top adopted instruments. See Figure 12 for more details.

One public initiative for innovation support which is increasingly adopted in many countries is the public acquisition or government purchases instruments, by which the purchasing power of the state is used as leverage to stimulate R&D+I activities, with a final goal to increase social and economic development. In Brazil, the adoption of such instrument is still very low. PINTEC has mapped the number of businesses enrolling on government acquisition programs: the proportion of ICT businesses that performed some kind of innovation under such programs (25% of companies, mainly in ICT and telecommunication services) was higher than the national average (15%). In contrast, that proportion was only 2% among ICT industry (manufacturing businesses).

[36] Laws nº 10.664/2003 e 11.077/2004.
[37] Law nº 11.196/2005.

FIGURE 12: MAIN SOURCES OF GOVERNMENT SUPPORT FOR INNOVATION ACCESSED BY COMPANIES, ICT SECTOR (TOTAL), INDUSTRY AND SERVICES SEGMENTS (%)



Source: Original, base on data from PINTEC/IBGE (2014).

Despite the amount of important innovation support instruments available in Brazil, the most recent edition of Innovation Research also shows the barriers mentioned by businesses that did not invest in innovation: high costs (58.4% of all businesses and 61.3% in the ICT sector), economic risk to innovate (50.4% of all businesses and 42% in the ICT sector), lack of appropriate financing for innovation (41.1% of all businesses, 39.2% in the ICT sector), lack of qualified personnel (29.8% of all businesses, 30.1% in the ICT sector), and few cooperation opportunities with other businesses or research institutions (20% of all businesses, and 21.5% in the ICT sector).

The State ability to induce R&D+I activity is an instrument that can be more intensely used in Brazil.

Human resources are of great importance to research, development and innovation activities, particularly in a dynamic and knowledge intensive sector such as ICT. According to data from PINTEC/IBGE for the period 2012-2014, ICT sector businesses employed 6,417 researchers and technicians in R&D activities. This represents 6% of the total workforce employed in R&D by all companies in the country.

As mentioned before, 30% of businesses with no innovation activities pointed out the lack of qualified personnel as highly relevant barrier. The absence of qualified human resources for R&D+I activity is a particularly crucial weakness for businesses in the ICT services segment. In this group, 36% of businesses that did not invest in innovation mentioned identified this reason as a highly important

issue.

> Confidence building measures for the private sector can be reinforced with predictability of policies and programs in the R&D+I sector. Further improvements in the legal framework for R&D+I are necessary in order to ensure and expand investments in R&D+I activities in ICT.

In fact, the ongoing industry and services transformation in the digital economy has significantly changed the required skills and qualification for professionals, not only in the ICT sector but also in other sectors in economy. Applications in microelectronics, automation, computing and platforms, and the massive volume of data generated at increasing speed, it all had imposed on businesses and governments a demand for new skills in the workforce. This new type of professional must have enough qualifications deal with the management and analysis of large volumes of information and data (also known as *big data*), which are key competences to ensure competitive advantages.

Many countries are dedicated to develop and train such kind of professional. For example, the National Science Foundation announced in 2012 a new program to support training of data professionals, while giving assistance to universities and research centers to develop interdisciplinary graduate programs for students in this area. This means that even those countries included in the world digital economy value chain are in risk of a specialized professional shortage. Recent studies have mentioned that the United States will face a deficiency of 140,000 to 190,000 data analysts, and of up to 1.5 million professionals capable of making decisions based on big data by 2018.[38]

> Technical training and workforce skills development remain as challenges to make the Brazilian ICT sector more competitive internationally.

Brazil has a vigorous higher education and research system. Statistics from the INEP higher education census of 2016 reveal that the country has 195 universities, 149 higher education centers, and 40 federal technology and professional education institutes. There is also a relevant educational system for labor and professional skills, notably the National Industrial Apprenticeship Service (SENAI), which offers professional educational and industrial skills, as well as provides technical assistance to industry.

Most of these institutions are connected with high-speed data networks and other connectivity services provided by the National Teaching and Research Network (RNP), an organization incorporated to the Ministry of Science, Technology, Innovation and Communications (MCTIC).

This infrastructure provided by RNP has a positive impact on scientific output, national and international research collaboration, knowledge dissemination, and in offering online courses.

[38] Available at: http://www.mckinsey.com/business-functions/digital-mckinsey/our-insights/big-data-the-next-frontier-for-innovation, viewed on 06/07/2017.

Currently, the RNP network connects 739 campuses of universities and federal institutes.

Infrastructure development for research labs and teaching facilities are an important driver in increasing network connectivity in many areas of the country. Currently there are 739 university campuses and federal institutes connected via high speed networks in Brazil.

With regard to research facilities, a study by IPEA[39] in 2012 identified 1.760 facilities[40] devoted to research and education, of which 14% are specifically dedicated to ICT research. According to the study, these facilities are located within 143 institutions and available to 7.090 researchers (an average of four researchers per facility). Nonetheless, 60% of such facilities hold up to R$ 500 thousand in total assets (equipment and other resources)[41]. This indicates that a significant part of the country's research infrastructure is small, fragmented and unarticulated, unable to build up the scalability required to provide high-impact, competitive, new generation R&D+I in digital technology.

Despite such findings, it is important to note that Brazil presents some very good examples of large-scale research infrastructures, which are network connected and well ranked in international scientific production. This is the case of the National Research Center for Energy and Materials (CNPEM), the research units of the Brazilian Agricultural Research Company (Embrapa), the Oswaldo Cruz Foundation (Fiocruz), and the integration and testing laboratory of the Space Research National Institute (LIT/Inpe).

Some noteworthy examples of the ICT research infrastructure are the National Scientific Computing Laboratory (LNCC) – where the supercomputer Santos Dumont is the central node (Tier-0) of the National High-Performance Data Processing System (SINAPAD); the Telecommunication Research and Development Center (CPqD), the Cybernetic Defense Center (CDCiber), and the National Telecommunication Institute (Inatel).

We need better coordination among ICT research facilities throughout the country.

This infrastructure has in fact, over the last few decades, provided the basis for a prominent international status of national scientific production. In absolute numbers, between 2007 and 2016, the number of papers published by Brazilian researchers in internationally indexed periodicals has grown 88% (from 36.573 to 68.908 yearly). During this period, the country remained in 14th position in the rankings of world scientific production, accounting for 2.1% of total production.

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[39] DE NEGRI, Fernanda; SQUEFF, Flávia de H.S., org. **Sistemas Setoriais de Inovação e Infraestrutura de Pesquisa no Brasil**. IPEA, FINEP, CNPq, 2016. Available in Portuguese at: http://www.ipea.gov.br/portal/images/stories/PDFs/livros/livros/livro_sistemas_setoriais.pdf.

[40] Research facilities includes laboratories, specialized libraries, observatories, experimental stations, high speed networks, telescopes, research vehicles and vessels, etc. (DE NEGRI e SQUEFF, op.cit., 2016:17).

[41] Cf. DE NEGRI e SQUEFF, op.cit., 2016.

However, patent requests in Brazil did not grow in the same rate. Between 2007 and 2016, the number of patent requests to the National Institute of Industrial Property – INPI (the Brazilian patent office) went from 21.638 to 28.009 (29% growth during the period, with a peak of 30.876 in 2013). One positive fact is that the 5,199 patent requests from residents in 2016 represented a 12% growth in comparison with the previous year, and it was the highest amount since 2007[42].

FIGURE 13: PUBLISHED ARTICLES, PATENT REQUESTS (INPI) BY RESIDENTS AND NON-RESIDENTS, BRAZIL (2007-2016)

Sources: SJR SCImago Journal & Country Rank, INPI Assessoria de Assuntos Econômicos, BADEPI v4.0.

Such numbers reflect a big gap between scientific and technological production in Brazil, resulted from many interdependent factors that must be appropriately addressed. These factors include the existence of a significant backlog of pending patent analysis. The government has recently implemented a number of measures to improve the structure and management of INPI[43].

In technologically dynamic sectors, such as ICT, obsolescence cycles are shorter and faster, and agility in patent processing is vital. ICT are among the types of technology with the most patents published in Brazil during 2016, which includes electrical and electronic devices and technology (representing 4.7% of all patents that year). For this reason, INPI has expanded its pilot projects network of *Patent Prosecution Highway* (PPH) to include ICT, as it was done in Japan and China, which should greatly increase the speed in patents processing for new ICT technologies in Brazil.

[42] Source: "Indicadores de Propriedade Industrial 2017", INPI. Link: http://www.inpi.gov.br/sobre/estatisticas/arquivos/indicadores_pi/indicadores-de-propriedade-industrial-2017.pdf, access on 11/12/2017.

[43] Such measures include updating norms and internal procedures, international cooperation, as well as hiring 210 new public servants between 2016 e 2017.

Along with the issues highlighted in this section, other measures can contribute to stimulate the involvement of businesses in technological development and innovation. One example is confidence building in the business environment, which includes simplifying laws and norms, ensuing continuity of government support programs, stimulating public-private partnerships, and making ownership of intellectual property more clear and simple. For this purpose, a very positive step was the approval of an Executive Decree (no. 9,283/18), applied to the Innovation Law (Law 13,243/2016).

Vision

Actions related to R&D+I in this Brazilian Strategy for Digital Transformation – E-Digital must be immersed in a prospective methodology which defines technological choices that can generate jobs and increase general income, productivity and competitiveness of the industry and services sectors. They must also ensure that Brazilian businesses take part in global value chains. Relevant tools to determine choice in with this type of methodology include foresight and forecasting, consulting experts (Delphi, panels and surveys), scenarios mapping and technological roadmaps.

Regarding specifically the ICT sector, it is important that E-Digital establishes priorities on research, development and innovation to stimulate and modernize the national production structure. According to the National Strategy for Science, Technology and Innovation 2016-2022 (ENCTI)[44], "enabling technologies are those with potential impact on the manufacturing industry, particularly the convergent technologies (e.g., biotechnology, nanotechnology and ICT), as well as additive manufacturing and advanced materials". Furthermore, ENCTI stresses the critical necessity of developing and modernizing existing technologies such as sensors, networks, high performance computers, communication protocols and software. They provide the basis for new ICT applications ICT, for instance, the Internet of Things (IoT), Big Data and Cloud Computing.

To this end, E-Digital must encourage R&D+I initiatives and develop production structures in microelectronics (namely capacity-building in design houses), sensors, automation and robotics, supercomputers, artificial intelligence, big data and analytics, high performance networks, cryptography, 5G networks, and cloud computing.

Furthermore, bearing in mind the diagnosis in this chapter, the strategic actions in R&D+I for ICT must aim at:

- Optimizing policies to expand private investment in R&D+I in ICT, as to improve competitiveness of Brazilian economy, generate jobs and promote social development.
- Articulating R&D+I promotion instruments, including budget managing, by integrating projects and research facilities in the ICT sector.
- Broadening the role public policies focusing demand, including government purchases in ICT and other technologies in strategic areas, as a way to promote R&D+I activity.

[44] Available at: http://www.mctic.gov.br/publicacoes, accessed on 25/07/2017.

- Connecting research institutes in all regions in Brazil with high-speed data networks, in order to foster scientific and technological exchange, while also extending the coverage of broadband network throughout the country.

- Establishing a technological roadmap for research, development and innovation in cyberinfrastructure, with long term investment goals, able to meet the private sector demand in ICT.

- Intensifying capacity-building in order to meet the challenges presented by new ICT technologies (e.g., big data, manufacture 4.0, artificial intelligence and internet of things).

- Promoting an enabling environment for R&D+I investments in ICT by the private sector, along with increased interaction between universities, research centers and businesses.

Strategic Actions

While enabling ICT technologies can provide the elements to modernize and expand national production, strategic actions in R&D+I must also identify choices in specific sectors. Thus, it is essential to define as a priority the investment on areas in which experimental ICT innovation and development may increase competitiveness, such as:

- Security and defense: development of platforms that ensure interoperability and coordination between command and control systems of the armed forces, with emphasis on radio communication technologies. It is important to engage the private sector in the development of communication protocols, cryptography and security equipment.

- Health: in particular, to implement actions directed to digitalize health records through public technology purchase contracts for the public health system, and to improve communication tools between citizens and health service providers using data analytics and telemedicine. Such actions may include use of RNP services and networks, for instance, the RUTE telemedicine network and the SIBRATEC network.

- Agribusiness, especially technologies related to precision agriculture, unmanned aerial vehicles (UAV), remote sensing and agribusiness data management.

- Smart cities, through the use of Internet of Things (IoT) related technologies, particularly in the fields of urban mobility, security and utility smart grids (electric power, water and sewage, etc.), among others.

Furthermore, it is important to implement actions aiming:

- To integrate instruments of R&D+I promotion, as well as research facilities devoted to the development of digital technology, using technology hubs and testbeds of innovative technologies, in order to ensure scale and a strategic approach in technology development.

- To develop prospective scenarios for R&D+I priorities that could increase employment, income, productivity and competitiveness, using methodologies such as *foresighting* and

forecasting, consulting experts (Delphi, panels and surveys), and/or building scenarios and technological roadmaps.

- To utilize the purchasing power of the State to foster the development of innovative solutions based on digital technologies.

- To improve legislation and the regulatory framework – such as the *Lei de Informática* and *Lei do Bem* – in order to make R&D+I support programs more predictable and reliable.

- To stimulate interaction between universities, research institutes and businesses in digital technology R&D+I, through support programs such as RHAE scholarships (Strategic Human Resources Training Program), as well as startup incubators, technological parks and other innovation environments.

- To ensure permanent dialogue between government, academia and industry, as means to obtain coordination and convergence of these strategic actions within the scope of E-Digital.

- To expand scientific and technological partnerships with other countries, with extensive use of joint calls for international cooperation projects in R&D+I.

- To strengthen governmental science and technology research institutes, in order to increase performance and information sharing.

- To support R&D+I projects in new digital technologies that have been identified as key enablers, with a focus on technology hubs, utilizing funds made available as a result of the revision of the Lei de Informática (MPV 810/2017[45]).

Indicators

- Traditional indicators of R&D+I for the evaluation of the overall performance in national economy (e.g., level of investment vs. GDP, level of investment in a sector compared to total investment, technical qualification levels, etc.), as well as indicators for specific cases (business) or business sectors.

- Indicators based on acknowledged international benchmarks, particularly those providing comparisons with other countries with relevance in the ICT sector (e.g., Korea, China and Japan) or on specific R&D+I indicators (e.g, Finland, Sweden and Israel).

  Other existing recognized international indicators may be used as reference, such as the *Global Innovation Index*,[46] in which Brazil appears in 69th on the rankings for 2016 and 2017.

[45] http://www.planalto.gov.br/ccivil_03/_Ato2015-2018/2017/Mpv/mpv810.htm. Accessed on 11/12/2017.
[46] https://www.globalinnovationindex.org/gii-2017-report, accessed on 11/12/2017.

C. Building Trust and Confidence in the Digital Environment

Making the Internet a safe and reliable environment that enables services and business transactions while respecting citizens' rights.

The Internet is still regarded by many as a separate dimension of our everyday life. The expression "to go online" is still of common usage. However, the growing volume of business transactions, financial operations and public services provided online tend to make this phrase a thing of the past.

The expansion of the digital environment translates into enormous opportunities for economic development, social inclusion and technological innovation. It also affects the exercise of fundamental rights. On one hand, digital technologies may act as facilitators of the implementation of such rights (for example, the Internet may serve as a means for citizens to express their thoughts and opinions); on the other hand, it may also represent risks (such as the use of digital tools to unduly expose the privacy and intimacy of third parties).

In this context of opportunities and challenges, coordinated action between governmental and private agents is necessary to mitigate risks and to ensure the continued development of the digital economy. This notion, present in most digital strategies worldwide, can be translated as the idea of building trust and confidence in the digital environment.

Ensuring that users and the private sector feel confident to develop their activities in the digital environment is a complex task, involving different dimensions of State action, here grouped into broad categories of (1) protection of rights and of privacy; and (2) safety and security in the digital environment.

1. PROTECTION OF RIGHTS AND PRIVACY

Diagnosis

The protection of rights in the digital environment is crucial to build trust and confidence. It is not enough for companies and individuals to feel secure from cyberattacks and security incidents; it is also necessary to envisage the digital environment as a space in which human rights are fully protected. Therefore, new technologies must be directed towards the protection of rights and promotion of the public interest.

In Brazil, there are important legislative guidelines on the subject. The Brazilian Civil Rights Framework for the Internet – Law n. 12,965/2014, known as "Marco Civil da Internet" or the Internet Bill of Rights

– provides principles, guarantees, rights and duties, but does not exhaust the subject, leaving room for future regulation of important aspects related to the Internet, such as personal data protection, e-commerce, cybercrimes, copyright, Internet governance, digital citizenship, among others.

The first and most fundamental dimension is that of human rights. Freedom of speech, communication, expression and association, the right to access information and the right not to be discriminated, must be embedded in the architecture and governance of the Internet. Violations of these freedoms and rights by the State, by businesses and even by other users need to be monitored and repelled. The Marco Civil clearly states, in its first two chapters, the commitment of the Brazilian legal system towards the protection of human rights on the Internet.

Ensuring the right to privacy and to personal data protection is a particularly relevant topic for Brazil, given the intense participation of Brazilians in social networks, instant messaging applications, internet banking and e-commerce platforms. The Marco Civil already brings an important set of provisions on privacy and personal data, ensuring certain rights, in particular the need for user consent for collection, treatment and transfer of personal data; the right to clear and complete information about personal data treatment; and the free provision of this consent, except in the cases of mandatory log retention, as provided for in the Law.

In any case, the need for further legislation to complement the provisions of the Marco Civil is widely recognized. Among the points to be addressed are further clarification of governmental responsibilities related to law enforcement, as well as broader rules on the use and treatment of personal data, encompassing both the public and the private sectors, throughout different economic activities. Future legislation on this issue should allow for the rational use of information, as well as for the protection of citizens' personal data.

Currently, over 100 countries, both from the developed and from the developing world, in different continents, have specific legislation on the subject. Different approaches have been adopted throughout the world, with different legal and economic impacts[47]. Brazil, for the time being, does not have a law to comprehensively regulate the protection of personal data.

In a globalized and interconnected market, large volumes of data flow across national borders in a continuous stream of long and complex value chains. The importance of free flow of data is recognized by leading countries in the digital economy[48] and by international organizations. The Organization for Economic Cooperation and Development (OECD), for instance, considers that this data-driven technological ecosystem will be one of the engines of economic growth in the 21st century[49]. The organization has dedicated efforts towards the discussion of the theme since the beginning of 1980, when it drew up the recommendations of the *Guidelines on the Protection of Privacy and Transborder*

[47] For an overview of different data protection models and a debate about their impact, see a study by UNCTAD entitled "*Data protection regulations and international data flows: Implications for trade and development*", available at http://unctad.org/en/PublicationsLibrary/dtlstict2016d1_en.pdf, accessed on 10/11/2017.

[48] An insight on the concepts and main questions in this subject may be found at https://ec.europa.eu/digital-single-market/en/news/staff-working-document-free-flow-data-and-emerging-issues-european-data-economy, accesed on 10/11/2017.

[49] More details on http://www.oecd.org/sti/ieconomy/data-driven-innovation.htm, accessed on 10/11/2017.

Flows of Personal Data[50], subsequently updated in 2013[51].

Digital Certification

In Brazil, digital certification was officially introduced with the creation of the Public Keys Infrastructure ("Infraestrutura de Chaves Públicas - **ICP-Brasil")**, by means of the Provisional Measure 2.200-2/2001. Today the country has approximately 7 million active digital certificates, 61% owned by legal organizations and 39% by natural persons. In the context of ICP-Brasil, there are currently 76 certifying authorities, 614 registration authorities and 8 timestamping authorities.

The Digital Certificate is an electronic document, that uses a cryptographic key and a specific standard (X.509) containing the owners' data and guaranteeing their identity, thus ensuring confidentiality, authenticity and endorsement of any signed electronic transactions, as well as the exchange of information with integrity, confidentiality and security.

The first application to widely use digital certificates was the Brazilian Payment System ("Sistema de Pagamentos Brasileiro – SPB"), under coordination of the Brazilian Central Bank. The Brazilian Secretariat of Federal Revenue was a pioneer in adopting digital certificates in the provision of online services to citizens, such as the Virtual Citizen Information Service ("Centro de Atendimento Virtual e-CAC", the Public System for Digital Bookkeeping ("Sistema Público de Escrituração Digital – SPED") and the Electronic Tax Invoice ("Nota Fiscal Eletrônica – NF-e"). In the Judicial Branch digital certification is also widely available, especially in electronic filing, available at the Federal Supreme Court, the Superior Justice Court and at several other courts nationwide.

New technologies such as blockchain and advanced biometric identification promise a large range of applications in this field and are already being tested, including within the Federal Government. However, up to this point in time, digital certificates are still the only technology that have the essential attribute of legal validity in the country.

It is, therefore, desirable for Brazil to establish a specific legal framework regarding personal data, protecting citizens' rights and conferring legal certainty for investments in the digital economy. Personal data is currently ruled by several legal provisions, including the Consumer Defense Code (articles 43 and 44 of Law 8,078/1990), which protects the personal information of consumers; the Law on Access to Public Information (article 31 of law n. 12,527/2011), which protects personal data in the context of governmental transparency obligations; the Consumer Database Credit Scoring Law (Law n° 12,414/2011), which safeguards personal data within the framework of credit analysis; among others. The Marco Civil (article 3, sections II and III, and article 7 of the law n° 12,965/2014) also ensures the protection of privacy and personal data protection.

There are sensitive issues related to consumer rights and consumer relations involving the use of digital technologies. Consumer protection issues, such as confidence in transactions, corporate accountability, transparency of contractual terms, transnationality, treatment of consumer complaints (exchanges, cancellations, complaints) and many others, assume complex dimensions in the digital

[50] Available on: http://www.oecd.org/sti/ieconomy/oecdguidelinesontheprotectionofprivacyandtransborderflowsofpersonaldata.htm, accessed on 10/11/2017.
[51] Available on http://www.oecd.org/internet/ieconomy/privacy-guidelines.htm, accessed on 10/11/2017.

environment.

Legal uncertainties related to the so-called collaborative economy also make the situation more complex, since innovative business models frequently raise questions related to the applicable legal framework and jurisdiction. This should not, however, imply a diminished level of consumer protection, especially in face of large platforms and marketplaces.

The protection of children and teenagers in the digital environment is also a topic that requires attention, since the Internet and other digital technologies offer risks to their security and privacy. Brazil already has legislation and specialized enforcement units to fight serious crimes like pedophilia, but it is necessary to curb other threats, such as abusive advertising directed at children and teenagers and misuse of their personal data.

There are also a number of other dimensions in which it is necessary to determine more clearly how the protection of rights will occur in the digital environment. The debate around algorithms and automated decisions is an important example. The understanding that individuals have the right to know which parameters direct the operation of a particular algorithm that can have impacts on their personal lives is becoming more consolidated, along with the possibility of appeal to a human decision in more serious cases.

New themes such as algorithmic transparency, artificial intelligence and the Internet of Things will require governmental capacity for innovation, with a view to ensuring citizen protection without inhibiting innovation and the beneficial use of new technologies.

Vision

The protection of human rights in the digital environment must be ensured through the development of mechanisms for institutional cooperation between public institutions and through partnerships with market agents. There is a long list of rights guaranteed by the Federal Constitution, by international treaties of which Brazil is a signatory the and, more specifically, by the Marco Civil, fully applicable to cyberspace. Proactive engagement of public authorities and large private Internet agents is necessary to ensure their application.

The guarantee of privacy, on the other hand, still depends on progress in the normative and institutional fields. The adoption of a law on personal data protection and the creation or designation of a national authority for its application are essential measures to avoid the abusive use of Internet users' personal data.

It is also necessary to introduce and stimulate the voluntary adoption of international standards of privacy by design and default and security by design and default[52], both in the production of national

[52] The concepts of privacy/security by design and default imply that minimal standards for privacy and protection and information security on digital products and services must be applied since the product or service conception ("by design") and automatically applied without any configuration or indication required by the user ("by default"). For more information, see http://www.eudataprotectionregulation.com/data-protection-design-by-default, accessed on 10/10/2017.

technology as well as in the purchase of hardware, software and applications.

In the field of consumer law, the challenge is to improve the mechanisms of consumer protection in the digital environment. It is necessary to discuss the specific characteristics of rights such as access to information, transparency, accountability, and dispute resolution in the digital environment.

All of the abovementioned efforts must have a special focus on the protection of children and teenagers online, through specific and more protective regulations for this group. Institutional cooperation and educational campaigns are also important instruments for the effective protection of children and teenagers.

Finally, it is essential to open a broad debate on new digital technologies and the protection of rights in the digital environment, with a view to assessing the legal and ethical implications of artificial intelligence applications, Internet of Things and other industries close to the technological frontier.

Strategic Actions

- To promote the approval of a specific law on personal data protection.
- To stimulate cooperation mechanisms and partnership between public institutions and market agents with a view to the protection of human rights online, with special attention to the rights of children and teenagers, in order to ensure the principles laid out in the “Marco Civil da Internet” and in the Federal Constitution.
- To strengthen international cooperation instruments between authorities and between access and content providers operating in different countries, in order to ensure the application of the law in the digital environment.
- To create or designate a national authority competent in the field of personal data protection and international data flows, able to standardize best practices and ensure the application of the law.
- To disseminate the adoption of digital technologies in the validation of transactions and electronic documents produced in the digital environment.
- To stimulate the definition and adoption of standards and certification of privacy by design and default and security by design and default.
- To understand and adapt to the specific characteristics of consumer relations in the digital environment, seeking flexibility for new business models and adequate consumer protection.

2. DEFENSE AND SECURITY IN THE DIGITAL ENVIRONMENT

Diagnosis

The data presented in the previous Chapter ("Infrastructure and Access to Information and Communication Technologies") reveals that Internet access levels are on the rise in Brazil. According to ANATEL, fixed broadband is present in 40% of the households, the 3G network covers 95% of the population and the 4G network covers 72% of the population. The indicators are positive, but increased access rates and larger adoption of digital technologies also increase the chances of cyber security incidents and the vulnerability of the network.

Brazil has made progress in the area of cyber defense in recent years. The creation of the Cyber Defense Center and Cyber Defense Command, specialized units linked to the Brazilian Army, and the prioritization of the topic in the context of the National Defense Strategy[53] are important milestones. The continuity of investments in this field, including research and development, and the training of qualified human resources are critical to national defense.

Most of the threats in cyberspace, however, consists of illicit actions aimed at obtaining undue advantages through the exploitation of security breaches in *software* and devices. Cybercrimes bring huge losses[54] for the economy. There are no reliable statistics about the financial impact of cybercrimes on Brazilian companies or about the volume of their investment in cyber security, although several international studies mention Brazil as one of the largest targets and sources of attacks.

National Policy for Information Security

The Federal Government, under the leadership of the Office of Institutional Security (GSI), is finalizing the formulation of the National Information Security Policy (PNSI) in the form of a bill to be presented to the National Congress. The PNSI focuses on cyber security by the dimension of information security management and recognizes the economic and social value of information in a data economy.

The policy is openly guided by respect for human rights and by the emphasis on coordination between federal and local governments, partnerships between state and private agents, international cooperation and prevention and education practices to promote greater security in the digital environment.

Brazil occupies an intermediate position in the Global Cybersecurity Index[55] of the International

[53] Available on: http://www.defesa.gov.br/arquivos/estado_e_defesa/END-PND_Optimized.pdf, accessed on 06/07/2017.
[54] The global cost of digital illicit activities is estimated by the company McAfee from US$ 400 billion to US$ 600 billion, although there are even higher estimates by other expert consultants. See more at: **Net Losses: Estimating the Global Cost of Cybercrime**. Available on https://www.mcafee.com/de/resources/reports/rp-economic-impact-cybercrime2.pdf, accessed on 06/07/2017.
[55] ITU. **Global Cybersecurity Index (GCI) 2017**. Available on: https://www.itu.int/dms_pub/itu-d/opb/str/D-STR-GCI.01-2017-PDF-E.pdf, accessed on 12/07/2017.

Telecommunications Union (ITU), ranking 38th in a list of more than one hundred countries. ITU's analysis considers several aspects, such as legal measures, sector regulation, organizational structures for response to incidents, capacity building and the existence of governmental agencies dedicated to information security.

The ITU classifies countries into three broad categories related to the strength of cybersecurity: initiating stage, maturing stage and leading stage. Brazil is in the intermediate group, since the country already has practical experience and a developing institutional architecture: there is criminal and compliance legislation, an incident response structure (CERT CSIRT etc.) and Government agencies that deal with the subject.

However, the detailed assessment of the elements that make up the index demonstrates that there are still major challenges to overcome. Despite recent advances, the country still needs to improve its regulatory and institutional framework to be equal to the challenges of digitalization of society and economy.

Vision

The continuous expansion of Internet access, the higher digitization of economy and the rapid growth of the Internet of Things increase the points of vulnerability and make the threats to cybersecurity and cyber defense more complex. The issue should, therefore, be regarded as a national priority.

Brazil has been treading a successful path in this area, but it is necessary to overcome some challenges that could disrupt this trend. Firstly, it is important to mention the need for a broad review and integration of legislation aimed at combatting cybercrime. Sparse and disconnected norms weaken the States' capacity for action and make the legal framework more opaque to users and private agents.

It is also necessary to invest in specialized human resources training and in the capacity for research, development and innovation in cyber security and cyber defense, in order to promote national technological autonomy in this sector. Efforts should be made towards the development of dual-use technology and knowledge, i.e. technology that can be used for both peaceful and military aims. The State should use its purchasing power to leverage the private sector in this field and directly promote basic research and technological development.

The biggest challenge, however, is the establishment of an appropriate institutional structure. It is important for Brazil to formulate a comprehensive national strategy for cyber security and defense, as well as mobilization plans for the different levels and spheres of Government. The strategy should devote special attention to the protection of national critical infrastructure, both to the infrastructure directly related to the operation of the Internet (servers, traffic exchange points, *data centers*), as well as to other critical sectors (electricity, water, oil and gas, basic industry etc.).

To ensure the successful implementation of this strategy, create expertise within the government, and increase the general level of alert and readiness in the country, it is also essential to rely on a specialized body within the public administration. This institution will have the central task of promoting wide cooperation between the public and private sectors – including for the protection of

critical infrastructure – a factor that is crucial for the effectiveness of the actions envisaged in the strategy and action plans.

To measure the success of the country in the areas of cyber defense and cybersecurity, and also to calculate the cost of failure, public authorities and the private sector should also unite to produce reliable statistics and data on vulnerabilities and on the economic costs of cybercrimes in Brazil. Appropriate metrics and information-sharing models can be developed through international cooperation with pioneer countries in this sector.

In the universe of cybersecurity, the limits of national jurisdiction are constantly challenged by attacks and transnational threats. International cooperation is therefore crucial for the effective prevention of and response to cybercrimes. In addition to the signing of multilateral or bilateral cooperation instruments, the exchange of strategic information and the exchange of human resources between agencies are important steps for coordinated work between agencies from different countries.

The ultimate goal should be to improve the relative position of the country in international indicators related to cybersecurity and to demonstrate that the Brazilian State is prepared to face the challenge of defending its sovereignty and enforcing law in the digital environment.

Strategic Actions

- To develop a national cybersecurity policy, including the definition of a specialized body at federal level responsible for the articulation of a national cybersecurity system and for the relationship with the private sector.
- To consolidate the legal framework related to cybersecurity, harmonizing the existing legal provisions and providing for new investigative instruments related to the digital world.
- To establish national and subnational plans for prevention, incident response and mitigation of cyber threats, including in the context of critical infrastructures.
- To establish cooperation mechanisms between governmental entities, federated entities and the private sector with a view to the adoption of best practices, information sharing, adoption of appropriate standards of safety, incident response coordination and critical infrastructure protection.
- To provide training for public agents in security and cyber risks mitigation and develop partnerships for training of human resources in the private sector.
- To implement broad educational campaigns to raise the awareness of the population on the theme of information security.
- To provide specialized training of human resources and invest in research and development in the area of cyber defense and cybersecurity, with a view to promoting national technological autonomy in terms of skills and products.

- To strengthen international cooperation instruments between authorities and between access and content providers operating in different countries, in order to ensure the application of the law in the digital environment, especially in cases where the transnational character of the crimes and cyber threats force the involvement of more than one jurisdiction.

Indicators

- ITU Cybersecurity Global Index[56].

- Public-private cooperation for the construction of reliable indicators on the number, nature and cost of cyberattacks and cyber incidents, focusing on national indicators (CETIC and CERT.br) and seeking international comparability between countries.

[56] Available on https://www.itu.int/en/ITU-D/Cybersecurity/Pages/GCI-2017.aspx
Accessed on 12/07/2017.

D. Education and professional qualification

Qualifying society for the digital world, with new skills and advanced technologies, and preparing people for the labor market of the future.

Digital education be increasingly become an important step for the exercise of citizenship and a precondition for successful professional activities. Citizens' capacity for self-determination and critical judgement in the digital world – at work, in virtual communities, as consumers and as citizens – will depend on a critical and well oriented digital education.

The provision of high-quality education is vital for socioeconomic development and for the prosperity and competitiveness of Brazil in regards to other countries. The importance of education in the digital age requires a proactive and decisive attitude of the Government, the private sector and society on the subject.

Several countries worldwide have faced large educational challenges in a strategic manner, and now reap the benefits of having elevated education to a national priority. Currently, digital technologies have a dual role in the subject of education: they provide new ways to educate and learn, and they are an essential component for the leap in quality that the country requires, if employed in a coordinated manner, exploring all the potential they have to offer.

For Brazil to reach international levels of quality of education and to enter the circle of the world's most dynamic economies, exploring its social and economic potential, two priorities should be established for the field of education and professional training:

- Improve the quality of education through broad access to digital content and technologies, with ongoing training and support to teachers and students; and
- Facilitate employability, the insertion in the labor market, the opening of new job opportunities and entrepreneurial abilities in the digital age.

The education of the future will occur throughout life (lifelong learning) and continuing education will play a central role in the life of an increasing number of people. Educational policies for the digital environment will play a relevant role in reducing inequalities related to the access and use of digital technologies.

Access to jobs, the exercise of citizenship and entrepreneurship will increasingly depend on appropriate digital skills, ranging from basic digital literacy to the acquisition of specific skills for the most dynamic technological sectors. Furthermore, many of the jobs and careers in the next ten years will depend on knowledge and skills in science, technology, engineering and mathematics (STEM Skills), and virtually all professions will require ICT literacy.

Principles for an effective Educational Technology Policy

National and international studies highlight that, for the use of ICT to have a positive effect on education, the implementation of programs and policies must observe and keep in balance four dimensions of the use of technologies. This approach is based on a theory called "Four in Balance" developed by Kennisnet Studies Center of Holland[57].

Source: CIEB[58]

These studies also highlight that effective policies regarding the use of ICT in education must comply with certain lessons learned from national and international experiences:

- The policy must be clear, with definition of short, medium and long term goals, covering all levels of Government (National, State and municipal).
- The policy should be updated periodically, including the strategies and goals.
- The policy must be coordinated with the various actors involved, providing for cooperation between the federative entities.
- Each actor responsible for implementing the policy must have a clear vision about its role and the goals to be met.

Managers, professionals and policymakers should also keep in mind that technology should not be employed in education in the hope of short-term results in students' learning through standardized tests. Technology may contribute to the improvement of learning. It may also produce impacts on

[57] Further information: https://en.wikipedia.org/wiki/Kennisnet and https://www.kennisnet.nl/about-us/, accessed on 30/06/2017.

[58] Available on: www.cieb.net.br/wp-content/uploads/2016/12/CIEB-Estudos-4-Politicas-de-Tecnologia-na-Educacao-Brasileira.pdf, accessed on 30/06/2017.

other important factors, such as:

- Improving the efficiency of school management.
- Better preparation of students for the labor market.
- Facilitating access to content and professionals of high quality, especially in isolated areas or areas with low population density.
- Offering better opportunities to students with physical disabilities, such as limitations in vision, hearing or mobility.

However, the use of technology in the educational environment should occur gradually, in a negotiated manner and according to certain levels of maturity, in order to avoid adverse effects, contrary to the desired goals: for example, worsening of results of traditional teaching methods, dispersion of students, increase in the level of conflict or of school evasion rates.

Diagnosis

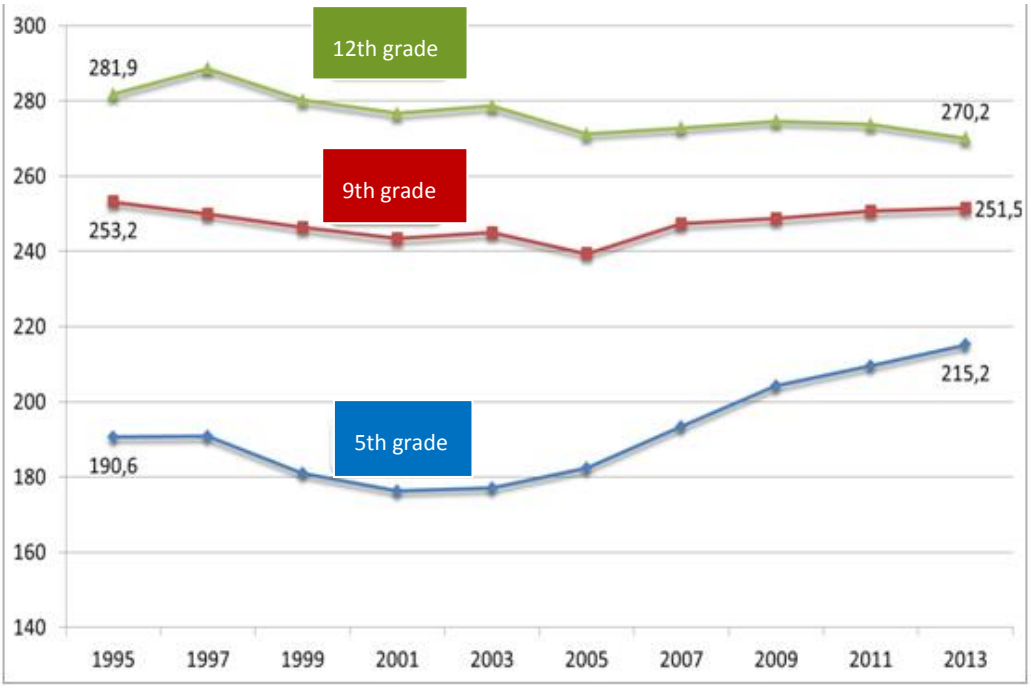
As mentioned, Brazil has historical experience in innovation and educational technology. However, the policy currently in place is still the 2007 reformulation of the ProInfo Program, drawn up originally in 1997. Twenty years after the publication of the first version of this policy, it is necessary to devise new initiatives adapted to the current reality.

A diagnosis as to the Brazilian educational technology policy, however, requires a broader look at education in general in the country. It is well known that Brazil undertook many efforts over the past 20 years to foster the broad dissemination of basic (including primary and secondary education), technical and higher education in the country.

With regard to basic education, largely universalized, the challenge is now the improvement of its quality. In international comparison, the country does not occupy a position that reflects its economic and social importance. In the International Student Assessment (PISA), promoted by the Organization for Economic Cooperation and Development (OECD) relating to the year 2015, Brazil held the 63rd position in Science, the 59th in Reading and the 66th position in Mathematics, in a total of 70 countries that participated in the evaluation.

Such results, to some extent, reflect the effort of universalization of education conducted in recent years, as evidenced by stagnation and the existence of a certain period of decreased results identified by the System of Basic Education Evaluation (SAEB) promoted by the National Institute for Educational Research and Studies (INEP):

FIGURE 14: AVERAGE SCORE IN MATH (MIDDLE AND HIGH SCHOOL)



Source: INEP[59]

Connectivity has been highlighted among experts as an important means for improving educational policies[60]. Connectivity plays a role on four pillars of an adequately formulated educational policy: (i) it enables improved school management, as it allows the formulation of more reliable indicators and the improved flow of information between managers, directors and teachers, (ii) it enables new manners of continuing training of teachers, (iii) it increases access to information by students, and (iv) it enables better monitoring of students by parents and guardians, facilitating and strengthening the involvement of parents in the education of their children.

Currently Brazil has approximately 150,000 elementary public schools, many of which are small rural schools (38% of the total number of schools) with only 8% of the total students. The vast majority of students (86% of the total) are in urban schools, with more than half (53% of total students) concentrated in large and urban schools.

The network of private schools in Brazil, on the other hand, has minor problems regarding connectivity, encompassing 40,500 schools with approximately 9 million students, representing 20% of the total

[59] Extracted from MENEZES FILHO, Naercio A**. "Como melhorar a educação no Brasil?"**, published at http://www.brasil-economia-governo.org.br/2015/11/09/como-melhorar-a-educacao-no-brasil/, 2015 (in Portuguese). Accessed on 30/06/2017.

[60] See news article: http://g1.globo.com/educacao/noticia/brasil-cai-em-ranking-mundial-de-educacao-em-ciencias-leitura-e-matematica.ghtml (in Portuguese), accessed on 06/07/2017. See also: PRETTO, Nelson De Luca. **Reflexões : ativismo, redes sociais e educação**. Salvador, EDUFBA, 2013. Available on http://www.repositorio.ufba.br:8080/ri/bitstream/ri/14628/1/Reflexoes_ativismo%2C%20redes%20sociais%20e%20educacao.pdf, accessed on 30/06/2017.

students.

As for Internet access, 59% of basic education public schools have Internet access, although there is inequality between rural and urban schools: only 24% of the total rural schools have access to the Internet, while 85% of urban schools are connected. This access profile largely reflects the telecommunications business model, in which infrastructure is usually concentrated in densely populated regions with a larger income profile.

Regarding the incorporation of technology in teaching, only 3% of public schools for basic education have computers in all classrooms, and in only 19% of schools is there sufficient bandwidth to allow students simultaneously to access videos and games. In addition, 67% of teachers did not participate in training courses on the use of technological resources for education, or participated only in courses on the use of basic tools[61].

Professional Training

One of the most prominent aspects related to the incorporation of new technologies such as IoT in production processes, or to the growth and development of *startups,* is the shortage of professionals with adequate training in the area of information technologies.

Brazil Mais TI Program

The Brasil Mais TI program was designed to facilitate vocational discerning and training for young people ages 16 to 25, and to contribute to new information technology (IT) professionals for a growing, strategic market in the country. For these ends, the programs offers basic, intermediate and advanced IT courses, as well as professional information in the IT job market. Today, Brasil Mais TI offers over 600.000 single courses.

This shortage of skilled professionals is a reflection of a widespread deficiency in IT skills throughout the population. The reversion of this trend requires not only the introduction of computing skills into basic education, but also the existence of continuous professional training programs.

One of the ways to make up for the absence of qualified labor is through the attraction of foreign professionals, a practice adopted by many countries. Brazil has not promoted policies to this end, and has attracted skilled labor only in specific periods due to high rates of economic growth.

Another alternative is the implementation of job qualification policies. In the Brazilian case, it should be noted that in 2008 to 2015 the number of enrollments in technical high school[62], including all administrative spheres and the private sector, grew from 933,000 registrations in 2008 to 1,694,000 in 2015. Of these, in 2015, 215,000 enrollments corresponded to courses in ICT related areas

[61] Other statistics on the use of technology in public and private schools in Brazil can be found on Cetic.br publications, available on http://cetic.br/pesquisa/educacao/ (in Portuguese).
[62] Includes courses that are coursed simultaneously with or subsequently to high school.

(computing, communication networks and others)[63].

Another important highlight is the offering of free online technical courses. The school census of 2015 registers more than 144,000 enrollments in online technical courses. It should be noted, however, that the qualification of medium-level technicians is just one of the paths towards vocational training, which must associated to the needs of industry and of the productive sectors[64].

On the other hand, higher education technological courses reached 1,029,000 enrollments in 2014, 133,000 of which in mathematical and information sciences.

Open Educational Resources

UNESCO defines Open Educational Resources (OER) as "any type of educational materials that are in the public domain or introduced with an open license. The nature of these open materials means that anyone can legally and freely copy, use, adapt and re-share them. OERs range from textbooks to curricula, syllabi, lecture notes, assignments, tests, projects, audio, video and animation."[65]

A common misconception is to assume that, if the content is made available for free, it can be considered "open content". Many contents available for free on the Internet are not open, since they do not allow the user to save, modify or share them. In many cases, the resources are available for a given time or with access barriers, for example, by requiring the sharing of personal data. The amount of open educational resources in the world is growing[66]. Research on the topic in Portuguese-language countries is increasing[67], and there are several portals and repositories with REA in Brazilian Portuguese[68]. International declarations seek to encourage governments to promote REA, as is the case of the 2012 Paris OER Declaration on open educational resources[69]. The priority of open resources is also recognized in the current National Education Plan (goals #5 and #7), as well as in Resolution CNE/CES nº 1, 11/03/2016[70].

REA may promote greater access to quality education, fostering new educational practices, driven by digital culture. They go beyond traditional closed educational products, by introducing the possibility of adaptation to local context, and creation and authorship practices by teachers and students, translating in a more adequate manner the innovative environment expected for education in the digital

[63] Data available at SCHWARTZMAN, Simon. **Educação média profissional no Brasil: situação e caminhos**, 2016, São Paulo: Fundação Santillana.

[64] Brazil was awarded second place on the World Skills international Competition, held in Abu Dhabi in 2017, and first place in mechatronics, industrial electricity, integrated manufacture and other categories. Available on http://www.portaldaindustria.com.br/agenciacni/noticias/2017/10/brasil-conquista-2o-lugar-no-mundial-de-profissoes-tecnicas-a-worldskills/, accessed on 11/12/2017.

[65] Definition by Unesco, available at http://www.unesco.org/new/en/communication-and-information/access-to-knowledge/open-educational-resources/what-are-open-educational-resources-oers/, accessed on 30/06/2017.

[66] See more at https://stateof.creativecommons.org/, accessed on 30/06/2017.

[67] See publications on this subject on http://revistas.uned.es/index.php/ried/article/view/16332, accessed on 10/11/2017.

[68] A OER landscape for Latin America is available at http://www.irrodl.org/index.php/irrodl/article/view/2426.

[69] Available on http://www.unesco.org/new/en/communication-and-information/access-to-knowledge/open-educational-resources/what-is-the-paris-oer-declaration/, accessed on 30/06/2017.

[70] Available on: http://portal.mec.gov.br/despesas/323-secretarias-112877938/orgaos-vinculados-82187207/34891-resolucoes-cne-ces-2016, accessed on 30/06/2017.

culture of the 21st Century. They create opportunities for new models of acquisition and distribution of publicly funded educational resources and create conditions for new business models[71].

Other technological trends related to education are[72]:

- Open Education. Often confused with free education, open education is replicable, combinable and has no barriers to access and interaction.
- Open and free courses. With the popularization of Massive Open Online Courses - MOOCS, online, open and free courses become a strong alternative to traditional study, especially for those who are out of school.
- Real-world skills. The job market increasingly demands skills that are most frequently acquired in informal learning situations, such as problem-solving, resilience and other emotional skills. Schools are still not ready to meet such demands.
- Customization and new sources of evaluation. Online activities analysis tools can be used as evaluation tools and also to create learning tracks according to the student's profile.

Vision

With regard to the strategic vision for the use of technology in Brazilian education, it is worth noting that two reference documents point out priorities in this regard. The National Education Plan (Plano Nacional de Educação – PNE) stipulates the following strategies:

- Strategy 5.3: "Select, certify and promote educational technology for child literacy (...)"
- Strategy 5.4: "Encourage the development of educational technologies and innovative pedagogical practices that ensure literacy (...)"
- Strategy 5.6: "Promote and stimulate the initial and continued training of teachers for child literacy, building capacities related to new educational technologies and innovative pedagogical practices (...)"
- Strategy 7.12: "Encourage the development, select, certify and promote educational technologies for early childhood, elementary and high school education, and encourage innovative pedagogical practices (...)"

[71] For more information, see http://www.cieb.net.br/cieb-estudos-inovacao-aberta-em-educacao-conceitos-e-modelos-de-negocios/ (in Portuguese), accessed on 30/06/2017.
[72] Extracted from "CIEB Estudos #2", Inovação Aberta em Educação, 2016, pg. 11, available on http://www.cieb.net.br/cieb-estudos/, accessed on 30/06/2017.

- Strategy 7.15: "Universalize, until the fifth year of the duration of this National Education Plan, access to the worldwide network of computers in high speed broadband and, by the end of the Decade, triple the computer/student ratio in basic education public schools (...)"

On the other hand, the National Common Curricular Base (BNCC)[73] stipulates that one of the ten general skills to be developed by all Brazilian students is to "understand, use and create digital information and communication technologies in a critical, significant, reflective and ethical manner, in diverse social practices (including within schools)", aiming at the communication, access and dissemination of information, as well as the production of knowledge and solution of problems. Technology is also pointed out as a strategy to achieve the other competencies provided for in the BNCC, and is mentioned several times throughout the document.

In this manner, having in view the diagnosis outlined above and the guidelines already provided for in the PNE and the BNCC, the Brazilian Strategy for Digital Transformation must seek to promote wide access to students and teachers to high-quality teaching resources and innovative pedagogical practices, through the universalization of high-speed internet access in public schools of basic education; ensuring sustainable funding in time, in conjunction with States and Municipalities; stimulating the autonomy of students and teachers regarding the adoption of technology for education; and periodically evaluating the implementation and the impact of such policies, the use of these technologies and their contribution to the Brazilian education.

Strategic Actions

- To prioritize the implementation of competencies related to Computational Thinking in middle school, as defined in the National Common Curriculum Base.

- To formulate a new national policy of educational technology to replace PROINFO, articulating the strategic dimensions of infrastructure, competencies, content and digital educational resources.

- To expand broadband connectivity in urban and rural schools, combining connectivity solutions through fiber optic cabling, radio and satellite networks, increasing the speed of access in schools that are already served by terrestrial telecommunications networks, and structuring a new funding model for high speed Internet for the public education system.

- To improve initial and continuing training of teachers of basic education, considering technological transformations and providing practical guidance as to the use of technology in the classroom.

- To encourage the production and dissemination of digital content created by teachers and students, as well as encourage the open sharing of publicly-funded resources, with and

[73] Available on http://basenacionalcomum.mec.gov.br/images/BNCC_20dez_site.pdf, accessed on 21/12/2017.

between public and private educational networks, giving preference to open educational resources.

- To review traditional policies, such as the National Textbook Plan (PNLD) and the ministry of Education's Technology Guide, for a planned transition from analog educational resources to digital mediums.

- To prioritize, in the New High School model, the strengthening of STEM subjects (mathematics, science, technology and engineering) and technical qualification tracks for sectors of the digital economy, taking into account the importance of stimulating girls and women to seek careers in ICT-related fields.

- To promote greater interaction between the private sector and educational institutions (universities, research institutes and professional and technical training institutes), in order to incorporate the demands and needs of digital companies of the future, applying concepts such as *lifelong learning* and vocational education.

- To facilitate the obtaining of certificates and the formal recognition of skills acquired in vocational training, either through partnerships with vocational education institutions or through partnerships with companies or other entities.

Indicators

The monitoring of the following indicators is suggested:

- Program for International Student Assessment (PISA), promoted by the Organization for Economic Cooperation and Development (OECD).

- Number of schools with access to the Internet and actual speed, measured by appropriate devices, such as SIMET developed by NIC.br, in possible partnership with the MEC.

- The average internet speed in Brazilian public schools.

E. International Dimension

Strengthening Brazilian leadership in global forums related to digital issues, stimulating competitiveness and the presence of Brazilian companies abroad, and promoting regional integration in the digital economy.

The digitization of the economy occurs globally, across borders and eliminating distances. Therefore, it is crucial to deal with this phenomenon from a global perspective, with international involvement in global and multistakeholder forums, and devoting special attention to cross-border issues related to data, goods and services.

Digital economy also provides excellent opportunities for greater regional economic integration, particularly in Latin America, with the expansion of trade, finance, people and communications flows, which allows lower costs, higher income and development gains. New business models enabled by digitalization require a proactive stance in international trade negotiations, such as those held before the World Trade Organization (WTO), where topics such as e-commerce are being discussed. Other key issues for the country to enjoy the benefits of digitalization include international data flows, location of companies and datacenters, modes of provision of services in other countries, technological standards, and taxation. Economic relations in the digital world also involve issues related to the legal and regulatory environment, such as personal data protection and privacy, copyright and the regulation of digital platforms.

There are increasing possibilities to enlarge the presence of Brazilian companies abroad, including initiatives that range from sending technology-based *startups* to major centers of innovation and entrepreneurship, to participation in global digital platforms, with increased exportation of goods and services.

It is also essential to contribute to the global decision-making processes related to the Internet, such as the management of critical Internet resources. Brazil has for many years held a role of leadership in these issues, and this role should be maintained, in support of multistakeholder representation in global forums, given the complexity of the Internet ecosystem and the persistence of the digital divide.

1. INTERNET GOVERNANCE

Diagnosis

The Brazilian approach towards Internet Governance has become an internationally consolidated

reference. Among Brazilian landmarks in this field, it is important to mention the *Marco Civil da Internet* (Law n. 12.965/2014), which establishes Civil rights and obligations in the use of the Internet and sets out principles such as network neutrality, privacy, freedom of expression, as well as mechanisms to promote greater legal certainty in those issues. The multistakeholder model of the Brazil Internet Steering Committee (CGI.br) has also been presented internationally as a positive example since its creation in 1995.

On the topic of Internet Governance, Brazil has traditionally emphasized certain positions in view of the international debate:

- Complexity of the Internet ecosystem, with diverse actors assuming different roles;
- Multistakeholder approach and the definition of distinct and complementary roles and responsibilities for each sector – pillars of the WSIS framework in the Tunis Agenda of 2005, reaffirmed by the WSIS+10 process carried out by the United Nations General Assembly in 2015;
- Persistence of the digital divide;
- Structural problems that contribute to the digital divide, such as the difficulty in access to technology;
- The asymmetry of representativeness among countries in international forums, given the human and financial resource constraints for engagement on all negotiation fronts.

The current Internet Governance system faces many challenges. The issues of cyber security, management of Internet critical resources, jurisdiction and taxation are examples of critical points for the global governance of the network.

Vision

It is important to maintain Brazil's leadership in Internet governance based on the principles set out during the World Summit on the Information Society[74]. As explained in the Tunis Agenda, "…the international management of the Internet should be multilateral, transparent and democratic, with the full involvement of governments, the private sector, civil society and international organizations".

It is also important to promote the principles of access expansion adopted in Brazil: investment in infrastructure, dissemination of high quality access, lower price and the rights protection. This approach should be taken in a balanced multisector environment of multisector, with proportional representation in all debate forums. The net is global, therefore its challenges should be handled in a global framework, with global cooperation. The focus of this approach is benefiting people with a

[74] See the Tunis Agenda for the World Summit on the Information Society at https://www.itu.int/net/wsis/docs2/tunis/off/6rev1.html.

development goal.

Brazil will also continue to strive for conditions of full participation of the different sectors, in their varied roles and responsibilities, in fora, processes and Internet governance bodies, including the exercise of leadership by Governments, where applicable. In the case of ICANN (*Internet Corporation on Assigned Names and Numbers*, the global authority for governance network resources), decision-making about the critical network resources management must be democratic and transparent.

It is necessary a realistic approach to the theme of governance, making sure that no agent has alone the total dominance of the resources, and striving to ensure rights and ensure duties. It should also, within the framework of the United Nations, progress in discussions on cyber weapons.

Strategic Actions

- Act in international fora in order to defend the principles consistent with the World Summit on the information society, with the understanding of the respective roles and responsibilities of Governments, intergovernmental and international organizations, as well as the private sector and civil society, from both developed and developing.
- Boost Internet governance topics in forums, negotiations, mechanisms and joints to treat this agenda, using partnerships in different areas (European Union, Mercosur, IBAS, BRICS, G20, UN, among others).
- Expand multilateral trading spaces of public policies, especially in the subjects of jurisdiction, cyber security and taxation.
- Act for implementation of new mechanisms of peaceful conflict resolution in the cyber environment, such as the initiative of the *Group of Governmental Experts* (GGE) of the United Nations[75].

2. COORDINATION AND INTEGRATION PROCESSES IN THE DIGITAL ECONOMY

The rapid digital transformation on a global scale, with impacts on economy, politics and society, has been the subject of intense joint in various international fora in which Brazil is engaged. The country has been active participant of discussions in multilateral processes of coordination and integration in the digital environment

Moreover, with the growth of trade in the digital environment, especially trade in digital content, it becomes necessary to adapt concepts, practices, and regulations to an increasingly digital economy. In this sense, the digital economy has gained prominence in negotiations in international fora.

[75] For more information on GGE activities, see https://dig.watch/processes/ungge. Accessed on 20/09/2017.

Highlights the activities that occurred throughout 2017 in the following forums:

- **G20**: first meeting of Ministers, Düsseldorf – Germany, 6 and 7 April 2017. The representatives of the G20 member countries signed the document "*G20 Ministerial Declaration: Digital Economy Shaping Digitalisation for an Interconnected World*"[76], whose annexes detail the public policies and priorities for implementation. In the second semester of 2017 the Argentina assumed the rotating Presidency of the G20 and, in close coordination with the Brazil, aims to bring focus to the region's priorities in digital themes.

- **OECD**: Brazil presented letter with formal request to join the Organization for economic cooperation and development (OECD), on 30 may 2017. The brazilian request follows the successful implementation of the programme of work that resulted from the cooperation agreement signed between Brazil and the OECD in 2015. The Brazilian elections is under review by the Council of the OECD.

- **BRICS**: third Meeting of Communications Ministers of the BRICS – Hangzhou, China, from 26 to 28 July 2017, with follow-up and implementation of the initiatives agreed upon by this Court in your 2nd meeting (India, 2016), and consolidated in the document "*BRICS ICT Development Agenda and Action Plan*"[77]. In addition, during the seventh meeting of Ministers of Trade of the BRICS, commerce was one of the highlights, which led to the creation of a specific working group for discussion of the topic.

- **MERCOSUR**: in this year of 2017, Brazil assumed the Presidency Pro Tempore of the regional bloc, having led the process that resulted in the establishment of the "Digital Agenda Group" (GAD – Grupo Agenda Digital), an auxiliary working group to the Common Market Group (GMC – Grupo Mercado Comum), with an aim to promote the development of a Digital Mercosul.

- **eLAC 2018**: preparatory meeting of the 6th Ministerial Conference on the information society of Latin America and the Caribbean, Santiago-Chile, held from 7 to 9 August 2017[78]. The Colombia will host, in April of 2018, the next Ministerial Conference on the information society of Latin America and the Caribbean (eLAC).

Deserves special mention the creation of a Digital single market in Latin America, inspired by similar process underway in the European Union. This is a new initiative that is gaining momentum among the processes of coordination and economic integration of our region. She can be in exceptional economic opportunity for the Country, opening markets for Brazilian products with projection through digital platforms and *marketplaces*, summed the comparative advantages in delivery logistics in the region. Private sector engagement in the processes of coordination and integration is a key factor in

[76] Available on: unctad.org/meetings/en/Contribution/dtl_eWeek2017c02-G20_en.pdf, accessed on 06/07/2017.
[77] Available on: www.ranepa.ru/images/media/brics/indianpresidency2/11-11-2016%20BRICS%20ICT%20Development%20Agenda%20&%20Action%20plan.pdf, accessed on 06/07/2017.
[78] The United Nations Economic Commission for Latin America and the Caribbean (ELAC) provides technical support to eLAC, a coordination mechanism for digital agendas of Latin American countries. The current work cycle of eLAC 2018, backed by the Ministerial Declaration eLAC 2015 and approved in the last Ministers Conference hosted in Mexico, focuses on the region's digital integration.

the country's insertion into global markets.

One of the focuses of this strategy is the digital platforms and *marketplaces*, as explained in the chapters ahead. The Brazil is responsible for 50% of the volume of Commerce in the whole Latin America[79]. The importance of this market segment of digital platforms for electronic commerce tends to grow with the process of integration and consolidation of the value chain in Latin America.

Strategic action

- Expand the active engagement of the country in the negotiations of the instances of coordination and integration in the Digital economy, ensuring representation and participation in the discussions and deliberations on this topic.

3. THE INTERNATIONALIZATION OF BRAZILIAN COMPANIES IN THE DIGITAL ECONOMY

The promotion of exports of Brazilian products and services, as well as the attraction of foreign investments for strategic sectors of the Brazilian economy, relies on the efforts of various private and public actors, especially the Brazilian Agency of Promotion of exports and investments (Apex-Brazil).

Apex-Brazil's actions aimed at facilitating the access of Brazilian companies to international markets, diversify the destinations of Brazilian exports and improve international perceptions about companies, products and services.

In addition, other specific public policy initiatives can also support the process of internationalization of small and medium-sized enterprises (SMEs). Actions of promotion and capacity building of SMEs, especially those who engage in a highly competitive market segment, such as international commerce, are critical to your success. In addition, SMEs have an important role in the generation of jobs, which in the digital economy are typically more skilled.

Diagnosis

The international e-commerce scenario, dominated by a limited universe of *marketplaces*, is identified as covering two large segments: commerce B2B (*business to business*) and B2C (business-to-*Commerce consumer*).

In both segments are identified opportunities for Brazilian companies, including cost reduction of prospecting for customers, product visibility and multiplication of direct sales channels. However, at

[79] Data from UNCTAD, available on http://unctad.org/en/PublicationsLibrary/ier2015_en.pdf.

the same time also challenges arise, such as the management of digital platforms, security sales, payment and logistics, to name a few.

The process of internationalization of Brazilian companies via e-commerce should be in stages, involving initially the establishment and management of own Internet site, followed by a second phase of internationalization of digital platform.

The central role of SMEs in the economy, as well as your growth potential with international commerce, is widely recognized. Several countries and regional blocs make explicit in their digital strategies initiatives[80] to promote the global operations of SMEs in the digital environment.

For a broader discussion of e-commerce in Brazil, and the role of e-commerce platforms in this context, see the chapter "New business models" of this document.

Vision

In this year of 2017, Apex-Brazil is developing an initiative called Brazil e-Xport Program[81], which aims to raise awareness, qualification and business promotion of Brazilian companies in the international market, through the tools of *e-commerce*. The profile of participating companies should be selected as the platform and features of the target market.

Have been identified as target markets, as a first step, the US, China and Argentina. In a second step should be added to Europe. The goals include the partnership with *marketplaces*, the training and the inclusion of companies in *marketplaces*.

Other actions of public policies and partnerships with associations and private entities[82] can provide a wide support network for the advocates and the empowerment of Smes in the digital environment, with a focus on opportunities International e-commerce.

Strategic actions

- To establish agreements and partnerships with international *marketplaces* , supporting exports via e-commerce for small and medium-sized enterprises (SMEs) in Brazil, and Apex-Brazil program Brazil Xport.

[80] An interesting set of initiatives in this field within the European Union is described in a review by the Ministry of Industry, Foreign Trade and Services. The review is available on https://www.slideshare.net/mdicgovbr/estudo-comparativo-sobre-comrcio-eletrnico-nas-pequenas-e-mdias-empresas-no-brasil-e-unio-europeia (in Portuguese), accessed on 20/10/2017.
[81] More details of the program can be found online at www.e-xportbrasil.com (in Portuguese).
[82] For example, the Brazilian Micro and Small Enterprises Support Service – SEBRAE (www.sebrae.com.br) and the Brazilian e-Commerce Chamber (www.camara-e.net).

- To promote the expansion of electronic trade exports of goods and services, mapping opportunities and barriers, and supporting the insertion of Brazilian companies in this market segment.

- To develop partnerships with international digital *marketplaces* , aiming at the promotion and export of Brazilian products and services on the Internet.

- To implement partnerships with associations and entities to support small and medium-sized enterprises (SMEs), to promote and to training activities in international commerce.

- To host events, business rounds and conferences, having as target group businesses and entities interested in export expansion via e-commerce.

- To develop a quality stamp for exports via e-commerce (for example, by Apex-Brazil or the Standards and Measures Institute – Inmetro).

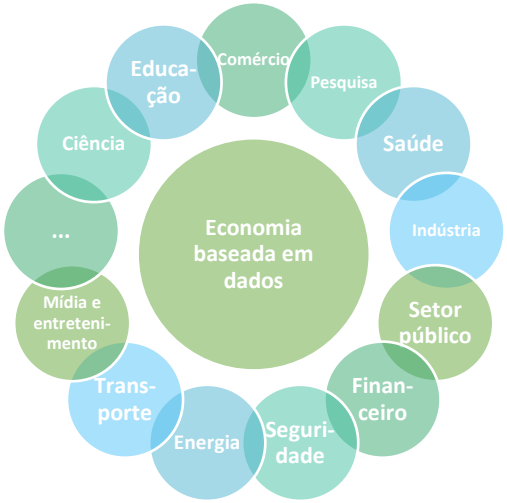
THEMATIC LINES – DIGITAL TRANSFORMATION

F. Digital Transformation in the Economy

Stimulating an increasingly digital, dynamic, productive and competitive economy in Brazil, aiming the global economy frontier.

1. DATA-DRIVEN ECONOMY

A new industrial revolution based on data, computing technologies and automation stems from the transformations in the digital era. A number of human activities and industrial processes is now enhanced, created and re-created, based on data volume that had never existed before[83]. In the digital economy, data is presented as a new production factor, like material goods and human capital. It thus creates a global market, in which value is created from generated content, shared by people, sensors and machines, and also multiplied by countless data-crossing possibilities in a gigantic repository of information and references[84].



The elements of cyberspace generate an environment of not only massive data production, but also of substantial information registry, when combined with different factors, such as:

- Lowering of data gathering, storage, processing, identification and analysis costs;

- Worldwide adoption of public policies aiming to expand the Internet access infrastructure, with a tendency to a gradual increase in the number of digital technology users;

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[83] **UK Digital Strategy**, 2017.

[84] This results in an increasingly data record environment in the digital world, which creates a "digital exhaust" of not only "native" digital data, but also originally analogic information, such as voice, typing patterns, cardiac pulse and breathing (as in medical records), rainfall, soil and industrial production records. On this subject, see also: "*White House Report. Big data: seizing opportunities, preserving values*". Executive Office of the President, May 2014.

- Increasing density of connection of people and countless devices, sensors and machines to the Internet, due to the Internet of Things (IoT) phenomenon.

Data can be treated as "raw material", serving as input to many processes with different purposes, and whose value depends on context and complementary factors related to one's capacity of extracting information. It is an interesting fact that the economic scarcity problem does not affect data: it actually multiplies its value by reuse and it can be indefinitely reused without decrease on reliability. The use of data may generate aggregated value with crescent returns.

Artificial Intelligence is a set of statistical tools and algorithms which generate intelligent software, especially designed for a specific activity. It is a useful technology for data classification, pattern identification and forecasting. A few examples of artificial intelligence include translation tools, voice and image recognition services, and search engines with ranking features, capable of relevance scoring according to the user's preferences.

Thus, a high volume of input is generated to improve traditional business models, create new products and services and develop brand-new technologies, like artificial intelligence, use of algorithms, machine learning, data-mining, augmented reality, cloud computing and big data. Such technologies have high potential to transform social relations.

Access to such input affects data-based innovation itself, which is characterized by the utilization of data and data-analytics to enhance and promote products, processes, organizational methods and markets[85].

New business models and market structures demand the formulation of new public policy and regulation, which can foster a robust data economy, protect consumer rights, free competition and privacy for citizens and businesses.

Diagnosis

We are now heading to a knowledge-driven world, both socially and economically, where the data volume grows progressively. Estimates are that the total volume of useful data will sum up to 16 zetabytes (16 trillion gigabytes) by 2020, a projected yearly growth of 236% between 2013 and 2020[86]. Many countries identify the necessity of stimulate data economy as one of the pillars for the digital

[85] OECD, **Data-Driven Innovation**. Available at http://www.oecd.org/sti/data-driven-innovation-9789264229358-en.htm, access on 07/06/2017.
[86] TURNER, Vernon; GANTZ, John F.; REINSEL, David; MINTON, Stephen. **The Digital Universe of Opportunities: Rich Data and the Increasing Value of the Internet of Things**. Report from IDC for EMC. April 2014.

economy[87]. Moreover, the top five companies currently listed among the largest companies in the world are from the data business, and together profited over 25 billion dollars on the first trimester of 2017 alone[88].

The OECD estimates that companies which base their businesses on data analytics increase their productivity by 5% to 10%, when compared with those who don't. Such productivity gains depend not only on data use and analysis, but also other factors such as data managing skills, innovative processes and specific characteristics of the correspondent business sector[89]. Also according to OECD, investment in intangible capital (knowledge-based capital) is growing in proportion to tangible (physical) capital, for instance, reaching 15% of United States GDP in 2011[90].

Big Data Analytics

Data treatment based on big data is sharply different from any other technic in this field, given the immense volume, variety and velocity (the so-called "3V"). The big data treatment generates the "mosaic effect", based on integration between an infinitude of data and information, even when the correspondent data is no longer connected to the original sources. This effect allows the "perfect personalization" on service providing, products buying and selling, job hunting or simple information search. Personalized decisions, however, create the possibility to different forms of discrimination and may present biased results, known as "filter bubbles".

Moreover, some of the major companies fusions and acquisitions in the technology sector may represent a great potential to increase data access.

The data market value chain is composed by a number of activities, which include data gathering[91], different types of treatment[92] and use in primary (when the exploration of data capabilities is linked to its source activity, for instance, the analysis of mobile traffic data by a telecom company for billing purposes) or secondary (when data is used for an objective unrelated to its source) applications[93].

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[87] The United Kingdom government estimates that the data economy shall grow up to £241 billion between 2015 and 2020. See **UK Digital Strategy 2017**.

[88] Article on *The Economist*: **Regulating the Internet Giants: The world's most valuable resource is no longer oil, but data**, May 6, 2017. In fact, the world market for big data technologies and related services was expected to reach 16.9 billion dollars in 2015, increasing at a composed growth rate of 40% -- seven times higher than the overall ICT market. See also: E-Skills UK, **Big Data Analytics An assessment of demand for labour and skills**, 2012-2017.

[89] OECD. **Data-Driven Innovation: Big Data for Growth and Well-Being**, 2015.

[90] OECD. **Supporting Investment in Knowledge Capital, Growth and Innovation**, 2013.

[91] There are many sources for data collection, including personal data, which may involve social media, online activity, public or commercial databases, location services, payments, triangulation by cell towers, digitalized physical records; and also non-personal data, originated from sensors, transportation systems, intelligent energy and utilities networks, wireless network mapping, etc. This market also allows the presence of specialized data-gathering agents, known as "data brokers", who aggregate information from different sources, with or without organizational intelligence. Such agents are often advertised as data collectors and sellers, as informational organizers, or even as players capable of creating value from inferences made upon collected information.

[92] Data treatment includes activities such as production, reception, classification, reproduction, storage, modification, extraction, profiling, mining, database crossing, evaluation and analysis, transmission, elimination and distribution, with the adoption of data analytics methods and tools.

[93] IDC, **European Data Market SMART 2013/0063, D8 – Second Interim Report**, 2016. Available on link: http://www.datalandscape.eu/study-reports

In the field of research and development in data analysis and treatment, the National Laboratory of Scientific Computing (LNCC) is the main research center in Brazil with initiatives in this subject. Equipped with high-performance computing (HPC) installations, LNCC implements research projects for big data, such as the INCT-CID, in cooperation with many research institutions both domestic and international[94].

It is important to consider that there are many types of data, including personal data (linked to identified or identifiable persons), entrepreneurial (linked to the development of different business models), industrial or production (machine operations, production control, etc.), nature (climate, relief and elevation, soil, livestock, plants, seeds, etc.), government and public services (transport, utilities, etc.), among others.

Bearing this in mind, when planning public policies for the data market, it is necessary to consider the vertical quality of each specialized subject, as well as its transversal effect on different economy sectors, contemplating the needs and specificities of each sector[95].

International data transfer

The global data flow generated by data markets was incipient 15 years ago, but it causes an impact on GDP growth today considerably larger than other commercial flows which exist for centuries[96].

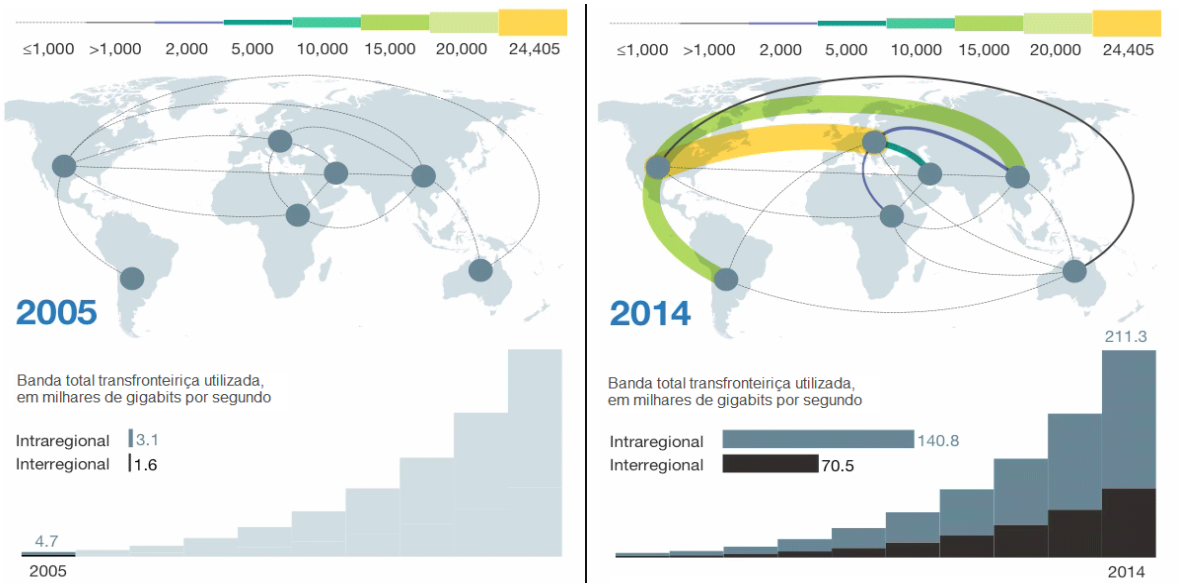
The flow volume is originated by information exchange in digital environment, whose intrinsic characteristic is the free data circulation, including the flow between borders. In fact, the digital data market is a global market from the beginning, with its biggest players simultaneously present in different countries, due to the ubiquity of digital technology, unconstrained by national borders.

[94] For a deeper insight in R&D initiatives on digital technologies, see section "B. Research, Development and Innovation" in this document.

[95] The need for data protection is an important example in this subject. It is a fact that some businesses seize this type of information as input for their activities, making use of health, housing, office, and vehicle data, sometimes covering entire urban areas. However, there are market niches, for instance, heavy industry, transportation and logistics, whose data usage is remarkably distinct from this type of specific information. Considering such distance in data inputs, it is crucial to define such a regulation proportional to the specificities of economic activity, avoiding the risk of hindering innovation.

[96] McKinsey Global Institute (MGI). **Digital globalization: The new era of global flows**. February 2016.

FIGURE 15: GLOBAL FLOW OF DATA AND TELECOMMUNICATION
Cross-border bandwidth use between regions in thousands of gigabits per second



Source: TeleGeography, McKinsey Global Institute analysis

Such increase, in one hand, allows companies to reach international markets using less capital-intensive business models, an alternative already essential to several business areas, such as financial services and information technology. In other hand, it presents new risks and challenges for public policy, prompting States to cooperate and harmonize legislation. Nevertheless, the international flow of information is inherent to data market and a vital element to foster the growth and development in a knowledge economy.

Datacenters: the data infrastructure

The datacenter is one of the basic infrastructure elements for the new digital economy. Datacenters are centralized repositories, integrated to a telecommunication network, with the purpose to keep, manage and disseminate data and information.

Datacenters are associated to the development of a competitive and vibrant data economy. Their presence in a given region may spill-over to the establishment of technology-based businesses and strongly IT depended services (such as software and digital content production). Datacenters are fundamental pieces for the cloud computing segment in the data economy value chain.

Brazil represents 2.5% of the world's Internet traffic, 40% of IP traffic in Latin America[97], and is the Latin-American country with the biggest concentration of installed submarine cables. However, it is home of only 0.9% of all datacenters in the world[98]. There are 0.022 datacenters in Brazil for each USD

[97] Cisco Visual Network Index (VNI) 2017, available on: www.cisco.com/c/m/en_us/solutions/service-provider/vni-forecast-highlights.html#

[98] Datacenter Map, 2017, available on: www.datacentermap.com/datacenters.html

1 billion of the country's GDP. This ratio may be nine times bigger in places with extensive investment in that infrastructure, such as Romania and Hong Kong[99].

A study published in a report by the Brazilian Federal Court of Audit indicates the elevated investment costs for datacenters in the country. It suggests important competitive challenges in this market for Brazil, despite country's potential to become a data hub in the continent[100].

The excessive dependency on datacenters located abroad has disadvantages which can be summarized in four dimensions, as follows:

- Internet service providers (ISPs): given that datacenters are the ground level for this type of service, their presence in other countries crowds out such businesses to the international market.
- Final users: rights and protections for data and information of Brazilians abroad, acknowledged by the Civil Rights Framework for Internet (Law 12.965/2014), are not easily enforced.
- Information industry: services provided from other countries do not generate revenue for domestic businesses, and technical infrastructure tends to be drained out of the country.
- Globalization: fundamental elements for building modern society and creating value in the digital economy remain established abroad.

Considering that datacenters are frequently associated to Internet Exchange Points (IXP), a policy supporting datacenter investments would promote competition and growth in the entire Internet ecosystem, with positive impacts throughout the value chain, including telecom operators, content providers, content delivery networks and ISPs.

In this scenario, attraction mechanisms for datacenters is strategic for Brazil. Such initiative would improve Internet access quality due to geographic closeness between user and content provider, thus reducing latency. In the same way, the presence of content in Brazil reduces bandwidth consumption on national backbones and submarine cables, allowing greater economy of network resources. Lastly, more datacenters hosted in Brazil mean higher governance over content and data and, consequently, stronger security for business and individuals information.

Additionally, it is important that the Brazilian government widens its open data policy as means to stimulate new businesses and technology solutions for citizens. Brazil ranked 8th at the Global Open Data Index in 2017, which measures government data openness in several countries[101].

Vision

- To regard the data market as a strategic element for economic growth.

[99] International Monetary Fund, available on: www.imf.org/en/Data

[100] Available on: https://contas.tcu.gov.br/juris/SvlHighLight?key=41434f5244414f2d434f4d504c45544f2d31343730373534&sort=RELEVANCIA&ordem=DESC&bases=ACORDAO-COMPLETO;&highlight=&posicaoDocumento=0&numDocumento=1&totalDocumentos=1 , access on 02/21/2018.

[101] https://index.okfn.org/place/, access on 12/11/2017.

- To reach balance between the safeguard of individual and civil rights and the incentive to innovation, according to the guidelines stated at the "Building Trust and Confidence in the Digital Environment" thematic section.

- Free flow of information and cloud computing are some of the essential factors to innovation in the data market.

- The importance of implementation of public policy to promote innovation and the rule of law in the data economy, enabling a thriving, new digital market.

Strategic actions

- To promote the approval of a policy aiming to incentive and attract investments on datacenters in the country.

- To improve the National Government Open Data Policy, as described in the thematic axis "Digital Transformation in the Government" , which involves all federated entities, and to foster the creation of data-based tools, systems and processes.

- To promote cooperation between authorities and the harmonization of data-related regulatory framework, aiming to facilitate the inclusion of Brazilian businesses, particularly small and medium enterprises (SMEs), in global markets.

- To promote cooperation between representatives from government, universities and private companies, in order to simplify the sharing of relevant knowledge and technologies for the data market.

- To develop a policy stimulating the adoption of cloud computing as an element of the technology framework in the different services and sectors of Federal Government.

- To evaluate potential economic and social impact of disruptive digital technologies, such as artificial intelligence and big data, and to propose policies that mitigate their negative effects and maximize positive results.

Indicators

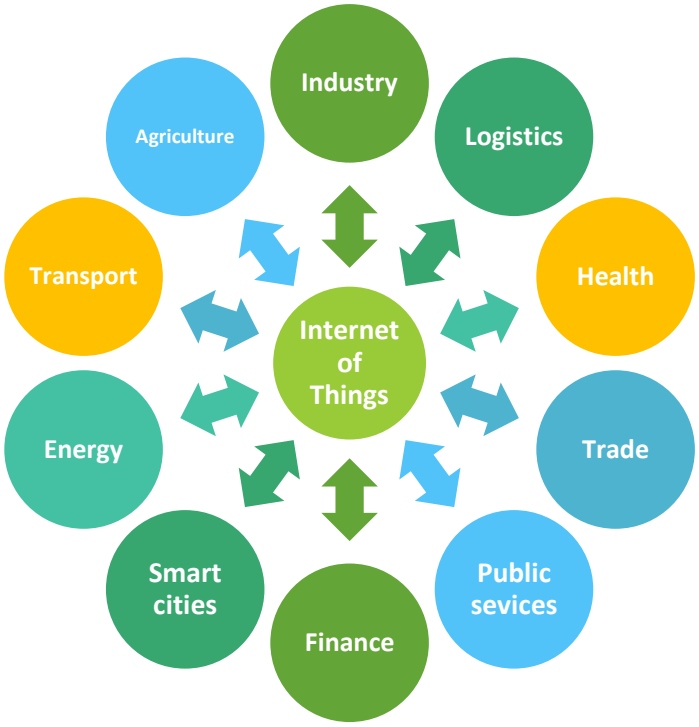
Indicators concerning the digital transformation is a challenge to be addressed, and one of the discussion subjects at the G20 Digital Ministers Meeting in 2017 (at Düsseldorf, Germany) stated in the document "G20 Digital Economy Ministerial Declaration: Shaping Digitalisation for an Interconnected World". Additionally, other studies, such as "Digital Spillover - Measuring the true impact of the digital economy" [102], represent an effort of detailing metrics to be incorporated to national statistics.

[102] See Oxford Economics, *"Digital Spillover - Measuring the true impact of the digital economy"*, available on http://www.huawei.com/minisite/gci/en/digital-spillover/files/gci_digital_spillover.pdf, access on 09/06/2017.

2. A World of Connected Devices

Internet of Things (IoT) is no longer a technological promise. Connected devices are everywhere: inside homes and cars, embedded in cities infrastructure, monitoring the productive process in industry and farms, tracking logistic transportation chains, facilitating service providing, and even over peoples bodies – wearable technology – connecting watches, shoes and other pieces of clothing. Large scale machine to machine connections (M2M) is already the reality in developed economies in the world, and they are expanding rapidly. Estimates indicate that the worldwide number of devices connected to the Internet may reach 30 billion by 2020[103] and the IoT impact on global economy may amount USD 11.1 trillion in 2025, which represents 11% of the world economy[104].

Figure 16: Dimensions of Internet of Things



The Internet of Things will have a massive impact in all economic sectors and on people's lives, generating a large quantity of data. A study of the telecom company Telefonica estimates that the global capacity for data storage and processing will reach 800 exabytes in 2020. As comparison, the same capacity was of 80 exabytes in 2015. A considerable amount of this data will come from

[103] European Parliament, Directorate General for Internal Policies. **Study on Industry 4.0.** Available on: http://www.europarl.europa.eu/RegData/etudes/STUD/2016/570007/IPOL_STU(2016)570007_EN.pdf.
[104] McKinsey Global Institute. **Unlocking the Potential of the Internet of Things**, June 2015. Available on: http://www.mckinsey.com/business-functions/digital-mckinsey/our-insights/the-internet-of-things-the-value-of-digitizing-the-physical-world, accessed on 10/07/2017.

connected devices.

IoT is the basis of the digitalization process, which has been transforming traditional production methods. Such methods become gradually based on digital applications, on intensive use of information and communication technologies, and on devices interconnection. The main vector of the digital transformation is the growing links between IT systems and subsystems, processes, objects and applications, and it impacts on all three fundamental economic sectors (agriculture, industry, services), in a phenomenon now known as the Fourth Industrial Revolution.

In addition to social transformation, we may expect that digital technology and IoT applications may bring about productivity gains and competitiveness for many countries. This is particularly relevant for Brazil, since the country has been facing losses in manufactured value added (MVA) capacity for the past decades when compared with other developing economies. Unido[105] estimates XX that Brazilian MVA participation in developing economies decreased from 12.2% to 4.4% between 1990 and 2014, while China's share, for instance, raised from 15.8% to 51.3% in the same period. Besides, Brazil's ranked lower in the emerging countries industrial competitiveness index in the past few years, going from 33rd to 35th position between 2010 and 2013. As comparison, China ranked 8th in 2010 and 5th in 2013.

This data calls for pressing actions to stimulate the development of new technology which may bring greater productivity and competitiveness in basic economy sectors: manufacture, agriculture and services. In this sense, it is important to bring together companies, the scientific community and the public sector, establishing initiatives aiming the following core goals: development and adoption of IoT and new digital technologies; establishment of standards for digital applications; data safety and security; modernization of the legal framework; professional capacity-building; improvement of infrastructure and business environment.

A few steps were taken to achieve such goals:

- The creation, in 2014, of the IoT Chamber, a multistakeholder forum which gathers universities, research centers, companies and the government, with a mission to define governance models and a regulation for IoT development, including actions to stimulate innovation and infrastructure building. Such actions include the elaboration of the IoT National Plan.

- Joint actions by the ministries of Industry and Commerce, and of Science, Technology, Innovation and Communications, including a public consultation involving over 300 experts, which will result on the National Strategy for Advanced Manufacture.

[105] United Nations Industrial Development Organization (UNIDO). **Industrial Development Report 2016**. Available on: https://www.unido.org/fileadmin/user_media_upgrade/Resources/Publications/EBOOK_IDR2016_FULLREPORT.pdf, access on 10/07/2017.

- A public call[106] by EMBRAPII – Brazilian Industrial Research and Innovation Association – to support initiatives in robotics, mechatronics and advanced manufacture.

- The establishment of a specific credit line for intelligent systems and advanced manufacture by the National Bank for Economic and Social Development (BNDES).

- The Brazilian Agricultural Research Company (Embrapa) 2014-2034 Strategic Plan[107]. It sets priorities in agricultural digitalization, with initiatives in automation, precision agriculture, informational systems, scientific computing, geological technologies and nanotechnology.

The National Internet of Things Plan

Since 2014, the Ministry of Science, Technology, Innovation and Communications (MCTIC) has been opening a dialogue with the private sector, academia and public organizations in an effort to build public policy for the Internet of Things. The forum for this dialogue is the IoT Chamber, a multistakeholder body created by the Decree nº 8.234 in May 2, 2014.

The final output of this dialogue is the National Internet of Things Plan, with the objective to "foster the implementation of IoT as a sustainable development instrument for the Brazilian society, capable of increasing competitiveness, strengthen national production chains and promote higher quality of life."

Several meetings promoted by the IoT Chamber between 2014 and 2015 resulted in an initial analysis of the IoT ecosystem in Brazil. This process was strongly supported by all involved stakeholders and motivated the elaboration of a national IoT plan.

Also, the MCTIC signed a cooperation agreement with the National Economic and Social Development Bank (BNDES), in order to conduct a study on IoT.

All agents involved in conceiving the IoT plan share the aspiration that IoT will generate a positive, relevant impact on economy and on people's lives. For that reason, the National IoT Plan comprehends different dimensions, key directives and concrete proposals.

Impacts on Secondary Industry: Industry 4.0

Industry 4.0, or advanced manufacture, consists in a complete digitalization of production processes, in which physical and digital components are associated in the same productive plant. This concept describes the organization of production processes based on digital technology and connected devices, which communicate autonomously to each other throughout the value chain. It is the "intelligent factory" model, where physical processes are monitored by computer-controlled systems, which create a virtual copy of the physical world and make decentralized decisions based on self-organizing

[106] Available on http://embrapii.org.br/chamada-publica-01-2016/ (in Portuguese), accessed on 10/07/2017.
[107] Available in Portuguese at https://www.embrapa.br/busca-de-publicacoes/-/publicacao/1025506/vi-plano-diretor-da-embrapa-2014-2034, accessed on 10/07/2017.

mechanisms[108].

Such manufacture digitalization processes include use of embedded sensors in almost all factory parts and components, cyber-physical systems, security systems, energy consumption systems, and analysis and monitoring systems for relevant data of a given production set.

New IoT applications can bring substantial improvements to industrial processes through the adoption of autonomous systems, which allow higher productivity in manufacturing and greater precision on production processes. The use of sensors capturing real-time data may prevent eventual problems and ensure safety. Digital applications can be used on predictive maintenance and anticipate the wearing process in machines and the need for parts replacement. Use of IoT on industrial processes may reduce costs by 10% to 20% on energy resources, by 10% to 40% on equipment maintenance, and by 10% to 25% on workforce efficiency[109].

Some elements can be generally considered as pre-requisites for the advanced manufacture development: standards for systems, platforms and protocols; changes on labor patterns which reflect new business models; digital safety; availability of specialized workforce; investments on research and development.

In Germany, the digital strategy initiative estimates that the use of IoT in industry (Industry 4.0) may promote a 30% increase in industrial productivity, 3.3% increase in efficiency, and a 2.6% reduction of annual costs. The sectors with higher potential of harnessing the benefits of Industry 4.0 include automotive, mechanic engineering, industrial processes, electronics, and ICT.

Besides establishing new management and engineering methods which will impact the entire productive chain, Industry 4.0 will change the fundaments of industrial competition and reconfigure the competitiveness differential among nations. Industrial competitiveness will be based on a country's domain over the production of digital components and associated technologies applied to industry.

Adapting industrial production to digital manufacture will require incentive policies for businesses to adapt to new techniques and to redesign the manufacturing structure[110].

Some economically developed nations are already facing this challenge in traditional industries or sectors with low adoption of digital applications. The German Digital Strategy estimates that six out of ten business in that country are capable to adopt Industry 4.0 technologies. Germany, in its *High Tech Strategy 2020*, had also established the *Industrie 4.0* initiative aiming to build a base ground launch German industries into world leadership on digital manufacture solutions, industrial automation,

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[108] European Parliament, Directorate General for Internal Policies, *ibid*.
[109] McKinsey Global Institute, *ibid.*
[110] In this sense, an Industry 4.0 initiative present at Germany's Digital Strategy establishes specific financing funds for RD&I in microelectronics: "We will introduce a funding program for microelectronics. The sensor and actuator technology found in machines and robots that is essential for Industry 4.0 is unthinkable without microelectronics, and is also key to maintaining our digital independence". Also, that Strategy stipulates 1 billion euros in subsidies by the German government to the microelectronics industry from 2017 to 2019. See the Germany **Digital Strategy 2025** at: https://www.de.digital/DIGITAL/Redaktion/EN/Publikation/digital-strategy-2025.html, accessed on 11/07/2017.

embedded software and other industrial systems. Also, the United States had created, in 2013, the National Network for Manufacturing Innovation (NNMI), the first technology hub entirely dedicated to IoT: a public-private partnership interaction platform involving national laboratories and research institutions dedicated to undertake strategic challenges in industry.

In this sense, it is important that Brazil reaches preparedness for the IoT and digital adaptation challenges in all industrial segments, including mining, oil and gas (and other extraction industries), heavy industry, and construction.

A survey[111] carried on by the Ministry of Industry, Foreign Trade and Services (MDIC) and the Ministry of Science, Technology, Innovation and Communications (MCTIC), involving over 300 experts, identified the necessity to concentrate efforts to promote the development of strategic technologies in order to further the establishment of Industry 4.0 in Brazil. Such technologies include collaborative robotics, artificial intelligence, big data, IoT, additive manufacture, nanotechnology and new materials.

The survey also highlighted the importance of new Open Laboratories, dedicated to develop digital industry technologies, considering that the combination of such technologies generate unprecedented opportunities for competitive manufacturing.

Furthermore, MDIC and MCTIC conducted an initiative, launched in 2015, involving a number of public and private institutions to collect expertise and information from hundreds of industrial innovation specialists, which will serve as input for an advanced manufacture public policy. Such initiative resulted in a report entitled "Perspectives on advanced manufacture by Brazilian experts"[112].

Impacts on Primary Industry: Agriculture

Brazil is a global leader on agriculture and animal husbandry, and the world's largest (or second largest) producer and exporter of seven agricultural products: orange juice, sugar, coffee, soy, corn and meat (beef and poultry).

This industry represents approximately 22% of national GDP and is having a continuous growth in productivity (around 3% each year) in the past few decades. Such performance is attributable to the country's comparative advantages and a robust environment for research, development and innovation, conducive to the adoption of new technologies.

The preservation of such leadership will increasingly depend on the capacity to drive the digital transformation in economy. The impact on agriculture will occur through the use, in agriculture, husbandry and silviculture, of technologies such as mapping and remote sensors, machine digitalization, IoT devices and sensors, and embedded software.

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[111] [112] MDIC, MCTIC. "Perspectives on advanced manufacture by Brazilian experts", November 2016. Available in Portuguese at http://www.mdic.gov.br/images/REPOSITORIO/si/dfin/Perspectivas_de_especialistas_brasileiros_sobre_a_manufatura_avan%C3%A7ada_no_Brasil.pdf, accessed on 14/07/2017.

However, it is important to stress the fact that the adoption of TICs in agriculture strongly depends on the availability of a capable workforce, sufficiently trained to handle this type of technology at the farms. Also, a broader coverage of Internet infrastructure in rural areas – particularly by mobile and satellite networks – is essential to provide access to digital applications, allowing the dissemination of information, training, and real-time market and database integration.

In this context, one of the key institutions on research, development, technological diffusion and capacity building in the agriculture industry is the Brazilian Agricultural Research Company – Embrapa – which has been the core actor of Brazil's agricultural modernization for the past 40 years.

Besides the aforementioned Embrapa's Strategic Plan for 2014-2034, an important action line assumed by the company is the insertion of agricultural assets in the digital market, which will increase the potential of the company's databases and its technological knowledge open to public. An Embrapa's evaluation identified over 40 digital products in several business segments, such as agriculture, agrometeorology, automation, use of land, experimental data, genomics and proteomics, SciTech information, animal husbandry, agricultural planning, and simulation.

The company also develops projects in robotics and Internet of Things, particularly those applied on precision agriculture, with the digitalization of sensors and machinery. Embrapa also conducts an entrepreneurship program called "Startup Challenge", aiming to engage startups and early-stage businesses on the agriculture industry. A 2016 study carried on by the University of São Paulo[113] shows the great potential of startups for agribusiness.

There is currently a fruitful and dynamic environment for digital entrepreneurship in agribusiness. The federal government created a few programs to help to identify and promote startups, such as the Startup Brasil Program (MCTIC) and the InovAtiva Brasil (MDIC). A survey by the Association For Promoting Brazilian Software Excellence (Softex) in 2016 had identified at least 75 digital startups focused on agriculture and over 150 businesses offering software products and services for agribusiness.

Impact on Tertiary Industry: Digitalization in Services

The services sector represents over two thirds of Brazilian GDP and its share on national value added economy is increasing. Between 2003 and 2016, the services sector share amounted from 65.8% to 73.3% of the total value added to GDP, according to the national economy indicators by the Brazilian Institute of Geography and Statistics (IBGE).

The connection between devices and other digital technologies will also impact this relevant sector. Many services are expected to have increasingly productivity gains, including health services, logistics, infrastructure and finance. An evidence for the great impact of the economy's digitalization on the services sector is the fact that most innovative, technology-based businesses in Brazil are in this

[113] Data available on http://www.startagro.agr.br/confira-o-infografico-completo-do-1o-censo-agtech-startups-brasil-em-primeira-mao/, accessed on 28/09/2017.

sector[114].

Despite the services sector relevance in comparison to other industries in Brazil, it is worth mentioning that the gap between services and other economic activities has being bridged by digital technology. In fact, intersection between manufacture and services sectors is gradually widening to a point that a clear distinction between the two is becoming impossible. Professions and job tasks are increasingly susceptible to automation due to digital technology, which allow a sharp decrease on information and transaction costs, as well as the developing of innovative business models in service providing.

A few examples of digital transformation in services are the digital platforms that combine social media, online collaboration and service providing. There are also applications for device interoperability for smart cities, health, retail, home appliances, offices, logistics, among others.

In the case of smart cities, IoT applications in urban mobility, security systems, energy, water, gas and other services focused on environmental and social sustainability in densely populated urban centers are more and more utilized. There are estimates indicating that the global market for smart cities technology solutions may reach US$ 408 billion in 2020[115] [116].

Urban transportation applications for smart cities may have a calculated impact of over US$ 800 billion in towns and cities all around the world. For water and air quality monitoring, IoT applications may represent an impact of US$ 700 billion per year. The use of smart sensors applied to energy and water distribution efficiency may represent an impact of over US$ 69 billion a year worldwide[117].

In the health industry, connected devices and IoT applications may optimize medical treatment and hospital management. Some examples include digital medical records, management of pharmaceutical supplies and clinical equipment, digital medical records, and wearable technologies, which may offer real-time remote monitoring of a patient's health conditions and provide assistance in long-distance medical procedures. IoT applications to health services are expect to impact the world market by US$ 1.6 trillion by 2025[118].

Logistics and transportation can also be greatly beneficiated by IoT. System interoperability is the most promising segment in logistics IoT for the industry of the future, and includes applications for transport by railroads, aerial, river and terrestrial. Some examples are the remote monitoring of containers and logistic routes, interconnected navigation, and autonomous cargo vehicles. The global impact of IoT technology in logistics and transportation may reach US$ 850 billion in 2025[119].

Considering the expected impact and potential applications of digitally connected devices, it is

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[114] Brazilian Micro and Small Business Support Service (Sebrae) startup survey: "**Pesquisa Lado/A , Lado/B Startups 2015"**. Available in Portuguese on https://www.sebrae.com.br/Sebrae/Portal%20Sebrae/UFs/SP/Pesquisas/lado_A_B_startups.pdf, accessed on 11/07/2017.
[115] Getulio Vargas Foundation (FGV), **"O que é uma cidade inteligente?".** Available in Portuguese at http://fgvprojetos.fgv.br/noticias/o-que-e-uma-cidade-inteligente, accessed on 11/07/2017.
[116] The Telecommunication Development Research Center (CPqD) launched the DIJOT IoT platform, already adopted by Brazilian businesses in the smart cities market. See more at www.cpqd.com.br.
[117] McKinsey Global Institute, *ibid.*
[118] [119] McKinsey Global Institute, *ibid.*

fundamental that the Brazilian strategy focuses on the development of competitive IoT solutions, professional capacity-building and incentives to the adoption of IoT devices, without overlooking the need for an attractive and safe normative and business environment, with confidence building for the final users.

Security and privacy in the world of connected devices

In the Internet of Things future, it is paramount that the widespread of connected devices does not bring with it a decline on people's safety and privacy.

Expansion of IoT bring us to a path leading to a near future when traffic, electricity grids, health facilities and other vital resources of modern society will all be connected by networks. In this scenario, cyber attacks and data leaks will have enormous impact. It is important that both the government and the private sector make massive investments on cyber security as an absolute priority.

There is also a great challenge on granting individual privacy in a hyper-connected society. A considerable amount of the immense data volume collected and treated by connected devices is personal data, whose monetization and use in new business models is increasingly recurrent. The lawful commercial use of personal data presupposes observance of users' rights. A deeper insight in this theme can be found in the chapter "Building Trust and Confidence in the Digital Environment".

Vision

To reach the full potential of IoT applications, digital devices and related technologies must evolve continuously, reducing production costs and building robust data analysis. For these ends, it is essential to establish training and research funding initiatives to develop new technologies, as well as build a favorable business environment to attract new investments. Furthermore, the use of IoT systems may raise issues on how to foster a safe, propitious environment for labor relations, user rights and data privacy.

Considering the undeniable digitalization process and its impacts, it is important to focus on:

- Development of technology and broadband infrastructure, as to allow the application of technology in agriculture, in digital manufacturing plants, and in high value-added services based on digital applications. In fact, in order to strengthen these sectors, is essential to develop broadband infrastructure, 5G mobile networks, design houses for microelectronics, and a sensors market.

- Professional training in required skills for new digital technologies. Articulated actions among government, industry, academia and the civil society are important to define new educational tracks aimed to this new professional profile.

- Coordinated policies in public and private sectors, which provide responsive and updated regulatory frameworks (adaptable to swift advances in the digital sector), equalize incentives to technological investment, and provide appropriate legal protection to consumers and workers.

Strategic actions

The strategic actions directed to the development and adoption of IoT and digital technologies must include:

- The approval of National IoT Plan and the implementation of testing platforms for IoT suppliers in each the chain of value related to the cross-cutting themes, defined as priorities by the IoT Chamber: health, agriculture, industry and smart cities.
- The improvement of the science, technology and innovation legal framework, intensifying the interaction between public research centers and businesses, and articulating national research infrastructures and research funds, as described in the actions highlighted at the "Research, Development and Innovation" section. The goal is to promote scalable gains and coordinate RD&I investments in Brazil.
- Assess the impact of new technologies in society, in particular the consequences of their use on labor relations and labor market, related to robotics and industrial automation.
- Implement actions aimed at developing a dynamic and competitive environment in the market segment for devices, sensors, machines and equipment of IoT.
- Promote a business and regulatory environment that fosters the attraction of new investments in connected devices, while ensuring trust and confidence in cyberspace and preserving users' rights.
- Encourage the adoption of IoT solutions through government technological demands.

Indicators

In this Strategy, suggested indicators include those defined at the National IoT Plan, the National Strategy for Advanced Manufacture, and Embrapa’s Strategic Plan (2014-2034).

3. NEW BUSINESS MODELS

The digital environment, particularly that made feasible by the Internet, reduces entry barriers to markets, open new business possibilities and allows the bringing about of disruptive business models. Transformations come fast and demands from regulation experts and policy makers great agility and flexibility on creating a favorable environment to the development of the digital economy.

Digital Platforms

There is not a unique, consensual definition for "digital platform". It is a term related to services and functionalities available online in great variety, which include search engines, social media, e-commerce, online shops and price comparison websites. Generically, platforms can be defined by some characteristics they have in common[120], such as:

- Features which facilitate transactions between users, as a way to generate revenue to platform owners.
- Ability to collect, use and process large volume of personal and non-personal data, with the purpose of user experience optimization;
- Capacity for building networks where each additional user enhances the overall user experience – known as the "network effect" [121];
- Ability to create and shape new markets in more efficient arrangements, with greater benefits to all users, generating strong and disruptive competition to traditional markets;
- Ability to organize new ways of social participation based on information gathering, processing, altering and editing; and
- Dependence on information technologies as mean to develop the mentioned capacities.

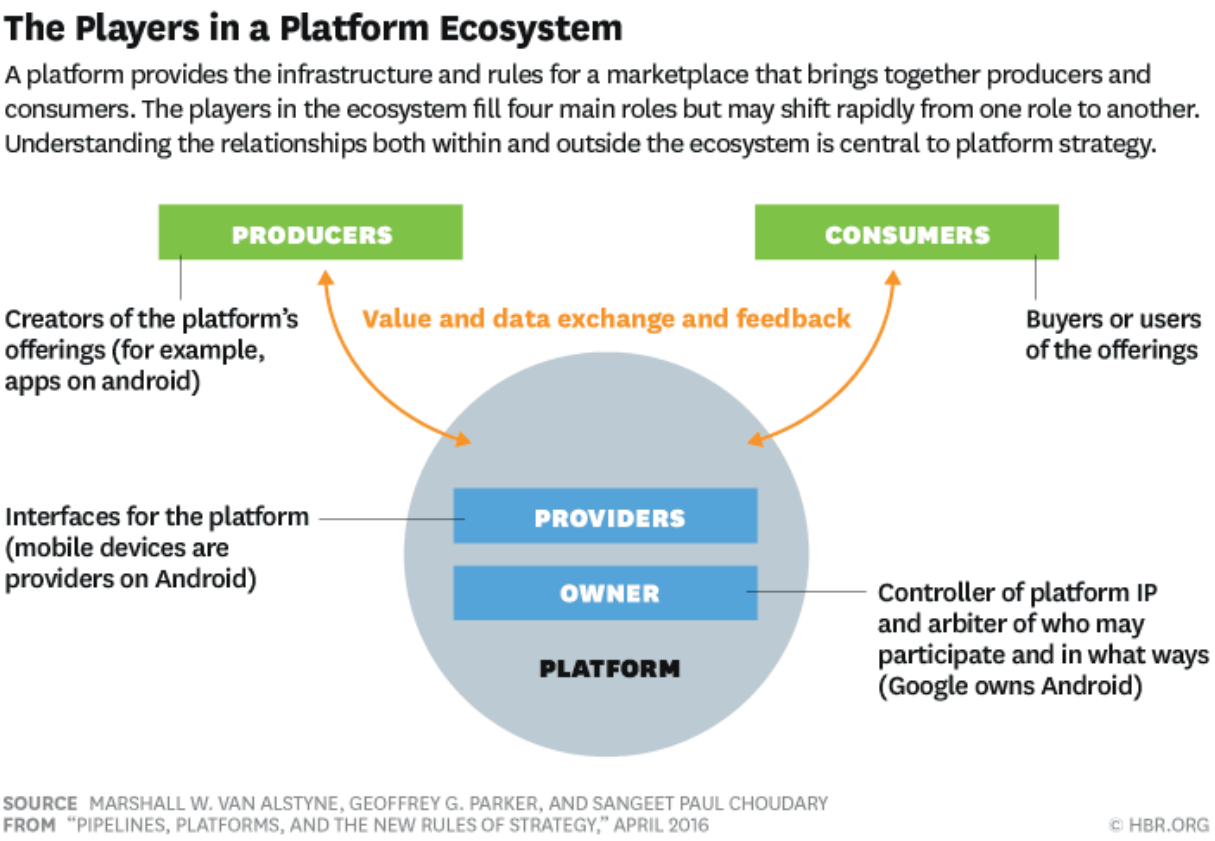
In order to manage such high volume of traffic and data, digital platform companies invest considerable amount of resources on hardware, software and staff. A 2015 OECD study, for instance, estimates that each one of the main online sales platforms holds 28 datacenters around the world, each containing between 50,000 and 80,000 servers. The largest businesses in this sector owned

[120] European Union Report, **Commission Staff Working Document on Online Platforms – Communication on Online Platforms and the Digital Single Market** COM(2016) 288, available on https://ec.europa.eu/transparency/regdoc/rep/1/2016/EN/1-2016-288-EN-F1-1.PDF

[121] The "network effect" may represent an entry barrier to new digital platform supplies, since it raises opportunity costs for the users to migrate information, relationships, activity history, etc. to a new platform.

together over 1 million servers in datacenters in 2013[122].

FIGURE 17: PLAYERS OF THE DIGITAL PLATFORMS ECOSYSTEM



An European Union report[123] on the subject classifies platforms in five different business models:

1. **Online marketplaces**, where transactions between buyers and sellers (of both services and goods) are mediated[124];

2. **Mobile ecosystems and application distribution platforms ("app stores"),** as smartphones became the focus for a new software and digital content market, allowing app stores to become online markets;

3. **Internet search engines**: the fundamental role of a search engine is to facilitate information

[122] Data extracted from **New Forms of Work in The Digital Economy**. OCDE, Working Party on Measurement and Analysis of the Digital Economy, Committee for Digital Economy Policy (WP-MADE/CDEP). June 13, 2016, available on http://www.oecd.org/officialdocuments/publicdisplaydocumentpdf/?cote=DSTI/ICCP/IIS(2015)13/FINAL&docLanguage=En

[123] EU, **Commission Staff Working Document on Online Platforms**, *ibid.*

[124] More details on the dynamics of online markets, network effect and lock-in effect can be found at https://digit.hbs.org/submission/ebay-the-perfect-storey-of-network-effects/ . Accessed on 29/09/2017.

finding on the Internet. The main revenue source of such service is advertising on search webpages.

4. **Social media and content platforms**: these services allow connections, content sharing, business, communication and idea expression for individuals and organizations. Their main revenue source is advertising and monetization of aggregated data from users; and

5. **Online advertising platforms**, which buy and sell advertising spaces on Internet pages.

With the advent of many market opportunities and strong incentives for innovation in technology and business models, digital platforms became a drive for economic growth, innovation, efficiency and competitiveness, bolstering investment in digital technology, e-commerce and online services.

Platforms financial returns vary, and may include direct payments from users, advertising, fees over particular transactions, donations, etc. Platforms can combine supply and demand of different markets simultaneously, explore network effects in and through markets, and shape the rules and conditions of such markets. A typical example of platform business model is the association of online information search and social contacts with targeted advertising, based upon users input and its correlation to the online advertising market. In order to supply such services, this business model monetize data aggregates, both personal and non-personal, which touches a light on the privacy subject discussed in-depth in the "Building Trust and Confidence in the Digital Economy" thematic axis.

Diagnosis

Online marketplaces

The main purpose of online marketplace is to be an online space dedicated to intermediate transactions, aiming cost reduction and the interests convergence between buyers and sellers. This environment is improved by trust building mechanisms, such as certificates, ranking of platform users, restriction of certain payment modalities to avoid fraud, establishment of codes of conduct and good practices, among others[125].

On one hand, some platforms create economies of scale, transition and efficiency costs reduction, and also opportunities for job openings and extra income for individuals and small and medium enterprises. Business include "physical" (accommodation, transport, repairs, personal services, etc.) and digital services (data input and treatment, graphic design, legal and business consulting, etc.).

On the other hand, some common particularities of online platforms – such as transnationality and susceptibility to the network effect, the lock-in effect and the first player advantage – may present regulatory and competition challenges.

[125] [126] EU, **Commission Staff Working Document on Online Platforms**, *ibid*.

Revenue of marketplace platforms usually comes from commissions charged by intermediation services in trusted online spaces and by advertising on platform's website[126].

Mobile ecosystems and applications platforms

The widespread of mobile devices was accompanied by full-time connectivity, not only of users but also of real-world everyday objects, such as cars, accessories, home appliances, machines, and others. Mobile devices also evolved to currently produced smartphones: complex tools whose functionality goes way beyond voice communication and includes access to diversified content, services and products from anywhere, anytime. This situation demands new and specific software applications to meet users preferences and a new access environment to digital content[127].

Mobile access to digital technology has becoming a dominant source of income for service providers, as the time dedicated to the mobile devices increased from 12.7% in 2008 to 54.6% in 2015[128], and the software download volume is estimated in 270 billion apps in 2017[129]. Furthermore, the app market expands quickly as from 2008, when the first app stores were launched, with a total generated revenue around 30 billion euros for developers in 2015[130]. Jobs created by the app industry in Brazil in January 2017 are estimated at 146,000. [131]

In this scenario, applications digital platforms for both mobile and desktop devices (known as app stores or app marketplaces) are key agents of digital economy by their influence on diversity of functions and features of the digital environment, especially if one considers the prospective diffusion of Internet of Things, which will connect the web a vast number of devices.

Such platforms present good conditions to developers to offer products and services in a variety of applications, while acting as a hub for different features for mobile functionalities according to users' preferences. In this way, transaction costs are reduced with lower expenditure in payment tools, accountability, definition of rules and terms of use, etc. It is a context which facilitates the network effect: the more applications are available on the app store, the more users will search for specific apps in that platform[132].

It is a fruitful environment for providing services and products, with wide room for innovation and development possibilities for small and medium enterprises. However, this same structure may also amalgamate access to apps into one or a few platforms, whose competitive advantages should be

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[127] EU, **Commission Staff Working Document on Online Platforms**, *ibid.*
[128] TechCrunch, *"Consumers Spend 85% Of Time On Smartphones In Apps, But Only 5 Apps See Heavy Use"*, published on June 22, 2015. Available on https://techcrunch.com/2015/06/22/consumers-spend-85-of-time-on-smartphones-in-apps-but-only-5-apps-see-heavy-use/, accessed on 11/07/2017.
[129] **App stores - Statistics & Facts**. Available on https://www.statista.com/topics/1729/app-stores/, accessed on 11/07/2017.
[130] EU, **Commission Staff Working Document on Online Platforms**, *ibid.*
[131] Available on http://www.progressivepolicy.org/publications/policy-memo/brazils-app-economy/, accessed on 10/11/2017.
[132] EU, **Commission Staff Working Document on Online Platforms**, *ibid.*

monitored for eventual risk of market concentration.

Internet search engines

This type of platform aims to facilitate the search for information by the end user, in a digital environment where a massive volume of data is generated everyday – approximately 4.51 billion webpages are indexed daily[133]. In terms of revenue, growth expectations in 2016 were amounted to 95.5 billion euros, which represented 53% of that year's total revenue in advertising[134]. In Brazil, online advertising revenue was estimated to reach 5.7 billion reais in 2016. [135]

The Internet search market is highly concentrated: only one service performs over 90% of all web searches worldwide, with a similar proportion in web searches in Brazil[136].

The most common search services are often grouped into different specifications: general search method, based on queries with words and expressions; image search, analyzing titles, size and/or image characteristics; map search, with addresses, locations or GPS coordinates; and the vertical model, specialized in specific online content, such as travel, health or academic information.

Due to the exponential increase of both available information and users of the digital environment facilities, search engines face the challenge of filtering and personalizing content access, a challenge that may become intensified by broader digitalization of entire economic sectors and other aspects of social life. As important tools for finding and accessing digital content, search engines are becoming true mediators to access to information.

Challenges to traditional regulation methods

The steep growth of digital platforms and their dissemination among the general public in the past few years have brought an intense debate over the platforms disruptive effect on their respective markets.

The traditional methods for market regulation are put into question, demanding efforts to evaluate and update rules and regulations facing new challenges in the digital environment, namely to competition, taxes, protection of fundamental rights, among others.

In this sense, economic regulation by anti-trust authorities may become a key mechanism if barriers to competition, resulted from market domain by the large digital platforms, are to be confirmed.

A regulatory policy in this subject should avoid excessive dependency on digital platforms that generate intense network effect, and guarantee a leveled playing field for competition to different agents and businesses offering innovative services to end users.

Search activities are carried on by algorithms and automated decisions by computers, which may rise

[133] Statistics available on http://www.worldwidewebsize.com/, accessed on 11/07/2017.
[134] Brazil – European Union Sector Dialogue. **OTT Regulation**. Idate, 2016.
[135] Digital AdSpending 2017- Interactive Advertising Bureau.
[136] Statistics available on Statista, http://gs.statcounter.com/search-engine-market-share and https://www.statista.com/statistics/309652/brazil-market-share-search-engine/. Accessed on 21/02/2018.

questions about the adopted criteria for the resulting output.

Content and social media platforms

Social media and digital content platforms usually do not charge directly their users, since their main source of revenue is advertising and monetization of aggregated de-personalized data. In 2016, the global social media market generated approximately 30 billion euros and is expected to grow to 45.5 billion euros until 2020[137].

Such applications offer interaction through virtual social networks and also reassure the freedom of expression, as they allow social interactions efficiently, with no necessity of meeting others in person.

By the same reasons, these platforms may influence individual behavior or even the business environment. Consequently, digital agents in social and content online platforms may be used in political or publicity campaigns, which raises the need for further ponderations about the market dimension and the protection of civil rights in such a scenario.

Platforms of online advertising

In an increasingly digitalized economy, advertising agencies have been using digital platforms dedicated to sell advertising space online. In the digital world, every access can be used as means for publicity and advertising, which can be improved through service personalization available on the web, as describe on the "Data-driven Economy" section of this document.

These platforms allow the reduction of under-utilized resources, as often happens in generalized advertising, with greater efficiency in content monetization and more focus on niche markets with lesser consumers. Such efficiency draws an expansion of advertising platforms, with considerable impact on the advertisement market. In 2015, some estimates pointed out that online advertising amounted US$170.17 billion, or 29.9% of the global revenue in the advertisement market[138].

Vision

- Recognition of the role played by digital platforms on innovation and economic development, considering their diversity on access to content, goods and services, as well as reduction of transaction costs and of market access for small and medium enterprises.

- Analysis and evaluation of the activities carried out by some players in the platform ecosystem, due to their mediation role on the access to information. Such role has positive effects in service personalization, though it may present a risk for freedom of expression and access to information.

[137] Brazil – European Union Sector Dialogue. **OTT Regulation**. Idate, 2016.
[138] EU, **Commission Staff Working Document on Online Platforms***, ibid.*

- Evaluation on the economic power concentration risk in the digital platform market, which demands an update in regulation and anti-trust authorities and norms.

- Fostering the development of national companies in the digital platform market, with respect to the legal certainty principle.

Strategic Actions

- To create a legal benchmark on the digital environment aiming its modernization, as to create incentives to innovation and investments, prevent excessive market power by some economic agents, and to make feasible the informational autonomy of consumers, considering the specificities of online markets.

- To stimulate compliance of digital platforms regarding fundamental rights, including the discussion on the use of algorithms for automated decision.

- To incentive digital technology businesses to adopt high-quality transparency standards for the criteria used in algorithms, as a way to maximize access to information by end users, granted the protection of trade secrets and respecting technical limitations.

- To improve competition conditions between online platforms and intermediaries which offer innovative services to final consumes, identifying mechanisms able to mitigate network and lock-in effects generated by the scale-up of digital platforms.

E-Commerce Platforms

One of the main engines of digital economy is the e-commerce pulled up by digital platforms dedicated to the transaction of goods and services.

Diagnosis

The global revenue of e-commerce platforms is rapidly expanding. Total sales in traditional retail markets were estimated at US$ 22 trillion in 2016, and total sales in e-commerce reached US$ 1.9 trillion, with a 23% growth in comparison to the previous year. [139]

Brazil ranked 51st in the 2016 B2C E-commerce Index, published yearly by the United Nations Commission on Trade and Development (UNCTAD)[140], having dropped from the 47th position in 2015.

[139] eMarketer Report: **Worldwide Retail Ecommerce Sales: The eMarketer Forecast for 2016**.
[140] Available on http://unctad.org/en/PublicationsLibrary/tn_unctad_ict4d07_en.pdf, accessed on 10/10/2017.

The index considers the proportion of Internet users, the number of safe data servers, the diffusion of credit card use, and the trust index by the Universal Postal Union (UPU).

Brazil ranks 10th in world's largest e-commerce markets[141]. Transactions in e-commerce reached 44 billion reais in 2016, with a nominal increase of 7.4% compared to 2015. The average ticket – the average price of a single sale – reached 418 reais, an 8% increase in relation to 2015[142], pulled by the sales of products with higher added value.

The amount of Brazilian online consumers in 2016 increased 22% when compared to 2015, reaching 48 million people. Of those, 21.2 million spent US$2.4 in shopping from international websites, with a US$ 35.69 average ticket[143]. The device most often used for shopping was the mobile device, in 21.5% of buys. Over 50% of the total financial volume in those transactions was spent on home appliances, electronics and smartphones.

In this scenario, Brazil's strengths lie on the large dimensions of consumer's market, the existence of advanced electronic payment services and modern e-commerce platforms able to handle high demand levels, and the existence of sophisticated logistical services in large urban areas. Some issues that may hinder further developments in e-commerce, such as safe transactions, protection in buying and selling agreements, conflict resolution mechanisms, and protection of consumers rights with no unnecessary obstacles for private initiative and competition, still remain in both Brazil and abroad.

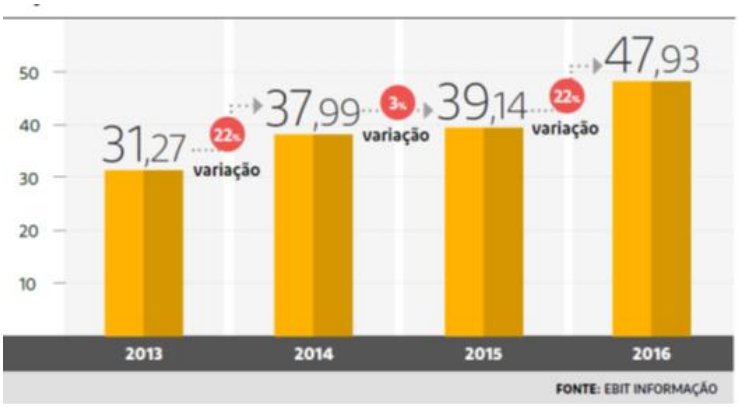
O programa Exporta Fácil

Criado com o objetivo de facilitar a inserção das micro e pequenas empresas no mercado exportador brasileiro, por meio da infraestrutura logística do setor postal, o sucesso da experiência da plataforma de comércio criada pelo programa Exporta Fácil levou a experiência a ser expandida entre os serviços postais dos países vizinhos da América Latina. O valor exportado via Exportafácil supera US$ 230 milhões anuais, sendo que os principais produtos comercializados são autopeças e vestuário. O programa tem um papel fundamental na expansão do comércio eletrônico transfronteiriço para as empresas nacionais.

National e-commerce platforms are focused on domestic market. The large size of Brazilian domestic market draws attention from international players in e-commerce; the internationalization of Brazilian e-commerce platforms, however, is incipient. The participation of Brazilian businesses on international e-commerce is well below its potential, which reflects on the commercial balance: Brazilian buys abroad sum up to 2.4 billion reais per year, while the sells adds up to 1 billion reais a year[144].

[141] [142] [143] [144] Ebit. **Webshoppers**, 35ª Edição, 2017.

FIGURE 18: NUMBER OF E-COMMERCE CONSUMERS IN BRAZIL, 2013-2016 (IN MILLIONS)



Source: Ebit Informação

Selling to international markets may bring positive effects, such as the widening of the client base (which reduces risk and increases financial independence), decrease of the seasonality effect in sales, and incentives to product or service improvements.

In some cases, international e-commerce platforms hinder Brazilian businesses from using their websites to sell to other countries (through geographic restrictions or similar rules) and, at the same time, allow foreign businesses to sell in Brazil. The lack of reciprocity show the necessity to evaluate the regulatory framework for international platforms.

Vision

- The following points must be improved for the e-commerce development:
- Strengthening of international presence of Brazilian e-commerce platforms, in alignment with the e-Xport Brazil Program, as detailed in the “International Dimension” axis.
- Capacity-building of small and medium enterprises (SMEs) managers for the digital world.
- Facilitated access to credit by business, especially small business dedicated to e-commerce.
- Simpler and digitalized fiscal and legal systems.
- Culture of business internationalization in the digital environment.
- Offering of information and training to the online exporter.

Strategic Actions

- To promote actions, such as the creation of logistics programs and opening of specific funds, to support small and medium enterprises (SMEs) dedicated to e-commerce.
- To integrate automatic, online and offline systems dedicated to payment charging, as well as e-commerce exports issuing procedures and side operations, including processes for logistics and taxation.
- To stimulate the adoption of alternative, friendly conflict resolution mechanisms for e-commerce consumer issues.
- To include articles and clauses concerning the international presence of e-commerce platforms in recent bilateral and multilateral commercial agreements negotiated by Brazil.
- To support the implementation of safety and security mechanisms for online shopping.
- To support initiatives for the development and use of digital payment.

Indicators

- B2C E-commerce Index, published yearly by the United Nations Commission on Trade and Development (UNCTAD)
- Exporta Fácil Program indicators (Brazilian Postal Service)
- Increase on sales from exporting SMEs (SISCOMEX)
- Increase in the number of exporting SMEs (SISCOMEX)

Creative Economy Platforms

The creative economy was the sector most heavily impacted by digital platforms. Among all value chains involved in digital transformation, music and audiovisual industries were the first to face swift and radical change in the way that their services and products reach the general public. A few years back, distribution was made in great part by selling physical copies of records and films, which involved copy production in different media, storage, distribution and merchandise space in physical stores. Today, the elements in this process were mostly substituted by streaming technologies, because of wide dissemination of smartphones and broadband Internet access. Control from artists and musicians over their own work is increasingly diffuse and weakened.

The impact is substantial in all sectors related to creative economy, presenting new regulatory challenges for the music and audiovisual industries.

Diagnosis

In the new scenario of digitalization and digital commerce, digital transformation greatly impacts on production, distribution and consumption of cultural goods and services, changing the existing business models, creating new businesses and widely modifying productive chains, with the emergence of new players.

Music

Brazil is currently the 11th largest musical market in the world[145] and the source of renowned creativity in the international music scene. Transition to streaming technology, however, lead to a decrease in revenue generated by the use of musical work. One of the most visible impacts of technological advancements and the new ways to enjoy music is the diminishing of royalties to artists in the new platforms, when compared with the average that existed before.[146]

This results from a phenomenon known as "value gap", by which the raise in music consumption is not followed by a proportional increase in revenue. Between 2014 and 2015, the volume of music accessed online increased 132%, while its revenue to copyright owners raised only 11%.[147]

According to the *Global Music Report 2017* by the International Federation of the Phonographic Industry (IFPI),[148] there are over 100 million paying users of music streaming services today. Between 2015 and 2016, revenue generated by digital music formats increased 17.7%, reaching a total of US$7.8 billion, and the streaming services revenue increased 60%, while the sales of physical formats dropped 7.6% and falling. The digital services revenue in the music industry are more than half of total revenue for the first time.

The same report states that the Brazilian records industry shrank 2.6% in 2016, due mainly to drops in CDs and DVDs sales. Conversely, digital sales increased 23% and the streaming segment increased 52.4%. Digital music market revenue reached 45% of total revenue and kept with the world trend.

Regarding the protection of copyright, concerns were raised by artist and composers around the world about the low paying rate from music commercially available in online platforms, in particular streaming services. There are issues of transparency, access facilities and the full understanding of platform rules, which require leverage for negotiation of payment terms in music platforms[149].

Despite the regulation recently approved by the Brazilian government on some aspects of digital

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[145] Pró Música Brasil – Produtores Fonográficos Associados. **Mercado Fonográfico Mundial e Brasileiro em 2016**. Rio de Janeiro, 22 de maio de 2017. Available on: http://www.pro-musicabr.org.br/wp-content/uploads/2017/05/Mercado-de-M%C3%BAsica-Global-e-Brasileiro-em-2016-FINAL.pdf (in Portuguese), accessed on 30/06/2017.

[146] United States Copyright Office. **Copyright and the Music Marketplace – A Report of the Register of Copyrights**. February 2015.

[147] *"UK Govt. Will Address Music 'Value Gap" as Part of Brexit".* Torrent Freak, published on 03/11/2016. Available on https://torrentfreak.com/uk-govt-will-address-music-value-gap-as-part-of-brexit-161103/, accessed on 30/06/2017.

[148] Available on http://www.ifpi.org/downloads/GMR2017.pdf, accessed on 13/10/2017.

[149] United States Copyright Office, *ibid*.

platform legislation[150], the transnational character of such services sets the agenda on international level. For this reason, Brazil together with other Latin American countries presented a discussion paper on the World Intellectual Property Organization (WIPO) in 2016, as a debate proposal about this and other aspects concerning the use of musical work in the digital environment.[151]

Audiovisual

The National Cinema Agency (ANCINE) developed a study with data from the audiovisual industry, showing that between 2007 and 2013, this industry's share in the Brazilian economy increased 66%, from 0.38% to 0.54% of GDP, with a total value of 24.5 billion reais in 2014. The paid TV segment, favored by the regulatory effect brought by Law 12.485, increased its participation in the sector's added value by 21.4% between 2007 and 2014.[152]

The online transmission of digital *video on-demand* – known as VOD[153] – may be classified into two categories: 1) VOD offered by cable TV companies as stand alone programs; and 2) over the top services (OTT), based on platforms installed over the broadband infrastructure which offer audiovisual services to end users.

The estimated proportion of people who accessed video on-demand by OTT platforms at least once a day increased from 30% to 50% of all the broadband Internet users, from 2010 to 2015. The average time spent weekly watching movies and TV series in OTT doubled between 2011 and 2015. In Brazil, the penetration of such services is estimated in 49% of Internet users, similar to the USA and greater then those of Canada and Mexico. [154]

Traditional TV cable operators struggle to extend their services and create alternatives to OTT, adding value and online content to their services with no extra cost to subscribers. At the same time, TV cable operators are also starting to explore their own OTT services independently, establishing their own OTT platforms for streaming.

A study conducted by ANCINE and the National Telecommunication Agency (ANATEL) in March 2016 indicates that streaming platforms are focused on market niches, offering content that compete against premium channel combos of cable TV, with lower prices. Furthermore, such streaming services

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[150] Instruction published on May 4, 2016 by the Ministry of Culture establishes "complementary procedures to entitle copyright collective supervision organizations the ability to charge fees, as set by article 5 of Law n. 12,965/2014".
[151] OMPI. **"Proposal for Analysis of Copyright Related to the Digital Environment"**, Standing Committee on Copyright and Related Rights. Geneva, Switzerland, December 2015. Available on: www.wipo.int/edocs/mdocs/copyright/en/sccr_31/sccr_31_4.docx, accessed on 11/07/2017.
[152] ANCINE. **"Relatório de Consulta Pública sobre a Notícia Regulatória sobre a Comunicação Audiovisual sob Demanda"**, and **"Recomendações da ANCINE para uma regulação da Comunicação Audiovisual sob Demanda"**. Available on https://www.ancine.gov.br/sites/default/files/Vod%20Documento%20P%C3%BAblico%20Final%20v3_2.pdf, (in Portuguese), accessed on 30/06/2017.
[153] Video on demand (VOD) can be defined as a catalogue of audiovisual works available online to be exhibited by non-linear broadcasting, in times defined by the final user.
[154] See ANCINE, op. cit.

depend on broadband Internet which still does not cover the entire country. [155]

The disruptive impact of streaming platforms is nonetheless undeniable. The audiovisual market is one of the most regulated industries worldwide, with rules covering content, financing, promotion and exhibition. Regulation does not yet reach new digital business models: a 2016 regulatory notice by ANCINE[156] affirms that current legislation on the audiovisual sector does not apply to streaming platforms.

Thus, action by the government is relevant, as it have been occurring in other countries, to ensure a well balanced competition environment, able to strengthen the industry, conducive to innovation and transformations, and yet preserving values as freedom of expression, promotion of national culture and protection of children and adolescents.

Vision

Music

- Participation in the international debate seeking the creation of an environment conducive to international regimes, with the ability to bring greater transparency in the use of musical work on streaming services and digital platforms.
- Modernization of copyright protection mechanisms in digital platforms.

Audiovisual

- Assessment on the need to sectorial regulation for the video on-demand (VOD) market, including guidelines for financing and exhibiting national audiovisual work in the new platforms.

Strategic Actions

- To expand diversity in the offering of audiovisual content to Brazilian consumers.
- To promote competitive balance among economic agents in the different segments of audiovisual and musical industries in the digital environment.

[155] *"Aspectos Econômicos e Comerciais do Serviço de Acesso Condicionado"*. Technical notice ANCINE – ANATEL, March 2016.
[156] Available on https://www.ancine.gov.br/sites/default/files/consultas-publicas/not%C3%ADcia%20regulat%C3%B3ria%20CAvD%20para%20Consulta%20P%C3%BAblica.pdf.

- To participate in international organizations aiming the promotion of multilateral regimes concerning transparency and the financial remuneration of copyright holders in digital platforms.

Indicators

- Music: Statistics on annual income for streaming (ECAD – ABPD/IFPI)
- Audiovisual: Data from ANCINE/Condecine.

Digital Entrepreneurship

Diagnosis

The changes caused by the digital transformation have been altering the way to generate wealth in the economy. The United Nations investment report[157] reveals that, between 2010 and 2015, assets in technology businesses grew 11% while those in other industries increased only 1% in average. In the same way, the gap between companies able to develop new technologies and those remaining in traditional business models is increasing progressively. In this context, it is reasonable to conclude is that the capacity of adding economic value is increasingly related to the ability of developing goods and services intensive in intangible capital, which is made possible mainly by digital technologies.

Another transformation triggered by the digital economy is the significant alteration in work relations. The tendency to segregate activities with task automation and the necessity to aggregate value to human activity are conducive to a scenario where the future worker will have grater responsibility to manage risk, strategy and operations instead of performing physical, repeated tasks. The vertical hierarchy line between boss and employee tends to be substituted by a multitude of horizontal relations, with a increasing number of people with greater autonomy in work and value creation.

In this scenario, the existence of emerging technology-based businesses, usually known as startups, is of great importance, as they provide digital services with high added value. Startups are agile businesses which can swiftly appropriate new ways and methods of work and production, and are responsible to insert entrepreneurial dynamism and innovation in different economic sectors. Startups have flourished and competed in the most diverse market activities, overcoming entry barriers even in oligopolistic sectors. All those elements are an indication that digital technologies have promoted new ways of producing and new economic relations, valuing self-employment and entrepreneurship, and indicating the need for a culture change for employers and employees.

The Brazilian information technology sector, contrary to tendencies in other economy sectors in the country, have been growing in the past few years. According to some statistical databases, Brazilian GDP decreased 3.8% between 2014 and 2015[158], while the national tech industry increased 20%[159].

In Latin America, venture capital investments are growing considerably, corresponding to US$ 594 million in 2015, a 53% increase when compared to 2012. Even with the 2015 economic stagnation, the

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[157] UNCTAD, *"Trends in assets, operating revenues and employees of the 2015 top 100 MNEs"*, in **World Investment Report**, Chapter 4, p. 162. Available on: http://unctad.org/en/pages/PublicationWebflyer.aspx?publicationid=1782, accessed on 13/10/2017.

[158] Agência Brasil: "IBGE: PIB fecha 2015 com queda de 3,8%". Available on: http://agenciabrasil.ebc.com.br/economia/noticia/2016-03/ibge-pib-fecha-2015-com-queda-de-38 (in Portuguese), accessed on 21/02/2018.

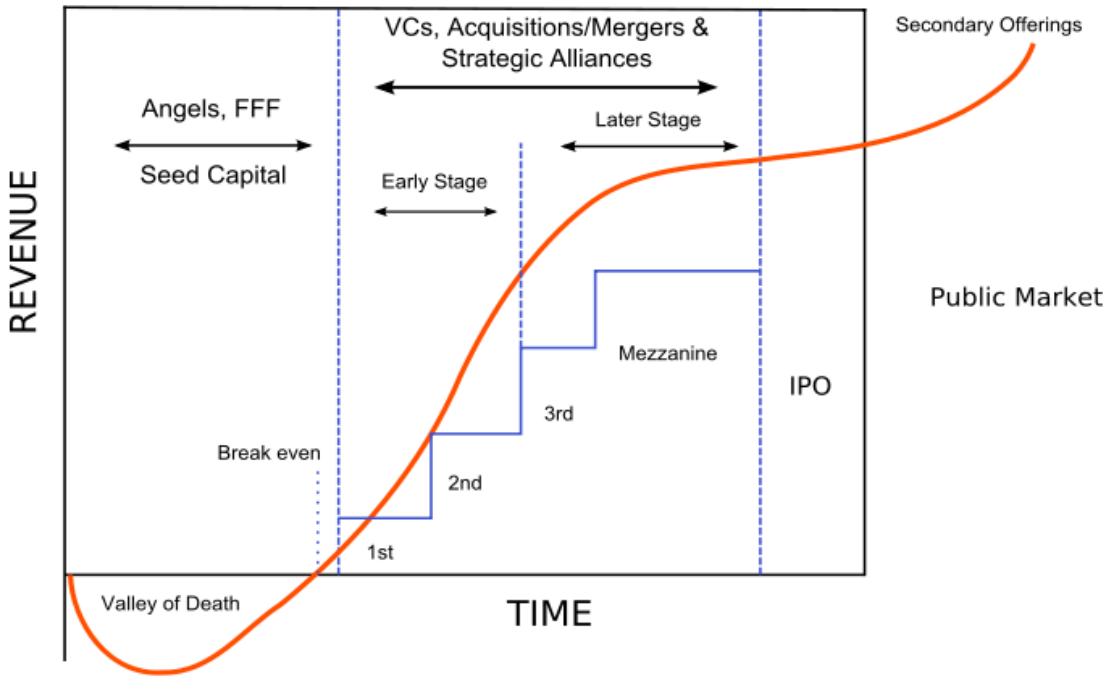
[159] Latin America Venture Capital and Private Equity Association (LAVCA). **Five Years Trends**, 2016. Available on: https://lavca.org/wp-content/uploads/2016/04/UPDATED-FINAL2-LAVCA-Latin-America-Venture-Capital-5-Year-Trends-04.27.16.pdf, accessed on 11/07/2017.

startup accelerators, angel investors networks[160] and venture capital funds in Brazil financed at least 195 startups during the first semester that year[161].

The startup and entrepreneurial investment market is growing in Brazil. Between 2011 and 2015, Brazil housed 63% of all startup investment in Latin America[162]. There are over 150 private equity and venture capital companies in the country, investing on over 1,500 nascent companies[163]. The *early stage* segment is also advancing quickly[164], with over 4,500 startups[165], 300 incubators and 25 acceleration programs in Brazil, along with 40 accelerators which invested R$ 51 million in 865 startups[166].

The following figure represents the startup financing cycle:

FIGURE 19: STARTUP FINANCING CYCLE



Source: NOVOA, Jaime. Article published in Startupexplore.com[167]

[160] According to the "Anjos do Brasil" angel investment network, angel investors are private people which invest their own capital in new businesses with extraordinary growth potential (such as digital startups). Usually, such investors create network associations to mitigate risk and make investment analysis more accurate.
[161] Privacap. **Spotlight on Brazil**, 2016. Available on https://www.privcap.com/wp-content/uploads/2016/01/2015.SR_.Brazil-1.pdf, Accessed on 11/07/2017.
[162] Latin America Venture Capital, *ibid.*
[163] Privacap, *ibid.*
[164] Privacap, *ibid*.
[165] Data available by the Brazilian Startup Association – Startupbase, at http://startupbase.abstartups.com.br/startups, accessed on 30/06/2017.
[166] ABREU, Paulo R.M. e CAMPOS, Newton M. **O Panorama nas aceleradoras de startups no Brasil**. FGV, 2016.
[167] The theoretical model illustrates different moments in the startup financing cycle. Financial demands in such businesses vary in time, depending on product or service maturity, market position, bootstrapping capacity, or establishing of the business model. Each investment round reflects different risk and return expectation, which results in different investment

In Brazil, some initiatives from the government and from private entities to promote entrepreneurship and startups are well succeeded. Some examples of such initiatives, carried on by the federal government, include the InovAtiva Brasil Program[168], the Startup Brazil Program, the National Business Incubator and Technological Parks Support Program (PNI)[169], and the Industry Startup Connection Program. [170]

Such initiatives are generally focused on innovative businesses in all sectors (such as ICT, industry, services, agribusiness), anywhere in the nation. They give assistance to novice entrepreneurs to transform promising technologies in fast-growing businesses, or facilitating their integration into the value chain of large corporations.

Digital Games

The digital games market generated US$ 1,27 billion in Brazil in 2016, which made the country rank 12th worldwide. However, most Brazilian game factories – 74.4% – have revenues up to R$ 240,000 a year; 24% are within the R$ 240,000 and R$ 240 million revenue range; and the remaining 4% earn between R$ 2.4 million and R$ 16 million. All earnings combined represent a very small participation in the world game market revenue. The Brazilian gaming industry is mostly composed by new, small businesses, in great part internationalized from day one. The industry is estimated to have doubled since the last assessment in 2014, which numbered 133 game companies.

Most entrepreneurs create games for mobile (80%) and online platforms (63%), and entertainment games are predominant (97%). Half of businesses are also dedicated to professional games. Final products are distributed on app platforms (67%), direct download platforms (39%), businesses own websites (38%) and social media (35%). Financing sources include own resources (64%), incubators (26%) and non-refundable funds (18%). The relationship between businesses and universities is of great importance to financing and game production.

Global data on the digital games industry demonstrate that Brazil has a relevant participation in the economic circuit, though without necessarily creating virtuous circles on domestic demand and supply. The Brazilian digital games industry is yet in the initial development phase and needs to be consolidated by sector expansion and greater professionalization of businesses and entrepreneurs.

Brazil, however, faces some relevant obstacles to the full development of a digital entrepreneurship of international magnitude. The most important obstacles include: (i) deficit of programmers and other qualified workforce estimated in 92 thousand professionals[171]; (ii) lack of motivation for students into

volumes. See: NOVOA, Jaime. *"Understanding differences in startup financing stages"*, article published on Startup Explore website, available on https://startupxplore.com/en/blog/types-startup-investing/, accessed on 30/06/2017.

[168] The Inovativa Program is an initiative by the Ministry of Industry, Foreign Trade and Services.

[169] The Startup Brasil and PNI programs are initiatives by the Ministry of Science, Technology, Innovation and Communications.

[170] The National Industry Startup Connection Program is an initiative b the Brazilian Industrial Development Agency (ABDI).

[171] Brazilian Software Excellence Association (SOFTEX). *"Mercado de tecnologia apresenta um déficit de 92 mil profissionais"*, published on 02/03/2016. Available on: http://www.cbsi.net.br/2016/03/mercado-de-tecnologia-apresenta-um.html (in Portuguese), accessed on 30/06/2017.

an entrepreneurial culture; (iii) long time and bureaucracy required to open and close businesses; (iv) labor laws do not allow wages agreements usually adopted by startups in other countries; and (v) high cost on money, time and staff dedicated to pay taxes.

Human capital is the fundamental input for nascent businesses, as it is impossible to develop products intensive on intangible capital without appropriate, competent workforce. In the short run, one solution to this problem may be to simplify and facilitate procedures required by the Immigration Law for recruiting foreign professionals [172]. In the long run, initiatives of professional training in digital technologies and of multidisciplinary studies in related fields must be adapted to meet the market needs, as detailed in the axis "Education and Professional Qualification" in this document.

One of the main challenges in financing digital entrepreneurship is to increase venture capital offer, which is essential to leverage startups growth. For this end, it is necessary to stimulate financing offer for the early stages of the startup life cycle, including the "death valley", aiming to provide easier, safer access to funds and financial support for digital entrepreneurship and risk investments. An example of such initiatives is the cooperated investment fund launched in November 2017 by the National Bank for Economic and Social Development (BNDES), which complements angel investors funds with the necessary resources for the startup to run.

Another great challenge faced by startups is global competition. The Internet allows a massive supply of services by foreign businesses and accelerates the emerging of new competitors and new products and services. For this reason, it is necessary to intensify actions aiming the internationalization of Brazilian startups and contribute to the development of national digital entrepreneurship – one example of such actions is the federal government program StartOut Brazil. It is essential to encourage a global mentality in new entrepreneurs from the beginning, and to set the conditions for international competitiveness of startups, including the reconsideration of some obligations (such as tax or labor obligations) that may imply extra costs.

Government support may also be an important catalyzer for entrepreneurial environment. Government programs demand closer coordination as they reach maturation, as a way to optimize resource allocation and the management of public instruments which can support startups in their different stages. This includes efforts to appropriately identify and improve roles and responsibilities of governments, private sector, academic institutions and the civil society, all contributing to the national startup ecosystem.

There are several difficulties to hire startups in public agencies, which is verified in many countries. The public administration runs on tighter rules for purchases and contracts, such as experience, referral and financial sustainability requirements, which may be prohibitive to startups and greatly differ from the way they operate. Startups, however, offer great potential of innovative solutions for the public sector, and countries such as Australia, United Kingdom, India and the US are considering this issue, assessing different ways to make public contracts with startups more flexible and feasible.[173]

[172] Law n. 13,455/2017.

[173] Startup Daily. *"Government launches ICT Procurement Taskforce to explore how to better do business with startups"*

This is a good opportunity for Brazil to formulate similar assessments. One proposal of public policy that may seize opportunities in the digital economy is to use digital solutions created by startups, with low implementation costs, for public services. Also, IT solutions based in open government data may be good alternatives for improving quality and efficiency in public services.

Fintechs – Digital financial technologies

In 2016, the Brazilian Central Bank created an inter-departmental workgroup to assess and evaluate technology innovations that impact the financial and payments systems. One of the evaluated technologies is the Distributed Ledger Technology – DLT, also known as *blockchain*. A number of public consultations in this subject were made in 2017.

Possible regulations will define the future of new digital technology applied to the financial sector. Regulation is increasingly considered as a push for innovation, as it may open ground for innovative solutions while preserving legal security and the rule of law.

Financial technologies and their related businesses (generally known as *fintechs*) may present benefits to the sector, such as allowing a highly resilient financial infrastructure, quick and efficient liquidity, and new ways to codify, share and analyze financial data. Also, there are possibilities for shorter and faster transaction chains and greater capital efficiency. For consumers, advantages include wider choice range for financial services, better financial advice and competitive prices.

Fintechs may also have a positive impact for society at large, offering a more inclusive financial system, with tailored and cheaper financial solutions, and better risk share and capital allocation. Furthermore, they are able to produce better credit scoring with a more precise credit and risk assessment.

Vision

Some initiatives may be enlarged or strengthened to make Brazil a more friendly environment for digital entrepreneurship. Such initiatives include incentives for business ideation and modelling, capacity-building for entrepreneurs, combined use of physical space (co-working and networking) at lower cost for early stage startups, incubation and acceleration programs, fund raising and insertion at the entrepreneurial ecosystem, incentives for initial investments, mentorship and building of market connections.

It is necessary to reformulate legal and tax mechanisms with the objective to facilitate startup financing and reduce costs and investment risk associated to bureaucracy and legal security. It is also necessary to facilitate the creation of more complex corporate forms (for instance, the transition from private limited company to corporation), which diversifies the available financing mechanisms for digital

http://www.startupdaily.net/2016/11/government-ict-procurement-taskforce-startups/; Code for America. "*Procurement 101*". https://www.codeforamerica.org/how-tos/procurement-101; The Economic Times. "*All startups are now eligible for exemption from any prior experience in public procurement*": http://economictimes.indiatimes.com/articleshow/53515664.cms?utm_source=contentofinterest&utm_medium=text&utm_campaign=cppst; The Guardian. "*Startups get less than 3% of government spend, this must change*". https://www.theguardian.com/small-business-network/2015/aug/19/three-percent-government-contracts-startups-change-growth, accessed on 25/07/2017.

businesses.

Another relevant aspect of digital entrepreneurship is the fostering of an entrepreneurial culture which may simplify businesses life cycle. Thus, it is important to strengthen actions that encourage a "failure-start-over cycle" mindset, modernize corporate law and forms, simplify rules to open and close a business, reduce bureaucracy, raise competitiveness, simplify license acquirement, and structure a regulatory environment which does not hinder innovative business models.

It is essential to seek a higher Brazilian rank in the international entrepreneurship indexes, particularly in digital entrepreneurship, as a way to insert Brazil in the global venture capital and investments chain. The development of a digital entrepreneurship culture is also desirable, with improvement in workforce and closer interaction between professional education institutions and the private sector.

Strategic Actions

- To support at least 200 digital startups each year through coordinated initiatives in the federal government.
- To improve legal framework related to workforce and labor relations in startups, including actions to simplify and facilitate procedures required for recruiting foreign professionals.
- To stimulate capacity-building in order to create a workforce specialized in digital technology, increasing the offer of expert professionals with adequate competences and abilities for the digital economy.
- To reformulate legal and tax mechanisms to reduce costs and investment risk, and to facilitate the creation of more complex corporate forms, which diversifies the available financing mechanisms for digital businesses.
- To stimulate financial offer to early stage digital startups, creating an internationally competitive environment which attracts venture capital investments.
- To stimulate an entrepreneurial culture with a "failure-start-over cycle" mindset, which may include actions to revise rules and procedures regarding bankruptcy, as well as opening and closing businesses.
- To strengthen initiatives to mitigate bureaucracy for stronger competitiveness, such as modernizing societal and corporate models, simplify license acquirement, and structure a regulatory environment which does not hinder innovative business models.
- To promote actions to internationalize Brazilian startups.
- To improve and articulate government initiatives which support digital startups, including startup acceleration, fund raising, mentorship and networking with potential investors, universities and businesses.

- To improve regulation to facilitate startup hiring by the government, creating opportunities to adopt solutions which addresses public interest issues in healthcare, education, public safety, and in other areas.

- To develop flexible regulatory environments (“regulatory sandboxes”) for testing of innovative business models.

Indicators

Suggested indicators include those developed by the Startup Brasil and Inovativa Brasil programs, as well as statistics compiled by the Brazilian Agency of Promotion of exports and investments (Apex-Brazil).

G. Digital Transformation in the Government

Making the government more dynamic, efficient, problem-solving and closer to the society, as to make citizens lives easier.

The Brazilian State has a fundamental role in digital transformation in economy and society, namely by its ability to foster its own digital transformation. The digitalization of public and government services is relevant not only to increase efficiency of government activities, in terms of costs and rationalization, but also to achieve greater effectiveness in social participation and in citizen's satisfaction regarding services provided. The state is a particularly significant protagonist in issues such as education and health services.

As an entity which organizes and represents society, the state concentrates increasing aspirations and expectations, intensified by the velocity of social, economic and technological transformations. In such scenario, there is no room for indifference by the state.

Digital technology holds a double-sided role regarding the state activities: creates potential for efficiency gains and service improvement, and presents challenges to social coordination by the state, directing towards it many different social demands.

There are at least three main guidelines for public policy on citizenship and digital government. Digital technology must be used to i) increase transparency and social accountability, ii) enlarge social participation in policy making, and iii) provide more and better digital public services.

By formulating and implementing policy within those three guidelines, the state is expected to meet the needs of society, preserving and strengthening its role as a coordinator of social transformation.

Thus, it is important to increase efforts for an intensive use of ICT, aiming to redesign state structures, procedures and processes, and tighten the relationship with other social players, in order to make public institutions more responsive and aligned with the needs of society at large. Data transparency and offering must be guaranteed, with the implementation of better digital interaction and collaboration channels between state and society, swifter and modern models for public service providing, and allowing greater convenience for the citizens.

ICT applications in public sector must be under a new paradigm. Introducing technology for punctual improvements in processes and services is no longer sufficient: there must be a redesign of a digital ecosystem which makes interactions between the state and society more simple and feasible. The fundament of the digital government is to create public value to society by utilizing ICT. In other words, it means to apply the transforming potential of ICT to benefit the society, as in:

- Goods and services more adequate to citizens' needs;
- Simple access to services;

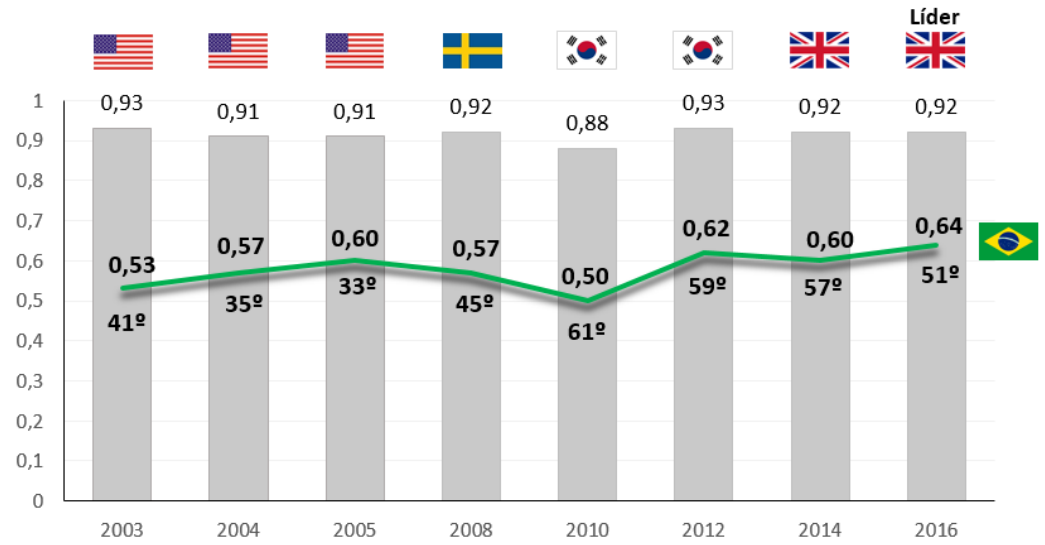
- Offering of public service offering which meet the needs for justice, equality, efficiency and effectiveness;
- Distributing public benefits efficiently and proportionally; and
- Creating value from open government data.

The state must be conceived as an entity inserted in the digital environment where public policy is designed as digital solutions. It is necessary to make a transition from the simple technology consumption to the full digital immersion in generating and providing services. There must be a leap from the "e-government" to the digital government.

Diagnosis

In 2016, Brazil ranked 51st among 193 countries in the United Nations E-Government Development Index (UN EGDI) [174], going up 10 positions since 2010, which indicates that the digitalization policy is in a right track, despite the need for adjustments. Brazil still ranks below other American countries, like the United States (12th position), Canada (14th), Uruguay (34th), Argentina (41st) and Chile (42nd). One of the main dimensions in this indicator is the online services index (OSI), in which Brazil ranked 38th in 2016 (data from 2015) among 193 countries, with a total of 0.7319 points.

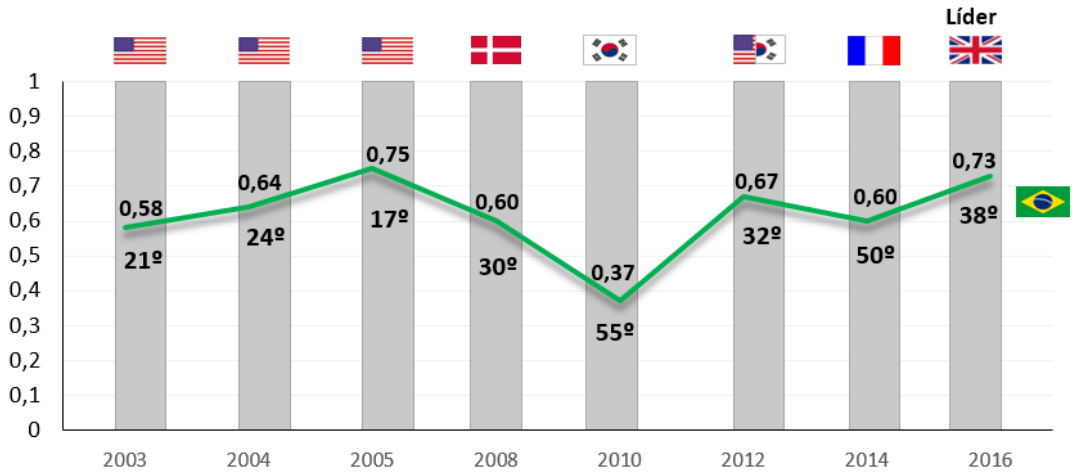
FIGURE 20: BRAZIL'S EGDI PERFORMANCE IN COMPARISON WITH THE WORLD LEADER



[174] UN EGDI is a United Nations research carried out every two years. It consists in a weighted average of three normalized scores on three important digital government dimensions: online services covering and quality (Online Service Index – OSI), telecom infrastructure development level (Telecommunication Infrastructure Index – TII) and human capital (Human Capital Index – HCI). The index value is normalized between 0 and 1 as a derivation from the arithmetic average of the three scores. More information at https://publicadministration.un.org/egovkb/en-us/Data/Coun-try-Information/id/24-Brazil .

Source: UN Research on e-Government

FIGURE 21: BRAZIL'S OSI PERFORMANCE IN COMPARISON WITH THE WORLD LEADER



Source: UN Research on e-Government

Online government services is expected to grow exponentially. According to Cetic.br estimates, 61% of the 107.9 million Internet users in Brazil have sought government information or services online in 2016. The most demanded public services and information were work and social security (28%), education (26%), taxes (24%), personal documentation (21%), health (16%), police and security (10%) and transportation (10%)[175]. Such data demonstrate the great significance of online public service demand.

Brazil advanced ten positions in the United Nations E-Government Development Index between 2010 and 2016, but still ranks 51 among 193 countries.

However, while the amount of Brazilians with Internet access is increasing in the past years, the proportion of Internet users effectively benefiting from online public services remains constant. This is an indication that service supply must be expanded, with greater efficacy and efficiency, so more citizens may request and follow up to public services without the need to visit a physical service center.

The main advantages of public process and service digitalization could include:

- **Meeting a growing social demand:** citizens are increasingly adapting to social media experience and private services provided in digital environment. Population in general,

[175] CETIC.br. **Pesquisa TIC Domicílios 2016**, available on http://cetic.br/pesquisa/domicilios/indicadores (in Portuguese), accessed on 23/11/2017.

especially younger people, are less and less tolerant with long lines and time consuming procedures for bureaucracy and paper work.

- **Economy:** online transactions tend to be significantly cheaper to citizens, businesses and the government. Not only time and money are saved, but also workforce, business processes and even rental space for personal service and document storage.

- **Integration and convergence:** digital interactions allow service centralization and, consequently, less fragmentation of different government services for citizens. Service convergence into a few contact points bring greater efficiency and convenience to people.

- **Security and privacy:** digital public services allow greater trust and confidence in personal data protection.

- **Service quality:** digitalization allows service standardization, which is a relevant trust factor in government.

Financial savings are an important incentive to service digitalization. The cost of an online service is often substantially inferior to a similar service provided in person, which represents a great economy in public resources. According to an international benchmark (see figure 22 below), the average cost of online services may reach 2.73% of an in-person service. Estimates by the Ministry of Planning and Budget point out that the average cost of a personal service is R$43.68, while the online version of the same service may cost R$1.20 – an economy of over 97% in public funds per transaction.

FIGURE 22: INTERNATIONAL COMPARISON OF PUBLIC SERVICES OPERATION COSTS BY TRANSACTION TYPE

Channel	Canada	United Kingdom	Norway	Australia	Average (US$)
Online	0.11	0.44	0.53	0.46	**0.39**
Telephone	4.57	5.89	7.01	7.66	**6.28**
In person	7.42	15.32	14.01	19.61	**14.09**

Operational cost for the state for each public service in average. Values are in purchasing power parity (PPP) US dollars.

Source: K. Kernaghan – Universidad de Brock (2012), Transforming local public services using technology and digital tools and approaches – Local Government Association (2014), Digital government transformation – Deloitte Commissioned by Adobe (2015)

According to this evaluation, a continuous digitalization of public services may represent an economy of approximately R$663 million a year for the government and of R$5.6 billion a year for the whole society, with a yearly total of R$6.3 billion savings.

A study conducted by Minas Gerais state evaluated the transaction costs of three service channels: online (the mg.gov.br website), telephone (Lig Minas 155), and automated service totems. The results were revealing, showing that digitalization indeed allows great savings in taxpayer money: the online service channel costed R$ 0.07 per transaction, the telephone service costed R$ 5.72 and the automated totem transaction costed R$ 0.35. Brazil advanced ten positions in the United Nations E-

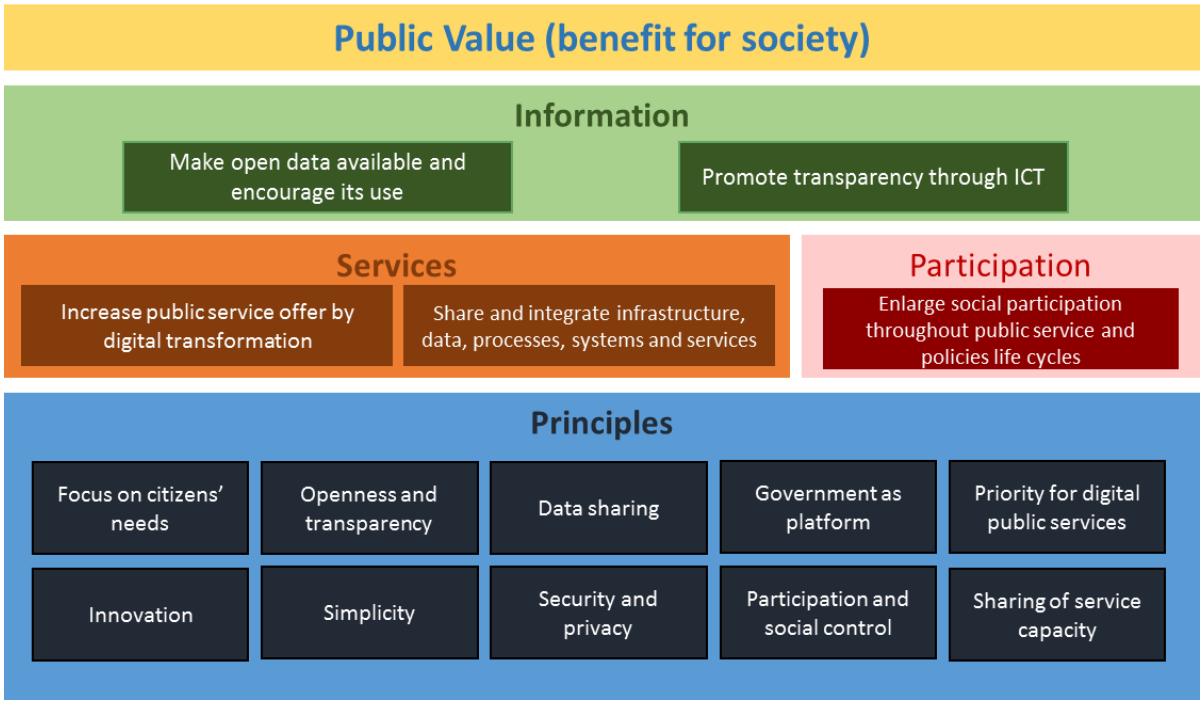
Government Development Index between 2010 and 2016, but still ranks 51 among 193 countries.

The Federal government implemented a number of initiatives to achieve greater efficiency and intelligence in public services using digital technology for both internal and external activities. The most recent initiative is the Digital Governance Strategy (EGD)[176], instituted by the Executive Decree no. 8,638 in January 2016 and revised in May 2018.

The purpose of EGD is to combine and integrate initiatives for digital transformation in federal government bodies and institutions, which will contribute to increase effectiveness and benefits for the Brazilian society through wider access to government information, digital public services and deeper social participation.

The EGD framework is represented by the diagram below:

FIGURE 23: DIGITAL GOVERNANCE STRATEGY FRAMEWORK



Source: Ministry of Planning, Development and Budget.

The economy of the future is strongly based on data use and treatment. A highly significant portion of this data is maintained or stored by the government. In this sense, the Ministry of Planning had structured three initiatives to upgrade government data use and handling: the Federal Government

[176] The Digital Governance Strategy website is www.planejamento.gov.br/EGD (in Portuguese).

Data Analysis Platform, the Interoperability Platform[177], and the Citizen Digital Authentication solutions.

The Federal Government Data Analysis Platform is a tech platform for government data analysis, trusteeship, mining and integration, which converges the main government databases in one place. It is composed by data crossing and analysis tools for decision making, with fraud and project failure identification features. Its goal is to reduce costs and simplify government data access in an integrated mechanism.

The Data and System Interoperability Platform is a interoperability bus system aimed to facilitate data reuse and integration for public service. One example of modernized service using this platform is the passport emission procedure, now based on electronic information exchange for some documental pre-requisites (such as regular electoral and military service records), which dispenses the presentation of the actual documents that the government already owns.

The Data Analysis Platform will be complete with a authentication solution for the citizen, which will propitiate public records integration between public offices. Its goal is to build and maintain a "golden record" of each citizen with public records and data quality. Such process will allow digital identification, offering a common, failure-free reference point with interoperability capacity among the main government databases.

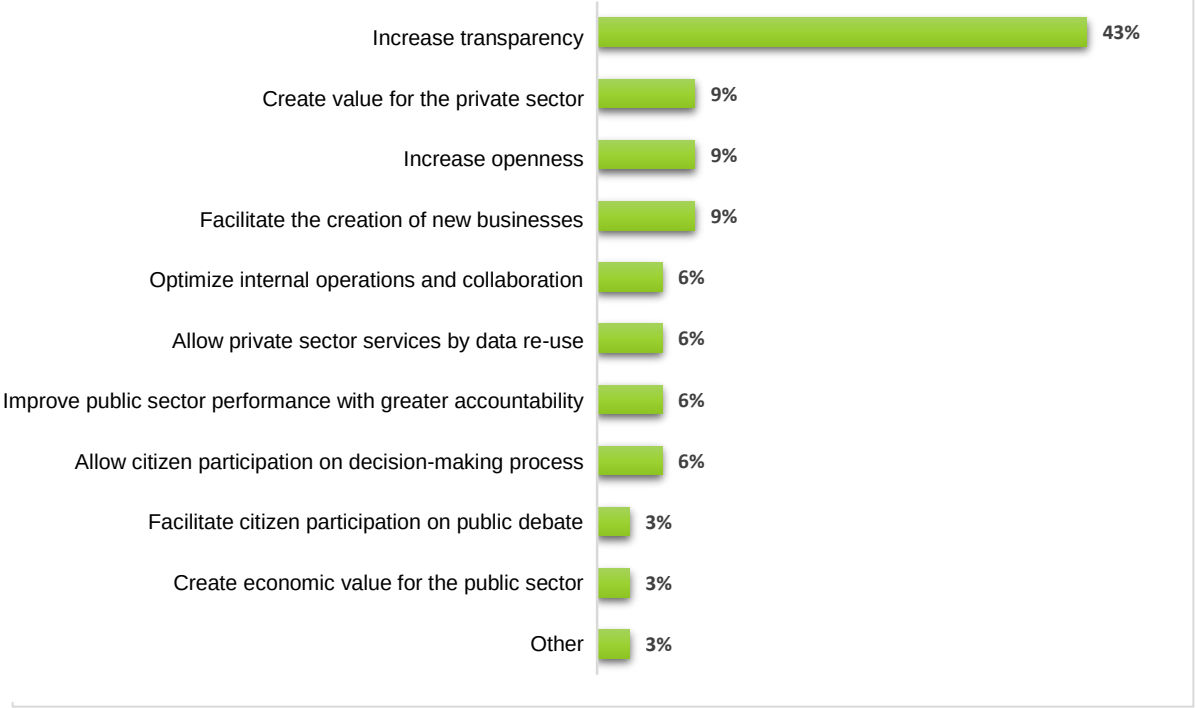
Another important front of EGD is the open data policy. An effective open data policy is crucial for the construction of experimental spaces in which innovative solutions for society challenges may be tested by citizens and enterprises in interaction with public agents, with transparency and accountability. It is possible to create value from data by its treatment, deriving new services and information from it. For that reason, it is important to develop an environment conducive to new business models built on open data, which will foster value generation and greater market dynamics in this sector, with positive social impact.

Digital transformation in the government allows better services to the citizens. Besides, government online transactions may save up to 97% of in-person services costs.

A study by the OECD[178] points out that open data policies in different countries target greater transparency, government social control, creation of public value, cost reduction for both public and private sectors, and new, more effective solutions for challenges in society.

[177] The Government Data Analysis and the System Interoperability platforms were created according to the Executive Decree n. 8.789, de 29 de junho de 2016.
[178] OECD. **2013 Survey on Open Government Data**, *in* **"Government at a Glance 2013"**.

FIGURE 24: MAIN REASONS FOR GOVERNMENT OPEN DATA STRATEGIES



Fonte: OCDE, 2017 Survey on Open Government Data, *in* "Government at a Glance 2017".

In Brazil, open data policy is implemented by the Brazilian Open Data Portal[179], a centralized platform for accessing government open data. It allows anyone to find and use public data and information. This policy aims to improve public management and efficiency, data crossing, early fraud detection and improved analysis and data intelligence within the government. The Portal also makes feasible the creation of new business models based on government open data.

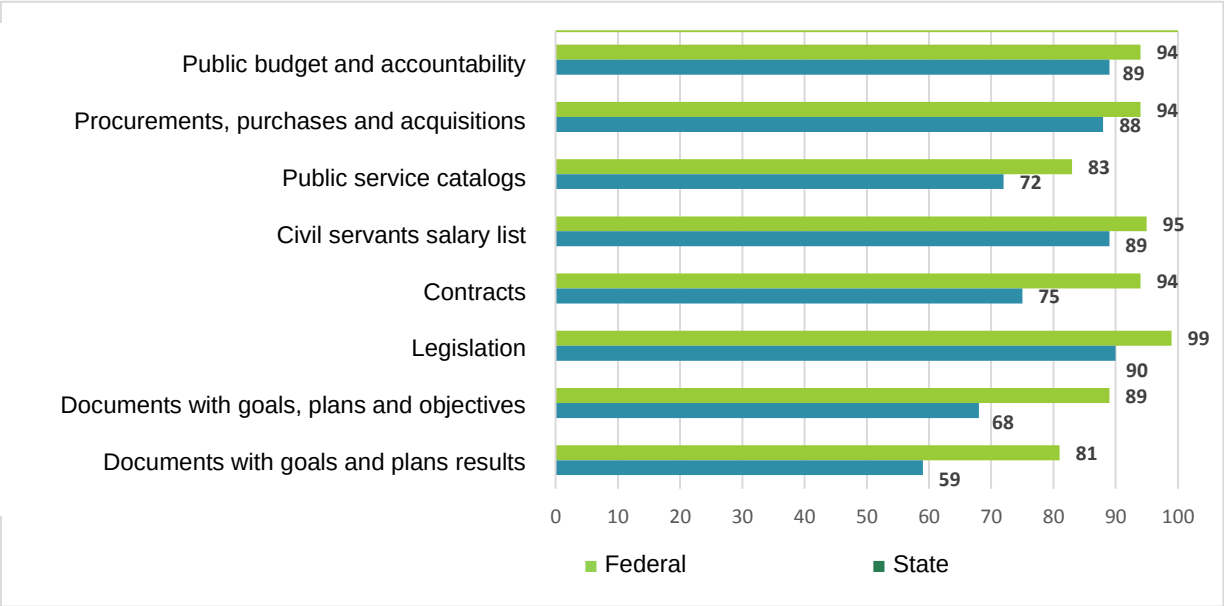
Apparently, public administration bodies in different levels in Brazil still consider the Internet as merely a broadcasting medium for legislation, norms, decrees, contracts, procurement and reports. Therefore, it is necessary to change the "online publishing" paradigm within the government in order to create value from public data: the Internet is not only a powerful instrument for transparency and social participation, but also for improving public services, including those not originally digital.

For such ends, government data must be complete, accessible, machine legible and available in simple and readable formats. There must be a public commitment by the government body to create value from its public data[180].

[179] Available on dados.gov.br.

[180] A collection of principles for government open data policies can be found at http://opendefinition.org/ and https://opengovdata.org/.

FIGURE 25: PROPORTION OF FEDERAL AND STATE GOVERNMENT BODIES WHICH PUBLISH INFORMATION IN THE INTERNET, BY CONTENT TYPE AND GOVERNMENT LEVEL (2017)



Source: Brazilian Internet Steering Committee (CGI.br)[181]

The Digital Citizenship Platform (PCD) is intended to increase and simplify the access to digital public services by Brazilian citizens. It was created as public policy in December 19, 2016 by the Executive Decree no. 8,936. This decree establishes implementation deadlines for electronic requests for public services aimed to people, businesses and public bodies.

This Platform is an integrated mechanism for public information, electronic service requests and direct service offering. For this ends, it offers:

i. Service requesting and follow-up facilities for people, businesses, organizations and public bodies, without the need of attending a public office;

ii. Wide implementation of such public services, including by mobile devices;

iii. Centralized channel for services and information as a “one-stop-shop” facility;

iv. User-oriented and simplified request, delivery and follow-up of public services;

v. Transparency in task execution and monitoring;

vi. Integrated, systemic performance of different public bodies concerning service

[181] Available on http://www.cetic.br/tics/governo/2017/orgaos/D2B/ , accessed on 30/05/2018.

providing.

The PCD is composed by five main components:

i. Federal Government Service Web Portal[182];

ii. Digital user access mechanism;

iii. Request and follow-up tool;

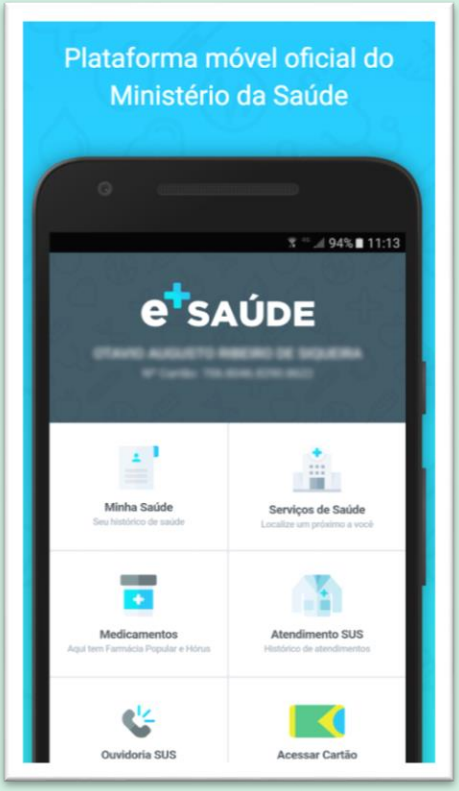
iv. User evaluation tool;

v. Monitoring panel for service performance.

[182] The Federal Government Service Web Portal is available on http://www.servicos.gov.br/ (accessed on 30/05/2018).

Digitalization and Health

In the context of national digital strategies, e-Health has become a priority due to its significant impact and wide benefits in different countries. In this relevant subject, the International Telecommunication Union and the World Health Organization edited together the ITU-WHO National eHealth Strategy Toolkit[183].



E-Health consists in the use of information and communication technologies to improve healthcare services in general. ICT may be used to develop and increase efficiency of healthcare management, on patient attention and monitoring, information handling, in decision making for clinical procedures, public healthcare modelling, epidemics detection and control, and in many other occasions.

E-Health is changing the way of organize and offer health services worldwide, including Brazil. Healthcare is increasingly linked to information and communication, and now depends on knowledge and technology for newer and more efficient mechanisms which improve the extent, quality and humane care of health services.

It is fundamental to adopt principles and strategies to integrate and promote interoperability of lifelong health registries, in order to promote better healthcare with a humane and civil treatment to patients.

Health technology also contribute to speed up healthcare processes, build capacities and abilities in medical teams, and make the health information flow more efficient to better support both medical and policy decisions. Efficient use of e-health must contemplate qualification of human resources, adequate information and communication services and systems, specific technology, standards for medical information and interoperability, governance, legislation and financing. It is also essential a wide, reliable broadband infrastructure which allows quality connection between health centers, including mobile devices, with agile communication between patients and professionals.

Many e-health initiatives have been developed in Brazil during the past two decades, some with very positive results. However, a structured E-Health Strategy[184] was only recently structured, based on guidelines and principles by the Single Health System and aligned with the Brazilian Digital Transformation Strategy.

Some of the highlighted initiatives in the E-Health Strategy are the “e-SUS” online medical appointment for basic healthcare, which is part of a national strategy for technology upgrade in the Health Information System and the Electronic Medical Record System. There is also the *DigiSUS*, a mobile web access platform for treatment monitoring in consultations, walk-in, and hospital care; and the *DigiSus Gestor* version of the same platform, which provides online health indicators from e-health systems to assist the health service manager or the policy maker with management information.

Vision

Considering the diagnosis described above, E-Digital establishes the following objectives for digital government:

- Digital governance
    - Establishing policies for digital governance with full integration between Federal, state and municipal levels of government.
    - Establishing of a governance system with cross-cutting, continuous processes and uniform methodology, aiming to modernize the state.
    - Sharing of service capacity: different public bodies should share infrastructure, services and systems in order to avoid redundancy, waste and extra cost, as well as the enclosure of information in silos.
    - Data sharing between public bodies in the Federal level whenever the opportunity of simpler processes and services arise.
- Digital public services
    - Consolidation of the Digital Citizenship Platform[185].
    - All services accessible through a unique, centralized channel.
    - All federal public services available online, at least at the request or scheduling stage.
    - Priority for public services offered in digital environments whenever possible, in the largest variety of devices and platforms available.
    - Service evaluation and feedback.
    - Fully operational service monitoring panel.
    - Single authentication system available for both natural people and organizations, aggregating the main security levels in only one tool.
    - Integration of services in all three levels of government (federal, state and municipal) aiming unified solutions for the citizen.
- Digitalization of Documents and Administrative Processes

[183] Available on: http://www.itu.int/pub/D-STR-E_HEALTH.05-2012, accessed on 30/06/2017.
[184] Available on: http://portalsaude.saude.gov.br/estrategiaesaude , accessed on 30/06/2017.
[185] Available on www.planejamento.gov.br/cidadaniadigital, accessed on 20/09/2017.

- Electronic Processing System implemented in all organizations within the Federal government and integrated with single authentication system.

- Access to information
  - Full compliance to the Access to Information Law (Law n. 12,527/2011).
  - Implementation of the Government Open Data Policy, in cooperation with other governmental bodies, aiming to consolidate a culture of transparency, social participation, accountability, research, innovation and entrepreneurship, through the use of free, reliable public data in open formats, made available in the Open Data Portal.
  - Building a public data ecosystem with the objective to more simple and cost-friendly public services, by the promotion of data crossing, data analysis, data intelligence and the use of government data as an important asset in the digital economy. This ecosystem should stimulate entrepreneurship and new business models which generate value in the digital market and benefit all people.
  - Government as platform: government institutions should be constitute and open digital platforms where different social actors may build technology applications for public services, fostering development and innovation.

- Integration
  - Implementation of interoperability initiatives for data government, building connections between the major government systems through the System and Data Interoperability Platform.
  - Complete exemption to present certificates and documents for digital public services when such data is already in government bases.
  - Intensification of data crossing and data intelligence activities, with greater efficiency in stopping fraud.
  - Harmonization of data and “data cleaning” in the main record bases, with efficient identification and single channel for information updates.
  - Encourage public organizations in federal, state and municipal levels to implement and evaluate digital governance policies in their respective areas of responsibility, combining initiatives, eliminating bottle necks and harmonizing practices and tools.

- Security and infrastructure
  - Cloud data storage, in compliance with security rules.
  - Secure digital certification available to people and businesses in their dealings with the government.

- Digital public services must promote data integrity, availability, confidentiality and authenticity, as well as protect privacy according to legislation.

- Participation and social control

  - Expanding social participation on public services and policy life cycles.

  - Transparency and publicity by public organizations on the use of public funds for services and programs, with timely, precise and reliable information disclosure.

  - Existence of a social participation digital platform as a locus of excellence for dialogue between government and civil society. Its objective ought to be the promotion of public interaction, publication of policy-related content, and access to online communication and debate tools.

Strategic Actions

- To make available at least two thousand different services on the Federal Government Service Web Portal.

- To revise and update the Digital Governance Strategy with better mechanisms for monitoring and evaluation.

- To encourage public bodies, states and municipalities to adopt implementation and monitoring programs for digital governance policies.

- To implement the certification and document waiver for digital public services already registered in government databases, according to Decree n. 9,094/17.

- To implement the single authentication system, combining the main security levels in only one digital tool.

- To promote the Electronic Process System in all public bodies within the federal government.

- To consolidate the Government Open Data Policy, strengthening a culture of transparency, social control and innovation, and promoting an enabling ecosystem for new business models and entrepreneurship.

- To integrate existing records in the government by a technology authentication tool, in order to improve data quality and allow efficient citizen identification with a unique, interoperable reference.

- To consolidate the Digital Government Platforms: Data Analysis Platform, Data and System Interoperability Platform, Transparency Portal, Government Open Data Platform, and the Digital Citizen Participation Platform.

- To maintain and improve a digital social participation platform as a place of excellence for dialogue between government and civil society.

Indicators

Measuring of digital citizenship and digital public services may include the following international indicators:

- United Nations E-Government Development Index, particularly in the online services and electronic participation dimensions.
- *Open Data Barometer* – ODB, developed by the World Wide Web Foundation to assess the prevalence and impact of open data initiatives worldwide in aspects such as readiness, implementation and effectiveness.

The Digital Governance Strategy has also developed a set of indicators related to each one of its initiatives, establishing goals for the next two yearly cycles.

Further contributions to measure the implementation of E-Digital strategic actions may include the results of TIC Domicílios and TIC Governo Eletrônico researches, assessed by the Information Society Development Study Center – Cetic.br[186].

[186] All researches and indicators by Cetic.br are available online at http://cetic.br/pesquisas/ (in Portuguese). Additional information on EGD indicators can be found, in Portuguese, at http://www.planejamento.gov.br/EGD.

MEMBERS OF THE E-DIGITAL WORKGROUP

MINISTRY OF SCIENCE, TECHNOLOGY, INNOVATION AND COMMUNICATIONS
Maximiliano Salvadori Martinhão
Miriam Wimmer
Daniel Brandão Cavalcanti
Artur Coimbra de Oliveira

MINISTRY OF INDUSTRY, FOREIGN TRADE AND SERVICES
Marcos Vinicius De Souza
José Henrique Videira Menezes

MINISTRY OF PLANNING, DEVELOPMENT AND MANAGEMENT
Wagner Silva de Araújo
Elise Sueli Pereira Gonçalves

MINISTRY OF FOREIGN AFFAIRS
José Antonio Marcondes de Carvalho
Benedicto Fonseca Filho

MINISTRY OF JUSTICE AND PUBLIC SAFETY
Frederico Fernandes Moesch
Dim Michelle Ferreira Rodrigues

MINISTRY OF CULTURE
Rodolfo T. Tamanaha
Nitai Bezerra da Silva

MINISTRY OF DEFENSE
Durval Sanches da Silva
Alex Queiroz Pereira

CABINET OF INSTITUTIONAL SECURITY
José Garcia da Luz
Alcimar Sanches Rangel

NATIONAL TELECOMMUNICATION AGENCY
Nilo Pasquali
Karla do Valle Abrahão Cavalcanti

EDITING AND DESIGN TEAM

Alexandre Lauri Henriksen
Cristiane Vianna Rauen
Daniel Brandão Cavalcanti
Luana Lund Borges de Carvalho
Marcos Toscano Siebra Brito
Miriam Wimmer
Pedro Gontijo Menezes
Samuel Barichello Conceição

Department of Digital Transformation Policy
Secretariat for Digital Policy
Ministry of Science, Technology, Innovation and Communications