Android's social and economic impact in Brazil

By Lívia Moura and Gustavo Camargo

android

BAIN & COMPANY

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They can be contacted in the following email addresses livia.moura@bain.com and gustavo.camargo@bain.com.

Content

1. Digital inclusion

Increase in the number of connected users

In recent years, the Brazilian's relationship with the Internet has changed significantly. With a plurality of means of access, the computer is no longer the preferred device, while the connection through cell phones and tablets has grown. The population connected to the Internet increased from 41% in 2010 to 70% in 2018. In addition to the new means of connection, the expansion of telecommunications networks to remote regions of the Brazil has also contributed to increase the number of users, thus allowing Brazilians of different social levels to have access to the Internet.

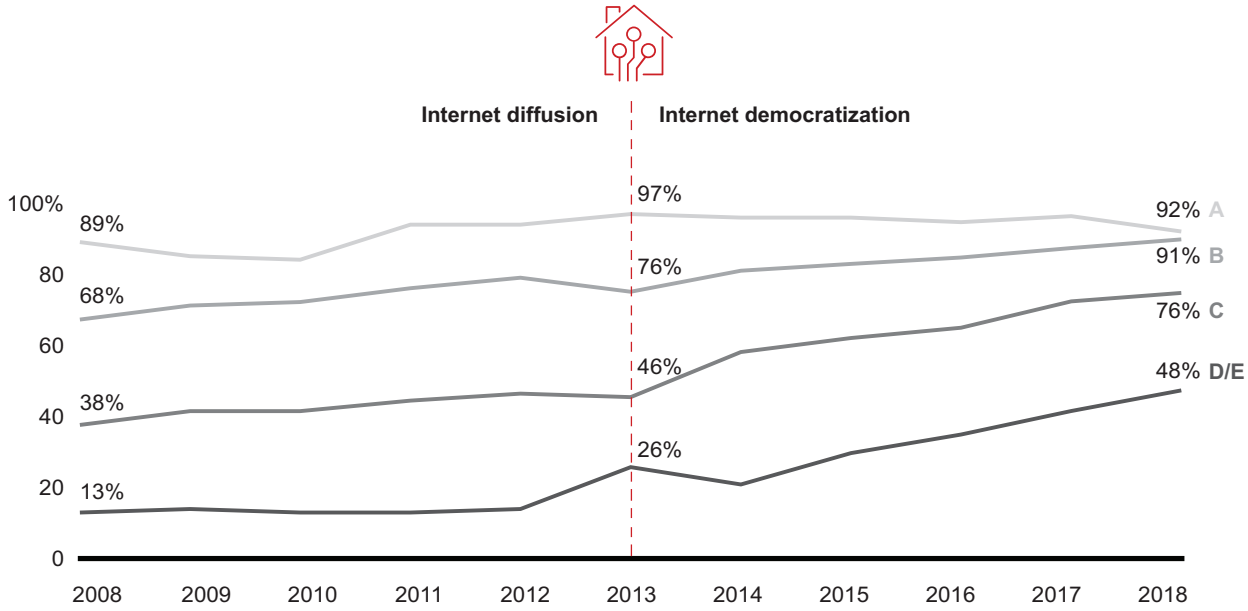
Democratization of Internet access

In 2010 in Brazil, only 13% of the lower income population (social classes D/E) had access to the Internet. From 2013 on, the democratization of the Internet started and, year by year, it accelerated significantly, reaching in 2018 48% of connected individuals in D/E classes *(Figure 1)*.

Democratization also took place geographically. In 2010, Brazil's Southeast region had 47% of its population connected, while in the Northeast that figure was only 28%, a difference of 19 percentage

Figure 1: Internet access by social class

Percentage of population with access to the internet by social class (2008-2018)



Source: TIC Domicílios

points. Due to the Internet democratization process already mentioned, the disparity was reduced to only 11 percentage points in 2018, when in the Southeast 75% of the population had access to the Internet, while in the Northeast 64% of the residents were connected.

Android as an important gateway to the Internet

In recent years, Internet access spread and democratization in Brazil have been driven by smartphones as an additional or main mean of access. Portable and, in many cases, cheaper, smartphones can perform connectivity functions similarly to a computer.

Due to the greater number of users, smartphone prices have steadily decreased, driven by gains in production scale and reduced component costs, generating greater demand. Likewise, telecom networks have expanded and improved the connectivity to serve the growing market demand.

The combination of all these factors generated, in recent years, a positive cycle of increase in the number of users, expansion of connectivity and relevant applications, and falling prices due to the scale reached.

Android contributes to this cycle through a free, open-source, dynamic, and accessible operating system that has two major effects:

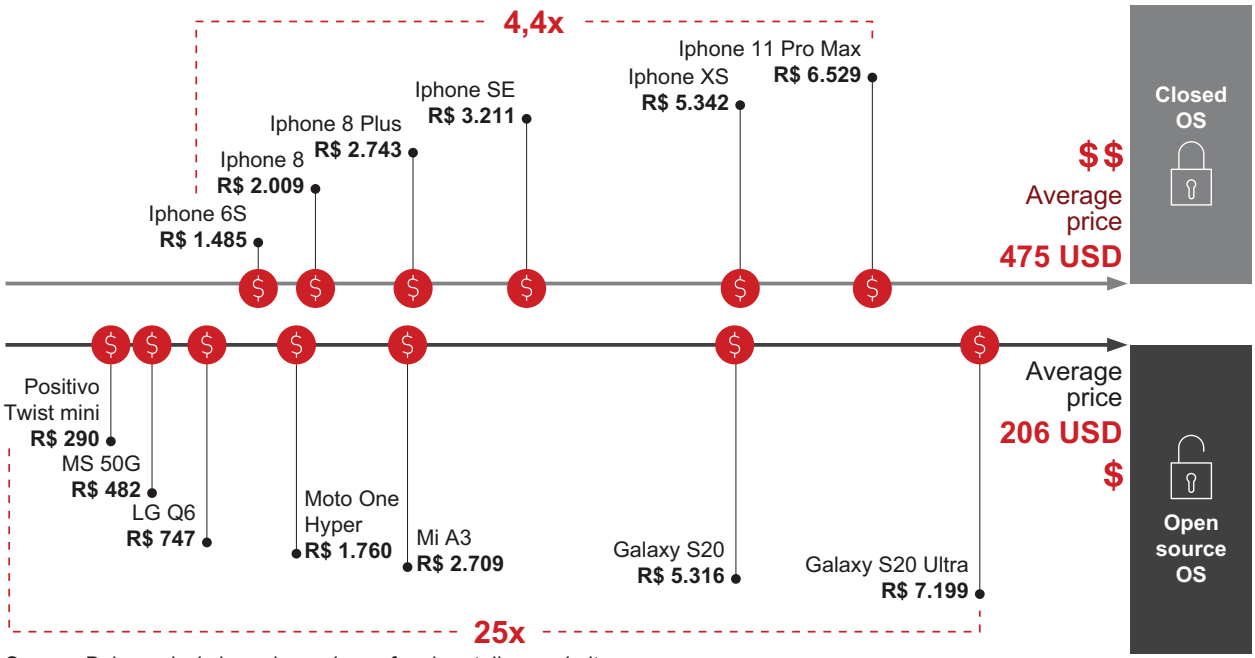
- The free, open-source operating system allows several manufacturers to develop a wide range of devices with different capacity, functionalities and price ranges *(Figure 2)*. The market is vast and ranges from premium models with prices up to R$8,000 to models built for users who want a simpler connection experience, with prices as low as R$250. These cheaper models were important drivers of digital inclusion, since 80% of people in the D/E classes pay less than R$1,000 for a smartphone.

- Android has also attracted a community of developers and software companies. The open-source operating system helps to create a highly collaborative ecosystem. For 83% of developers this is one of the main reasons for choosing the system. The collaborative ecosystem, alongside the spread of Android, enabled new industries and ways of working, and the development of applications that transformed society.

The number of Android users contributed directly to the increase of Internet access. Over the last five years, 24M Brazilians have been introduced to the Internet through an Android device *(Figure 3)*.

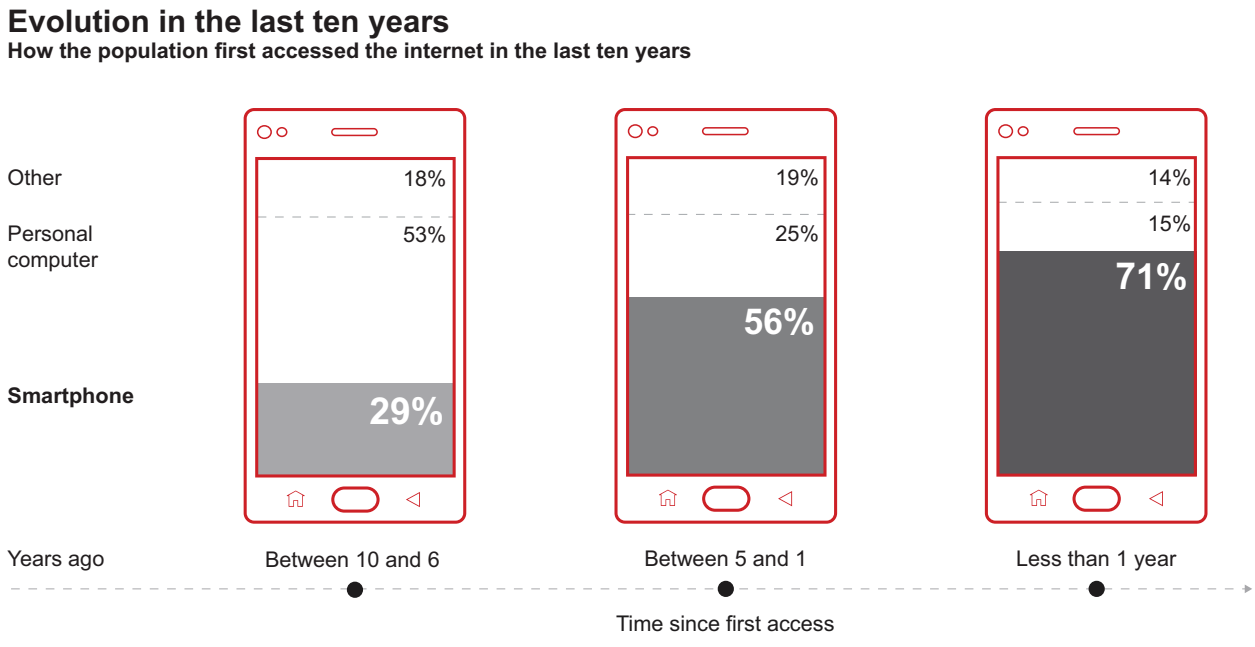
93% of Brazilian smartphone users believe that Internet access had a positive impact on their lives and more than half of them say that such impact made their lives a lot better.

Figure 2: Price point variation by operating system



Source: Bain analysis based on prices of main retailers websites
Note: Exchange rate of 5,29 (Sep/20)

Figure 3: Internet access by device



Source: Bain Smartphone User Survey

Internet access methods and habits

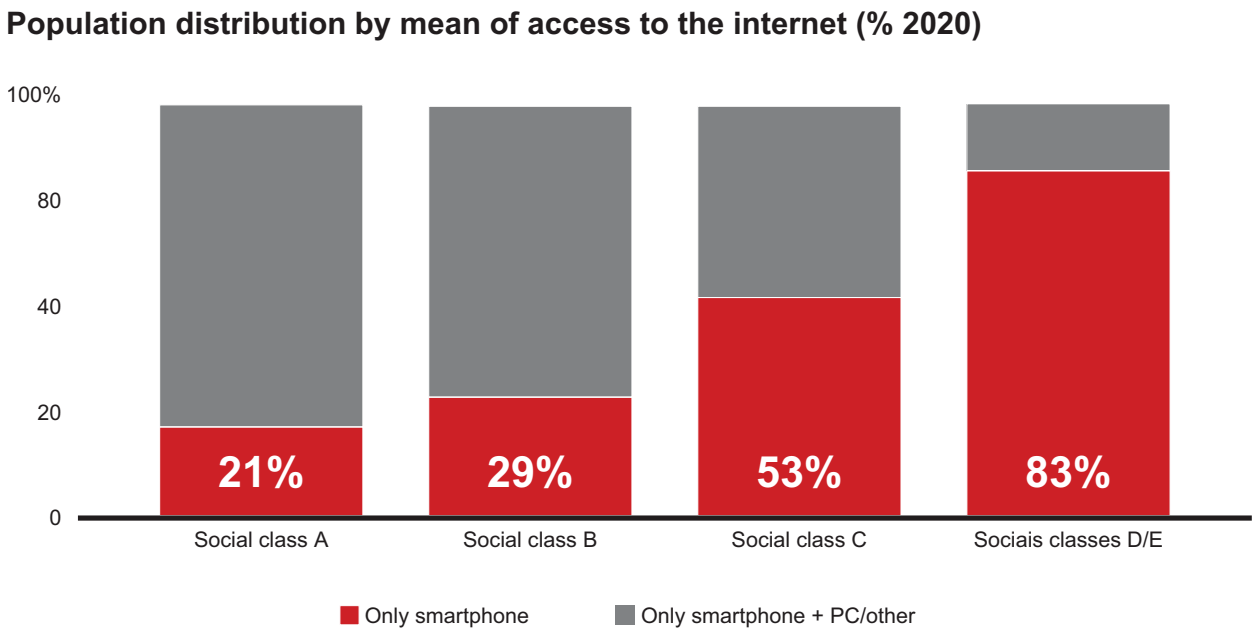
Today, 97% of users access the Internet through a smartphone, and 51% access it exclusively this way. In the D/E classes, the smartphone has an even more significant role: for 83% of users, the smartphone is the only mean of access *(Figure 4)*. In Brazilian states like Acre, Piauí and Sergipe, more than 70% of the digital population uses only the smartphone to get online.

Today, 63% of users under 18 years old access the Internet only through their smartphones. Among people over 40, 45% use this device exclusively. Despite the lower preference for the smartphone, older people tend to be increasingly digitalized. And, as young people tend to maintain their preference for the smartphone as they age, it is expected that the smartphone importance for Internet access will further consolidate over time.

Smartphone uses

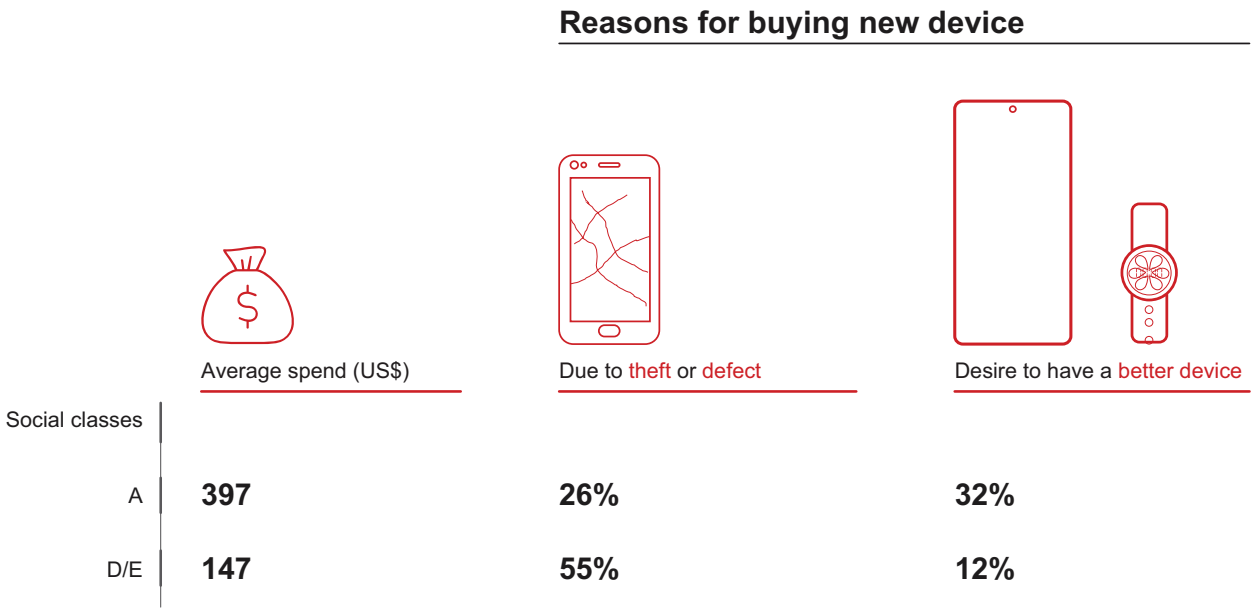
The smartphone has become an important item in the basket of goods of the Brazilian consumer. Average spending on devices varies widely across different social classes. While people on the A class spend an average of R$2,100 when buying a new device, users of classes D/E spend an average of R$780. It is also possible to note that users from different social classes switch devices for different reasons *(Figure 5)*.

Figure 4: Means of access to the Internet by social class



Source: Bain Smartphone User Survey

Figure 5: Reasons for switching devices by social class



Source: Bain Smartphone User Survey
Note: Exchange rate of 5,29 (Sep/20)

Differences in consumer behavior are also observed among different user age groups. For the younger groups, replacement is driven by damage or theft, while older groups look for device upgrades. Regarding expenditure on devices, patterns are observed across three different age groups. Young people up to 24 years old spend the least, regardless of social classes, due to lower financial independence. In both A and B social classes, people between ages 25 and 39spend the most in their device—around 15% more than people above 39. In classes C and D/E, however, there are no significant differences in expenditure between the two age groups.

Despite the large number of devices that are stolen or damaged, the number of users who purchase device insurance is still low, at only 14% of owners.

In Brazil, smartphones also influence consumer behaviors in other realms. Around 36% of Brazilians pay for subscription services such as Netflix, Amazon Prime, Spotify, Deezer, and Globoplay, to name a few. Globoplay is a Brazilian digital content platform that has grown significantly since its launching.

The more digitally mature the user, the greater the chance of paying for subscription services such as those. About 40% of people inserted in the digital environment for more than five years subscribe to at least one of these services, while only 25% of users who have been accessing the Internet for less than five years do it. Despite the gap in subscription behavior, monthly expenditure is similar—R$45, on average.

Regarding online product purchases through smartphones, digitally mature users buy more often and spend 5.5 times more on these transactions than recent users. The increase in spending over time is also observed in lower income classes. In the D/E classes, mature users who shop online spend on average five times more than recent users.

Due to technological evolution, the smartphone hardware has become more powerful, making it possible for users to use several functions with a device that fits in their pocket. Alongside this, a large number of companies develop apps to improve a wide range of day-to-day activities. As a result, the smartphone has transformed the way people live and organize their activities. Today, 90% of users employ the device every day.

By analyzing Brazilians' usage preferences, it is possible to notice that communication (including messaging) has a prominent place in terms of both importance and frequency of use. Next, come social networks. Another group of activities indicated as important—showing that the smartphone has transcended its original communication purpose and adds value in several relevant spheres—includes tasks previously performed only in person or through a computer. Chief among them are education, personal finances, news reading, photography, entertainment, and navigation with maps *(Figure 6)*.

User comments about the smartphone's impact on their daily life:

"My smartphone has a huge impact; without it, it would be very difficult for me to have a reasonable income selling clothes at home, since I don't have a physical store. I use Instagram, Facebook, and WhatsApp to post pictures of clothes, special offers, everything. I also use these apps to schedule appointments with customers. My smartphone is key for everything related to my work."

- Report of a 23-year-old smartphone user, social class B

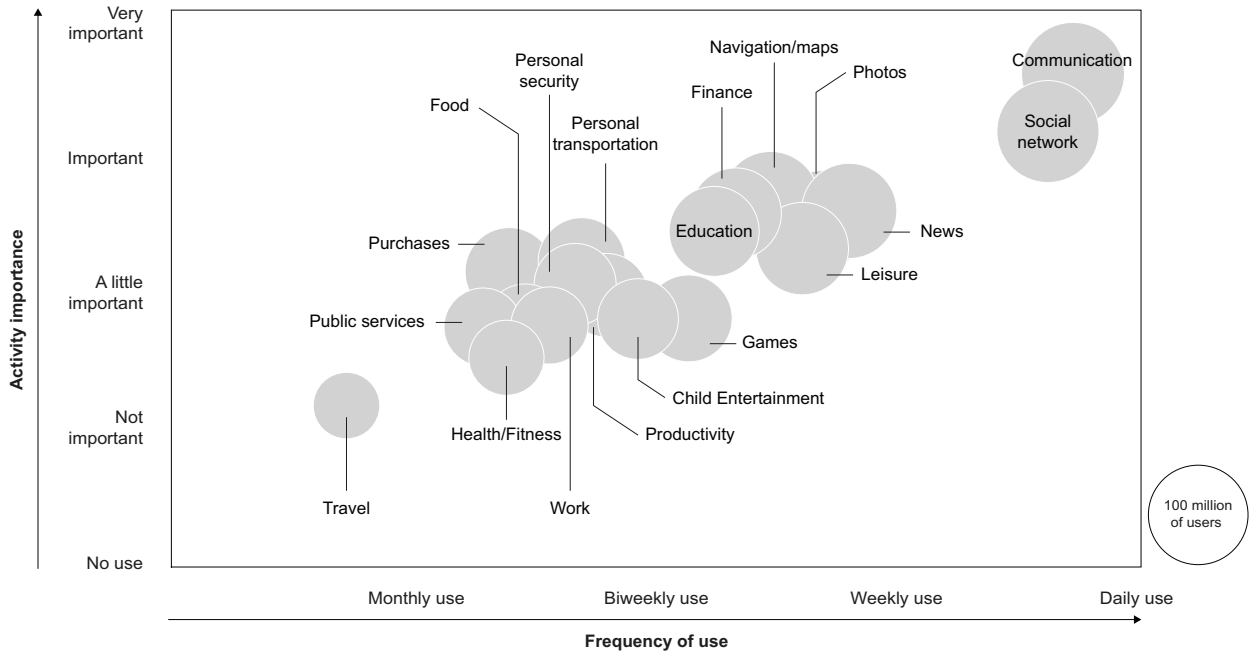
"Due to the smartphone, online courses are much better. Personally, it enabled me to have another way of life... I have a daughter in a wheelchair and online courses help her study. It did impact our lives."

- Report of 52-year-old smartphone user, social class D/E

The increasing digitalization of the population is accompanied by the digitalization of various public services. Currently, 75% of federal public services are digital (fully or partially) and the digitalization pace has been accelerating, as in the private sector and in the society as a whole.

The popularization of the smartphone contributes to this transformation. According to the survey, almost 60% of users use the device to access public services. Official documents such as work permit, driver's license and CPF, for example, can be used digitally with a smartphone. More than 100 applications from different government agencies have been launched, aiming to facilitate the use of public services and increase access to information. One example is Viva Bem, launched by the Ministry of Health to help in the routine of patients who use medication on a frequent basis. In education, EduCapes gives access to a vast collection of texts, books, video classes etc.

Figure 6: Frequency of use and importance per activity on the smartphone



Fonte: Bain Smartphone User Survey

During the Covid-19 pandemic, the smartphone was once again a gateway for the population to access financial benefits granted by the government. Emergency Aid, for example, was available through a process that was 100% digital. The user registers the CPF, monitors the approval status and the aid availability online and receives the money automatically in a digital account through CAIXA Tem app. In addition, the person can make payments and purchases with a virtual debit card and does not need to go to bank branches.

In addition to facilitating and democratizing the population's access to public services, digitalization initiatives can also generate significant savings for the country.

User comments about use of public services through smartphone:

"In terms of public services, banking and mobility, my smartphone had a huge impact. I enjoy it a lot; I always use digital documents like CNH, voter registration card, work permit and others. "

- Report of 37-year-old smartphone user, social class C

"The smartphone helps me because I have a company and it facilitates the invoice issuance."

- Report of a 45-year-old smartphone user, social class B

"I think digital public services are important because if I forget documents at home, I have access to them in my smartphone. And this has helped me in many situations."

- Report of a 32-year-old smartphone user, social class B

Digital acceleration

Nowadays, the role of digital has become more important than ever. The pandemic and social distance led to changes in people's lives, who replaced face-to-face activities with online alternatives. In such a challenging moment, we observe a transformation that had already been happening and the beginning of a new era, in which Brazilians will be more connected.

The frequency and diversity of uses of the smartphone has increased. 70% of consumers have intensified the use of communication and social media platforms such as Youtube Facebook, Instagram, Whatsapp, TikTok and Youtube. For the first time, 46% of consumers watched a "Live" on their cell phone. This new activity was experienced by people of different ages, not just the youth. Among consumers over 55, 33% saw their first "live" during quarantine.

The relative importance of online shopping has grown significantly. During the isolation period, 34% of Brazilian consumers placed their first order for food delivery using apps. Among those who already used such Delivery applications, there was an increase in spending on this channel: 11% of consumers reported spending more, net of those who decreased spending. Spending on WhatsApp purchases also increased for 8% of consumers (net).

People who used apps like Ifood, Rappi and Cornershop had, in general, a good perception of their experience. This indicates that the use of this type of service tends to continue after the pandemic.

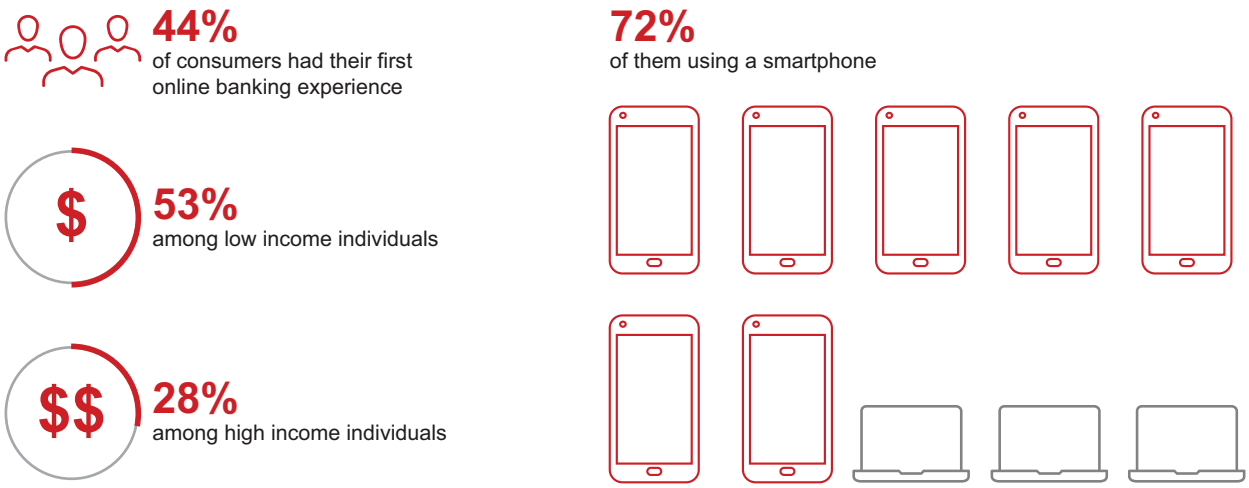
Mobile payments have also grown rapidly. 44% of people reported their first online banking experience; among them, 72% used the smartphone for their first attempt. The adoption of this habit stands out in the lower social classes: 53% of low-income consumers used online banking for the first time during the pandemic, while in high income, the percentage is 28% *(Figure 7)*. Possibly this difference occurs because the high income already used the resource before, reinforcing the important role of digital in contributing to the democratize access to some types of services.

Other services such as education and health started to be used digitally by thousands of people. Since the beginning of the pandemics, 28% of consumers have taken their first online course and 17% have had their first virtual medical consultation using the smartphone. Companies migrated to virtual setups, and as a result, 19% of consumers reported using virtual work software for the first time, through their smartphones.

The increase on people experimenting digital activities for the first time happens in all social classes and age groups, pointing out the relevance of these new habits. This reinforces the tendency that many of the changes may stay. In addition, most consumers believe they will maintain their new activities after the end of the isolation period, in particular the use of online banking and food delivery services.

The smartphone also helped those who had their income impacted during the pandemic: 32% of consumers say they started using their smartphones as a mean of complementing their income. Sales of products on social networks or specialized websites, online classes and delivery applications are some of the examples mentioned by these people. Some of them have reinvented themselves during the pandemic period with the support of technology.

Figure 7: Adoption of new habits during the pandemics - Online Banking



Source: Bain Smartphone User Survey

Stories - people who reinvented their businesses using the smartphone

Raquel's Story

Raquel is 21 years old, lives in São Paulo and has worked for some years as a living character animating children's parties. Since the parties were cancelled due to the pandemic, she had to reinvent her professional activity. She started making video calls with children, both for celebrating dates and for having individual conversations with them.

Using the smartphone, she adapted her ways of working in order to succeed. She created a folder, promoted her services in Facebook groups and started to make appointments directly with the end customer. For video calls, she uses the WhatsApp video function or the Zoom application. In addition, she controls receipts through bank's application.

According to Raquel, the smartphone helped a lot in this reinvention, "for the promoting the services, for the video call... it helped me due to the camera quality, due to the agility it allows and the accessibility of being at hand."

"For customers, it is easier to contact me; they can share it with other people, it is much faster, much more agile."

- Raquel is 21 years old and lives in São Paulo

João's Story *:

The personal trainer João was one of the professionals impacted by the closure of gyms. To continue his classes and maintain the relationship with clients, he adapted the gym sessions to a virtual format. The smartphone, which was already important to communicate with clients and control payments, became more important.

"In this moment, the technology allowed me to continue with the gyn classes ", he said. At first, some adjustments were necessary. "I had to understand the space the client has at home and assess which equipment or furniture could be used for the exercises. Being able to follow the client though video during the new exercise routine was very important to avoid injuries."

He also highlighted that the physical activity routine helped clients to improve quality of life and mental health during the pandemic.

* João is a fictitious name, as the person chose to share the story anonymously

Wíliam's Story:

Wíliam is 26 years old, lives in São Paulo and holds a degree in Information Systems. He started to be interested in and to study programming before university, noticing the potential of mobile development services. Today, he works autonomously developing his own applications in the Android platform, focused on

services such as curriculum creation, shopping lists, recipes etc. During the pandemic, he distributed free premium access codes to one of his applications, through Facebook groups aimed at LGBT audiences. The application helps users to develop and format their curriculum via mobile.

"Many people have lost their jobs and are looking for new positions. I decided to make the access codes available to anyone who needed it. Several people are using the application, there was a significant increase in accesses and downloads. "

Wíliam's initiative have positive impacts for many people: "It is very simple to fill out; you easily have your CV in PDF and can share it anywhere. It has helped me a lot", said an application user.

- Wíliam is 26 years old and lives in São Paulo

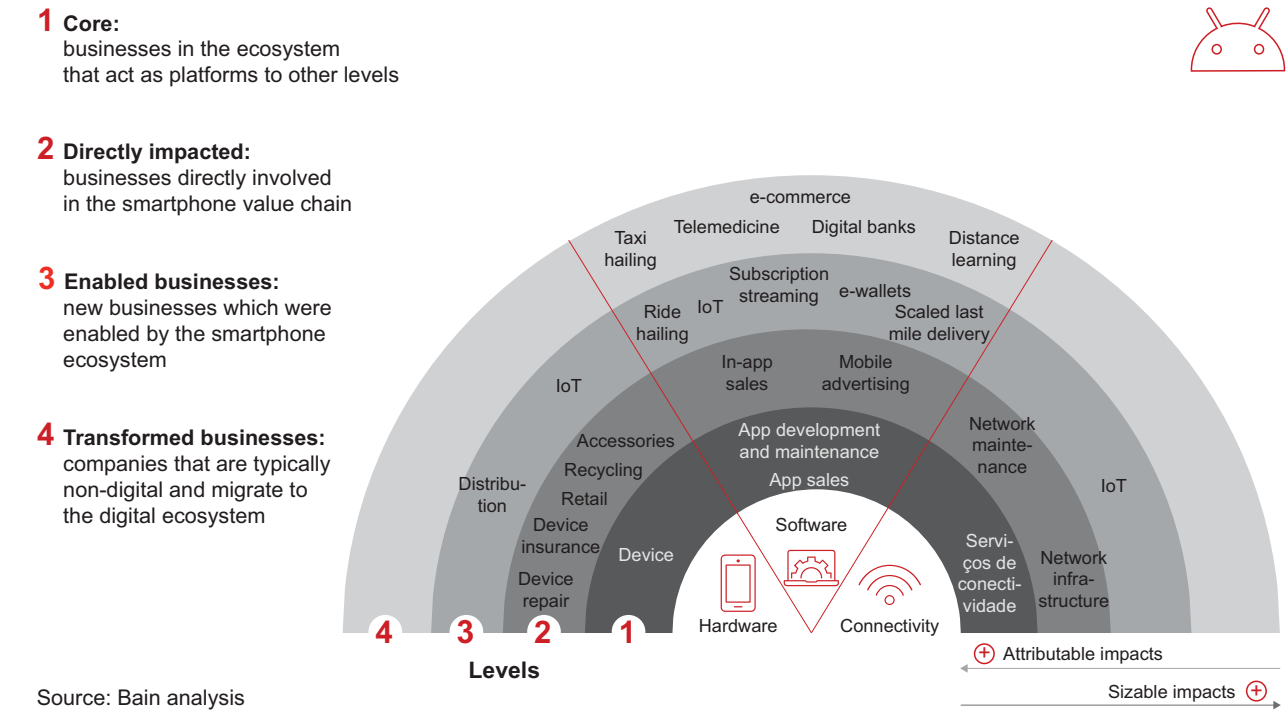
2. Social and economic impact

The smartphone ecosystem comprises industries associated with the hardware, software and connectivity. In each of these industries, there are businesses with economic and social aspects to which Android contributes directly and businesses that were enabled by the ecosystem indirectly *(Figure 8)*.

In 2019, within the smartphone ecosystem, the Android platform contributed to generate revenues estimated in R$136B in the directly involved companies. This figure represents approximately 2% of the Brazilian GDP in 2019. In addition, there are around 630 thousand jobs in the direct value chain around the Android platform. This is equivalent to approximately 35% of workers in the technology and telecommunications industry *(Figure 9)*.

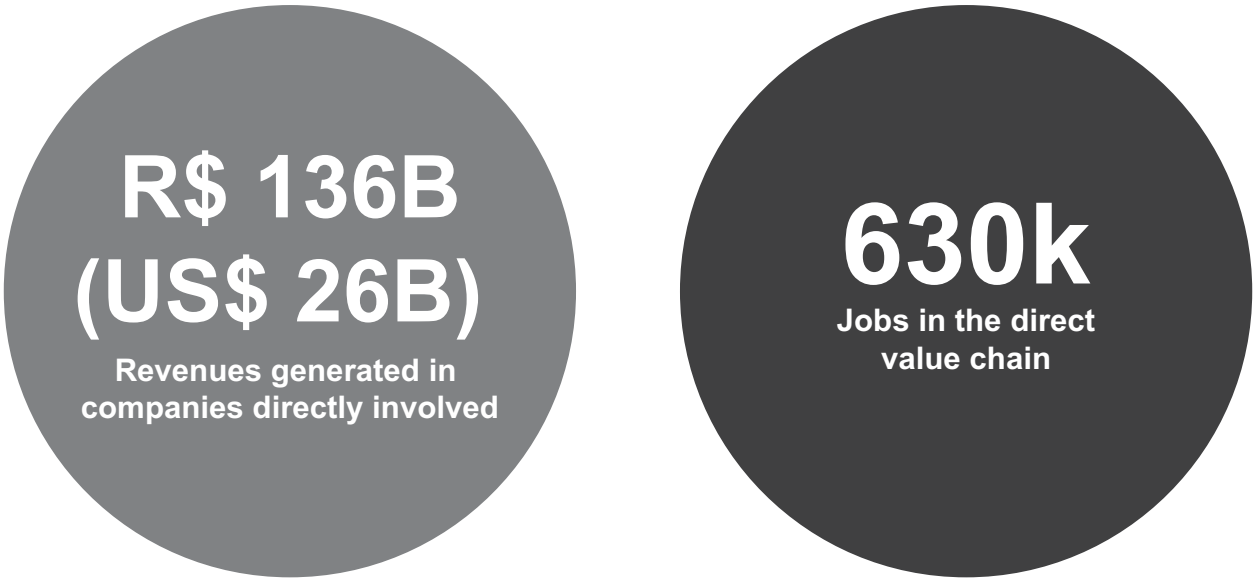
In addition to the direct impact, a relevant amount of revenues and jobs is generated by companies enabled by the smartphone ecosystem. As examples, there are the apps for private urban transport, apps for delivery services and digital banks. These businesses are enabled by the value chain that begins with the app sales and development services, followed by the in-app sales and in-app advertising businesses. Just Uber, the largest urban private transport application in Brazil, has a network of 1 million drivers and delivery partners, according to the company.

Figure 8: Android value chain layers



Source: Bain analysis

Figure 9: Economic impact and employment figures



Source: Bain analysis

Hardware

In a simple way, hardware is the device manufactured for the user. From the initial concept to the device itself, it is necessary to go through a long value chain that includes the extraction of raw material, the assembly of the device, and distribution to stores. In addition to the device itself, the hardware chain integrates a number of other associated service businesses, such as providing device insurance, repair services and selling accessories.

New players and market relevance

Since 2002, when Blackberry launched the first smartphone, many players entered and exited the Brazilian market, which is very dynamic. Among the current 13 main players, eight entered in the Brazilian market after that year. Today, around 50M devices are sold per year in Brazil. This is the equivalent to say that in the last year 1 out of 4 Brazilians bought a new smartphone. Device sales in Brazil represent 56% of the total in South America *(Figure 10)*.

Figure 10: Hardware industry numbers

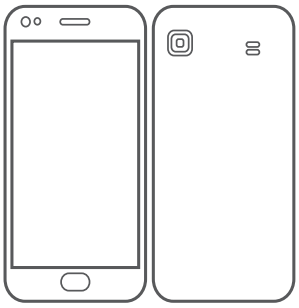
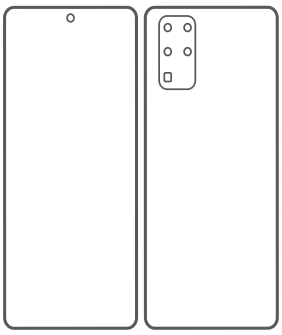
Source: IDC and Bain analysis

Hardware evolution

Throughout its nearly 20 years of history, smartphones have undergone many transformations that have significantly changed their functionalities and uses. By comparing the first and last generation of smartphones of the same product line, it is possible to note significant advances *(Figure 11)*.

The technological advances enabled better processing capacity and functionalities, allowing smartphones to basically perform the same functions of a computer. In addition, nowadays the smartphone can play the role of other electronic items such as devices for listening to music or digital cameras. As an example, 89% of users use the device to take pictures. A user who has a more sophisticated smartphone is able to capture high quality photos and videos, automatically store them in the cloud, quickly edit the content and easily share it on social media.

Figure 11: Comparison of technical hardware specifications

Samsung	Galaxy S (2010)		Galaxy S20 (2020)
		VS.	
Processor	Single-core | 1 GHz		Multi-core | 1x2,84 GHz, 3x2,42 GHz, 4x1,8 GHz
Camera	Single camera | 5 MP		Triple camera | 12MP, 64MP, 12MP
RAM memory	512 MB		12 GB
Storage	8/16 GB		128 GB
Batery	1.500mAh		4.000mAh
Display	233 ppi		530 ppi

Source: GSM Arena and Bain analysis

Stories of hardware companies impacted by Android in Brazil

Motorola

Motorola is a telecommunication company that entered in the Brazilian market in 1971 and since 1996 has been manufacturing locally. Today it has about 500 direct employees in the country. According to the company, its goal is to frequently innovate in order to offer solutions that improve consumer lives. The company worked with different operating systems until 2009, when it made the strategic decision to adopt the Android as its only platform and to dedicate exclusively to the smartphone market.

The DEXT model was the first one to adopt the Android system. Models have evolved along with the mobile industry. In 2013, with the moto g model, Motorola developed a new product category, the intermediary smartphones, bringing products with high quality technical specifications for affordable prices. Globally, more than 100 million units of the model have been sold. According to the company, this model has been one of the responsible for democratizing Internet access in Brazil and worldwide.

The Android platform played an important role in this democratization process, as the President of Motorola Brazil, José Cardoso, said: "Android has allowed Motorola to focus on developing products with differentiated design and experiences that really make sense, making consumers' lives easier. Thus, Motorola was able to stand out in innovations ranging from the first voice assistant on the Android market with the moto x, in 2013, to more recent ones such as the motorola razr, a device with

foldable screen in flip format, and smartphones compatible with the network 5G. "

Today, smartphones are essential for people live. José Cardoso emphasized this importance: "During the pandemic, cell phones became a key investment of many people to maintain productivity in home office. It allows for the continuity of classes and physical activities by videoconference. For some professionals, it even allows them to continue offering their services, such as psychologists and the entire food chain through delivery applications."

(All information was provided by Motorola).

Positivo Tecnologia

Positivo Tecnologia is a publicly traded Brazilian company created in 1989 with the initial objective of producing personal computers. In 2011, the company launched the Positivo Ypy tablet, using the Android operating system. It was the first tablet developed exclusively for the Brazilian consumer, with content in Portuguese. Soon after, in 2012, the company entered in the smartphone category.

Positivo Tecnologia has become one of the largest producers of Android products in Latin America. Since 2012, more than 5 million Android devices have been produced by the company, which currently has about 2,000 employees and a distribution network including 12,000 points of sale.

According to the company, their smartphones generally have a more affordable price and, thus, an important role in serving different social classes and democratizing access to technology. "Android is an extremely important piece in the equation of being able to take technology to a much larger number of people in Brazil." said Hélio Rotenberg, founder and president of Positivo Tecnologia.

(All information was provided by Positivo Tecnologia).

Future perspective

In the history of hardware, as new devices and features are launched, the price of existing devices falls, and they become accessible to more people. This movement should continue to occur, so that in the future a greater portion of users will have access to functions now restricted to smartphones that are more sophisticated. This applies especially to improvements to the processors, screens and cameras on the devices, which will provide users with a much better experience when reading news, watching videos and playing games on their smartphone, for example. The same price dynamics applies to accessories and other devices related to the smartphone.

The next evolutions of the devices tend to be associated with the journey of virtual reality and augmented reality (VR and AR). In a simple way, VR transports the user to a simulated world (real or imaginary), while AR brings simulated objects to the user's world. Hardware evolutions will allow applications that use VR and AR to be disseminated and improved. For instance, a greater diversity of content/types of games and an immersion experience closer to reality is expected. Another example are the industrial applications. The evolution of hardware will allow interactive online training via

smartphone. By pointing his smartphone camera at different parts of a machine, an industrial technician can receive written instructions on the screen on how to fix each component.

Technological advances in the hardware to allow for the several smartphone uses have enabled new applications. As an example, speech recognition originated in the telephone industry has allowed the development of smart devices like Google Home or Alexa. Smart devices can understand human speech, transcribe it into a written command, and execute the assigned command.

New technological advances should continue to occur, enabling for example the expansion of the Internet of Things (IoT). It is expected that smartphones, wearables, drones, and, in the mid-term, autonomous and connected cars and smart city infrastructure play an even more relevant role in our lives.

As an example, the wearables, technological devices that can be used as accessories, has become more popular with technological advances in hardware. These devices, such as smartwatches and smartbands, serve as sensors and have monitoring functions that help users have a healthier lifestyle, controlling their calorie expenditure, blood oxygen level, heart rate, among other functions. The devices also offer solutions such as payment methods, notifications tracking, GPS or reminders. In the future, wearables are expected to play an even more important role in areas such as health, education, payments, etc.

Connectivity

Connectivity is the ability to connect and communicate with other computers, electronic equipment, software, or the Internet. The connectivity services are provided by the telecommunications companies and enable, for example, the infrastructure and network maintenance businesses.

Evolution of access to the mobile service

In Brazil, mobile connectivity started with the 1G analog network, installed in the 1980s, restricted to voice transmission.

The 2G digital network arrived in the country in the 90s. Despite being rudimentary to exchange data, the network established parameters used until today in mobile phone calls. At the time, 2G technology already took important steps allowing the exchange of text messages via SMS.

The 3G network, which helped the mobile Internet to become more popular, started in Brazil in 2004. 3G allowed access to multimedia resources, video calls, websites, e-mails, video downloads, online games, among other activities incorporated in the users' routine, but still with relatively low speed.

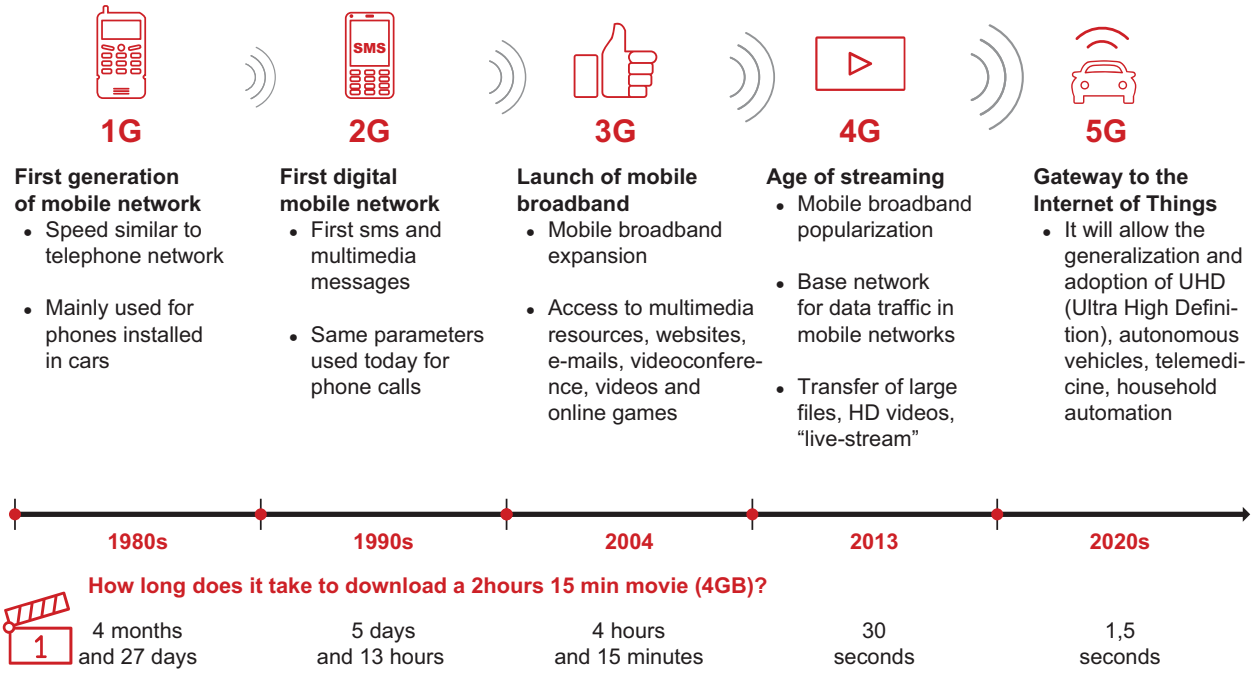
The 4G network, known as the LTE (Long Term Evolution) network, arrived in Brazil in 2013. Today, 4G is the most popular mobile data network in the country, reaching 95% of the population and 88% of the municipalities. Its rapid expansion is a significant achievement, as in 2016 only 19% of

Brazilian cities had 4G coverage.

The 4G network played an essential role in democratizing Internet access in Brazil. 4G drove the expansion of the installed mobile network to remote regions and reductions in costs of mobile services provided by operators.

Figure 12 shows the evolution of telecom services in Brazil.

Figure 12: Telecom services evolution in Brazil



Source: Straits Tomes and Bain analysis based on expert interviews

Future Perspective

After almost 10 years since 4G was launched in the world, expectations for this new decade are focused on the 5G arrival. The network has been implemented in some regions such as European countries, South Korea and the United States, but still with limited coverage.

The recent digital inclusion of the Brazilian population, the low operating cost of the 5G network and the potential new use cases in the medium and long term encourage the network deployment in Brazil. The 5G network will likely be launched on a large scale in Brazil in late 2021 or early 2022, after the auction of higher frequency bands than those used so far.

The expansion and consolidation of the 5G network will bring a better performance connection, expanding the capacity offered in the 4G. Low latency, the data transfer time, is also one of the main characteristics of the 5G network.

In the short term, 5G will mainly allow the evolution of applications available in 4G, with more quality and speed. As an example, the average download rate, which today is 15-25mbps at peak usage times, could increase more than ten times when 5G is implemented on a large scale. This will significantly improve the user experience on a daily basis when downloading files, documents and videos and playing games on the smartphone.

Another example is the video streaming in 4k/8k resolution, which allows for a higher quality of images, with more vibrant and realistic colors. Today there are hardware devices with these resolutions, but the data consumption per user is too high for the 4G network. With 5G, more people will be able to watch at the same time a live soccer game at 4k/8k resolution and have an experience much closer to the feeling of being at the stadium.

In the medium term, the transformations enabled by 5G tend to be deeper and include a greater variety of use cases. Considering the Internet of Things (IoT) applications that will benefit from 5G, an example would be the applications related to urban infrastructure, such as intelligent traffic lights to improve traffic monitoring in real time.

Further down in the 5G journey, another trend that will likely be disseminated is Edge Computing. This model approaches processing sites to users, reducing the latency perceived by users and improving their experience. As more people adot digital habits such as remote work, virtual collaboration, video streaming and online games, the data volume increases, as well as the demand for greater speed to allow for a better user experience. This generates the trend of having the processing sites closer there the data is generated, enabling use cases that benefit from low latency.

Software

The operating system of a smartphone, such as Android for example, allows applications to be installed on the device, enabling various activities, from the use of a simple calculator to access to maps and traffic in the city in real time.

This range of applications exists due to the mobile application industry, which comprises:

- Application companies, those that created their business based on applications
- Traditional companies that hire mobile developers
- Companies that develop applications for other companies, the Software Houses

New ways of working

With the expansion of the software ecosystem, new professions and ways of working became possible. Two types of workforce gained traction in the society: those involved in the application development (programmers, designers, testers, etc.) and the "gig economy", made up of temporary workers and freelancers that work through apps (drivers, delivery people, salespeople, teachers).

The development of mobile applications requires several activities, performed by people in different roles. To simplify, in this report we will refer to them as developers.

Application developers are part of workforce relatively recent in Brazil. For instance, 75% of workers have joined it the last 5 years. More information about developers is available in the Developers Profile section of this document.

The gig economy's workforce has grown dramatically in recent years as technology companies like Uber, Ifood, Rappi, Hotmart, GetNinjas, DogHero, among others arrived. IFood, a Brazilian company that operates in food delivery, has 83 thousand registered delivery people in the country.

The gig economy can create options for people who are searching for a new job or looking to complement their income. Sometimes it allows the worker to have greater control over the workload and choose their clients, while allowing the employer to have more flexibility and less labor-related taxes. In other cases, it can bring challenges to employees and risks to the model.

Last, the growth of e-commerce platforms has been demanding employees for different functions, reshaping the work dynamics in the retail sector.

New business models made possible by smartphones: an example of urban transport

The smartphones transformed several industries. Among them, the transportation sector. New businesses have changed the way people move around cities by connecting private drivers with passengers.

This industry's revolution happened because the new business models managed to operate at both ends of the market - demand and supply. On the demand side, they created a value proposition with low prices and high quality services for passengers. On the supply side, they created job opportunities for people looking for income sources (primary or secondary).

One of the Brazilian companies that made a bet in the smartphones to transform the transportation

market is called 99. It was founded in 2012 with the initial objective of connecting taxi drivers and passengers, and, accordingly to the company, ensure users have the best experience in the private transportation market. During the beginning of its activities, 99 went through challenges. For instance, one of the founders mentioned in some interviews that only few taxi drivers used to have smartphones. In some cases, 99 had to teach the driver how to use the device.

In a competitive market, 99 continuously adapted its model. An example: in 2016, when the city of São Paulo legalized the private driver services, the company launched 99Pop. With this new service category, generally offering more affordable prices than taxis or cars that are more comfortable, the company connects 18 million passengers to 600 thousand drivers in more than 1000 cities across the country. In 2018, it became the first Brazilian unicorn, meaning the first startup of the country evaluated in more than USD 1 billion.

Future Perspective

When customers evaluate a product or service, they assess its perceived value. The "elements of value" - fundamental and unique attributes - for consumers can be classified into four categories: functional, emotional, transformational and transcendental *(Figure 13)*.

- The base elements are focused on meeting functional needs such as information, simplification or time savings.
- On the second level, there are the needs that involve emotional elements such as well-being, fun and entertainment.
- The third space is dedicated to transformational elements, such as motivation or self-realization.
- At the top of the pyramid, there are the elements associated with transcendence.

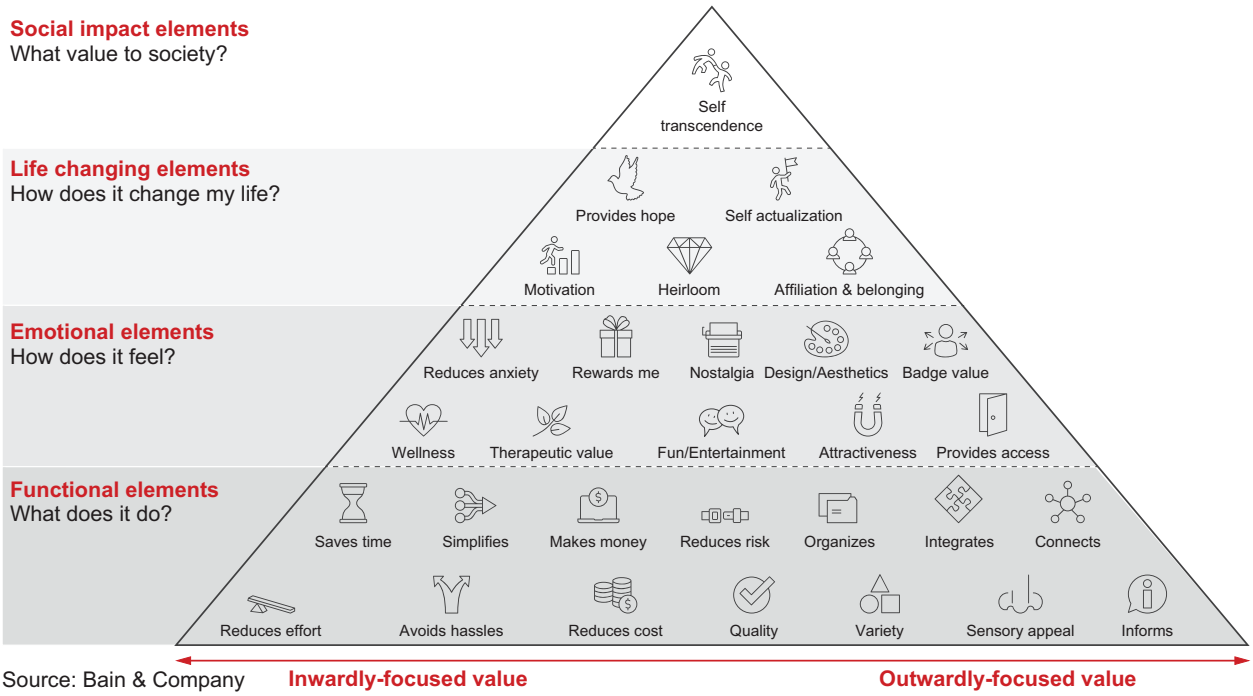
Some elements have an internal focus, mainly addressing the personal consumer needs. For example, the functional elements "Reduce effort" and "Save time" are at the heart of the value proposition of IFood, a Brazilian food delivery app. Other elements are focused externally, helping customers to interact or navigate the external world. For instance, 99, a Brazilian urban transport company, serves several functional elements, such as the external attributes "Connects", and "Integrates".

The main business models emerging from the application ecosystem allowed by the smartphones started serving the first level of the pyramid, solving functional needs. Gradually, business evolved to the second level, meeting emotional needs.

Businesses such as 99, Nubank, iFood, Revelo or Hotmart, share values of these layers, such as: reduction of effort, variety, quality, simplification, and gain in time, among others.

The continuous evolution of the ecosystem has deepen the fulfillment of customers' functional and emotional needs, and has gradually created business models that address the upper levels of the pyramid.

Figure 13: Elements of Value Pyramid



Source: Bain & Company

Some examples of business models that have created value in the upper layers are meditation apps, motivational support communities or fundraising campaigns for charities through the practice of physical activities.

Gympass, for example, offers benefits that initially comprised access to health clubs, dance schools and yoga studios. More recently, the company has started to offer other services, such as consultations with psychologists and meditation programs through partner mobile applications. Thus, the company acts centrally in the emotional well-being, physical and mental element, but also covers elements of the life-changing category.

The company Joyz created a social network designed to help people in situations of social vulnerability, in addition to NGOs and shelters. Through the application, which works in a similar way to Instagram, the user can donate to a cause chosen. Therefore, the company acts centrally in the element of self-transcendence, in the category of social impact, but also touches lower elements of the pyramid, such as affiliation and belonging.

New business models, based on and supported by applications, are expected to meet more of the complex needs of consumers.

3. Developers profile

Meeting the developer

Mobile application developers are part of a new and growing workforce that develops, tests and program apps .Today, 69% of these workers identify themselves as male and 29% female *(Figure 14)*.

In addition, the workforce is young - 60% of developers are under 30 years old - and are concentrated in the Southeast, where 65% of developers live, followed by the Northeast and the South, with 12% and 11% respectively.

The developer activity allows self-learning and encourages the continuous growth of the professional. Online programming courses, communities, forums and colleagues are the main sources of knowledge that allow the developers to become more qualified and advance in their career. The self-learning profile helps explain the fact that 50% of developers did not complete a university education. Even in their spare time, developers look to improve their skills. Weekly, 46% of professionals spend an average of 4 hours programming as a hobby.

The developer profession is new and has had intense growth recently. Almost half of the professionals in the market, around 45%, have been developers for less than 2 years. This figure rises to 78% when we consider developers who started their career in the last 5 years *(Figure 15)*.

On average, 35% of professionals have a formal labor contract; however, there are also many freelancers in this market - 30% of the developers. This figure is significant when compared to other industries, in which freelance professionals, on average, represent 25% of the workforce.

Development platforms

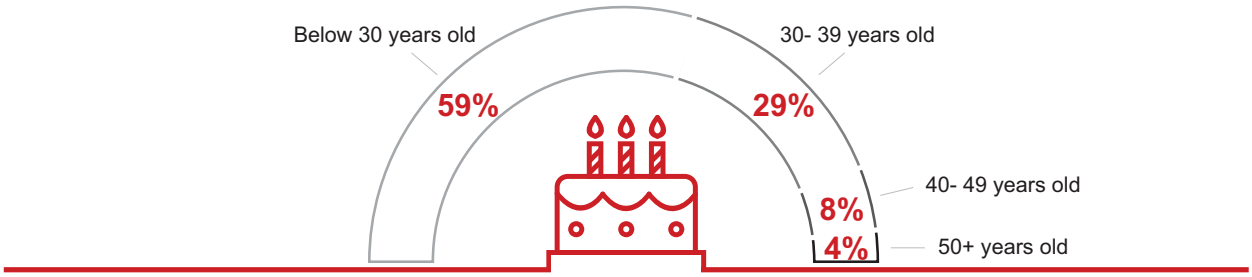
Similarly to digital inclusion, Android is also a very important gateway to the programming world. Around 78% of developers have started their journey with Android and the platform continues to be relevant along their career. Today, 80% of developers work with Android and 60% with IOs *(Figure 16)*.

Despite using multiple platforms, the time dedicated to each is different. On average, the Brazilian developers dedicated 66% of their total programming time last year to Android, while 26% of the time was dedicated to the iOS platform and 8% to others. In addition to spending most of their development time on the Android platform, 73% of developers consider it the main one.

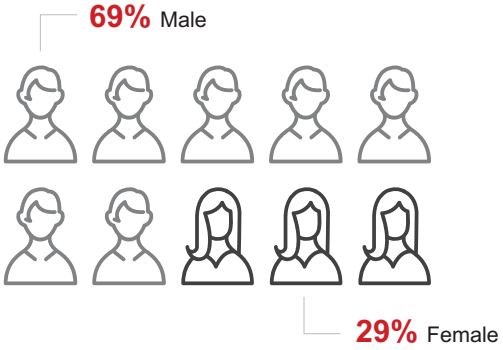
Figure 14: Demographic profile of developers

(% of respondents)

Age groups distribution

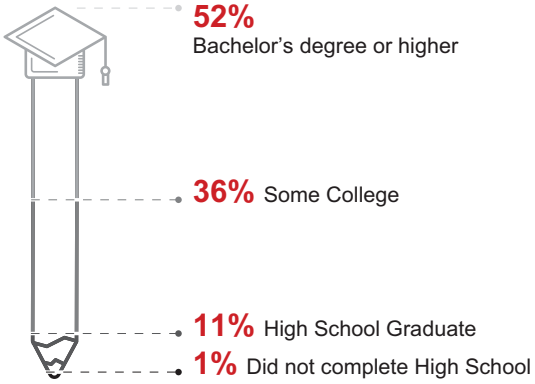


Gender distribution



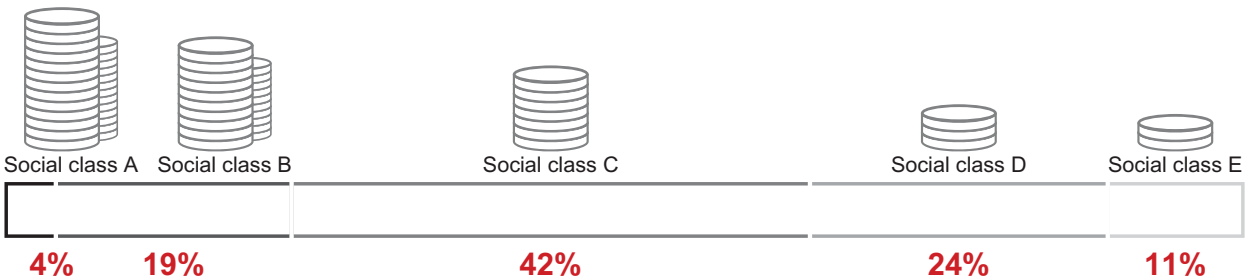
Footnote: 2% chose not to answer

Education level



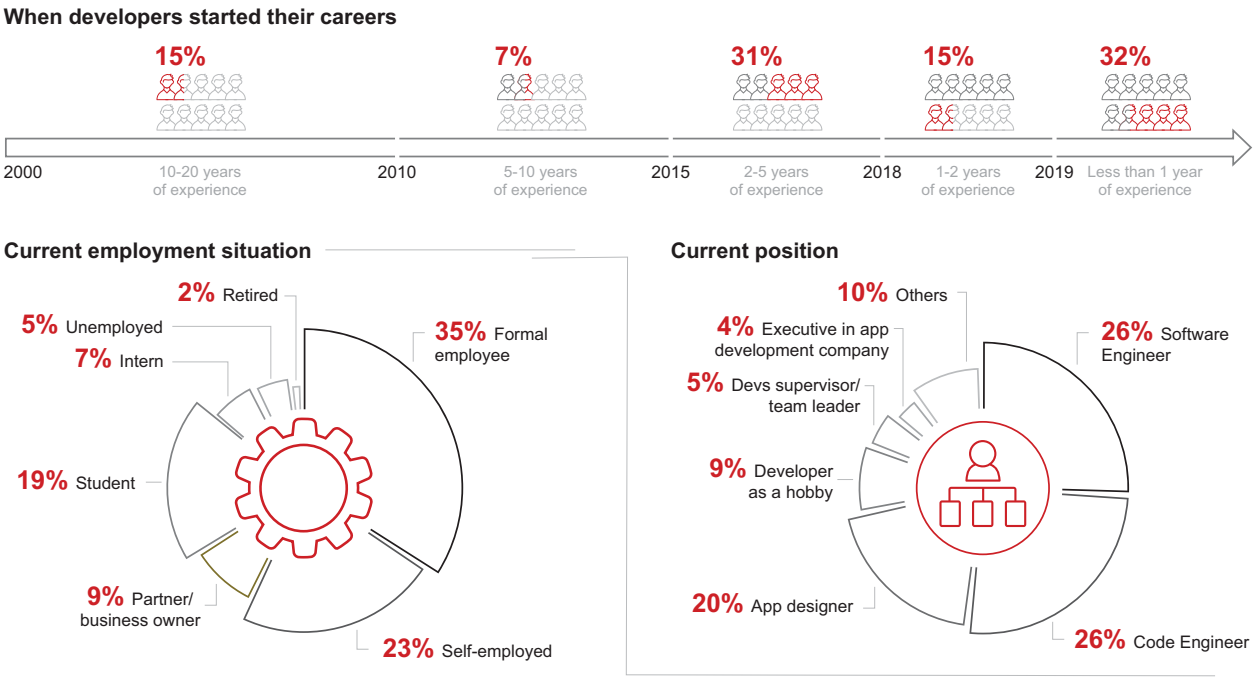
Regional distribution

Social-economic distribution



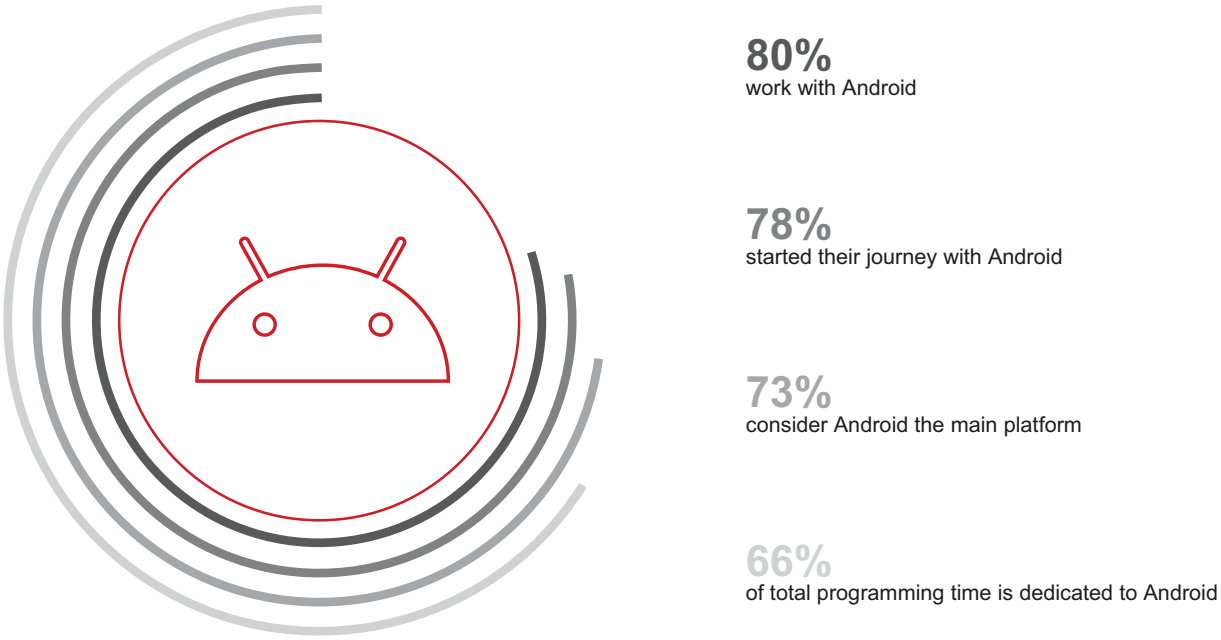
Fonte: Bain Developer Survey

Figure 15: Professional profile of developers



Source: Bain Developer Survey

Figure 16: Developers and Android



Source: Bain Developer Survey

Android as a programming platform

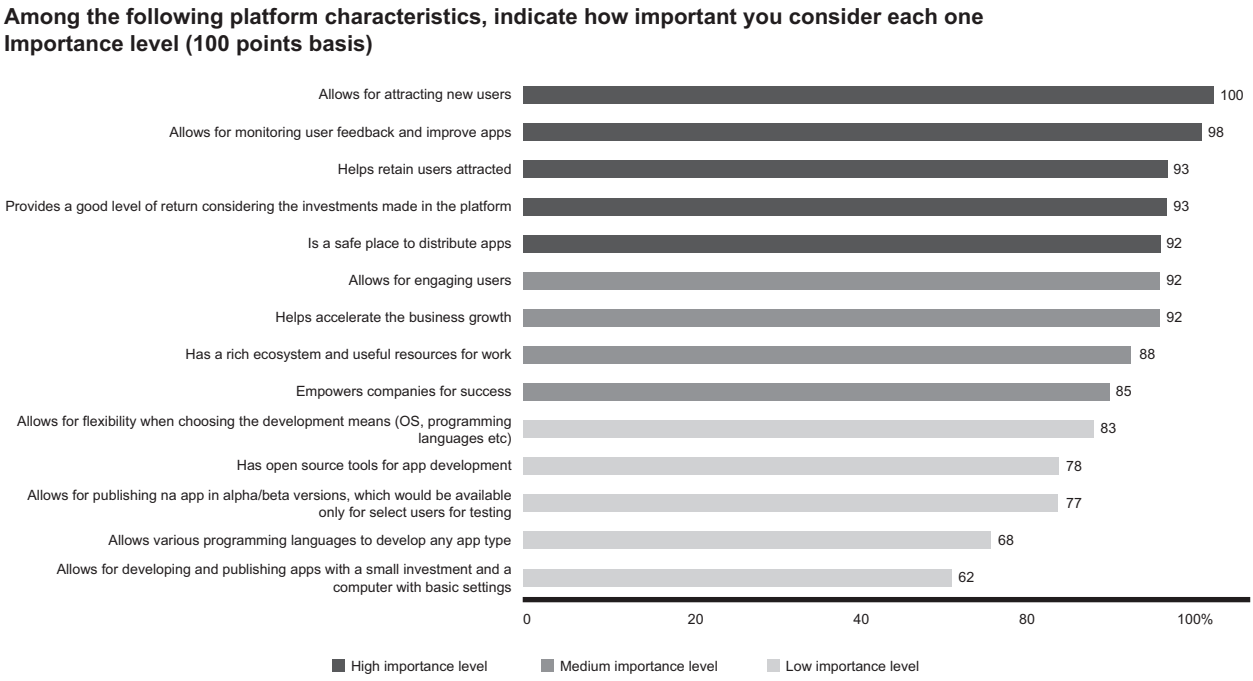
When asked about which characteristics are most important in a development platform, professionals mentioned the following ones: how the platform contributes to attract of new users, to improve the quality of services and to retain users. Less important were the low need for investment to develop and publish an application, the diversity of available languages and the possibility of publishing a beta application *(Figure 17)*.

According to developers, the Android and the IOS platforms fulfill these criteria differently *(Figure 18)*.

The Android platform was considered preferable when the developer seeks support tools for development. Functionalities such as the provision of Open Source technology, beta publishing, low investment and a rich and resourceful ecosystem have been well evaluated for Android. In addition, the platform stands out with the best rating for attracting new users, in line with the larger number of Android users in Brazil.

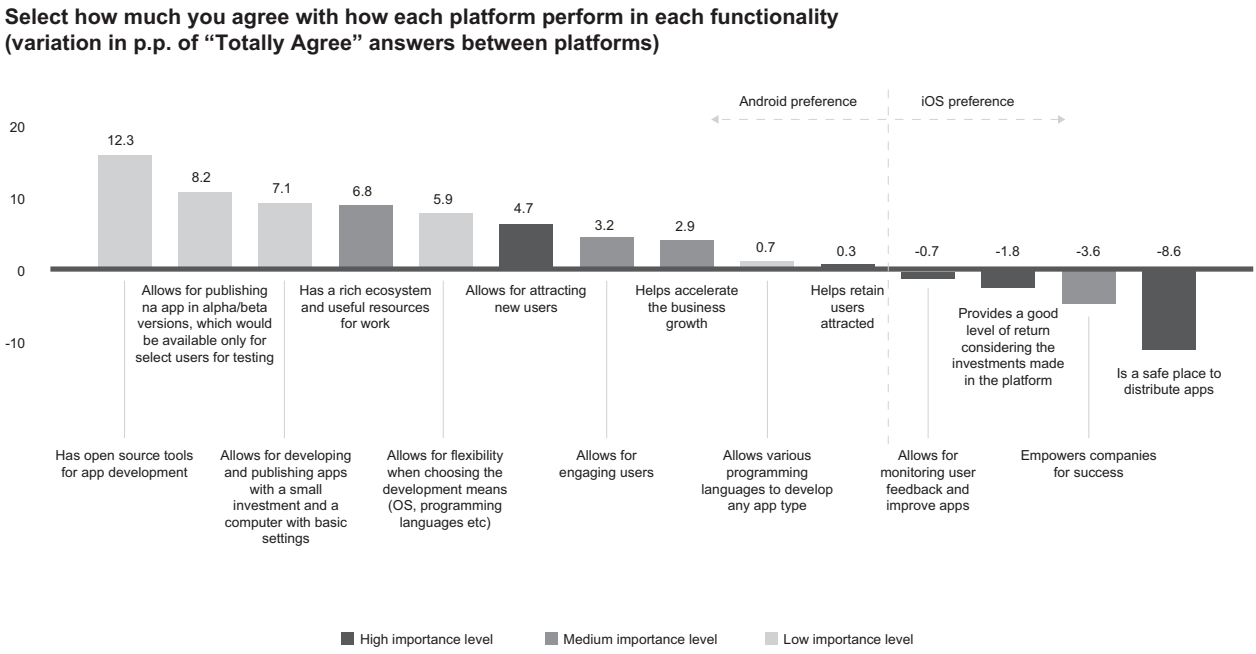
The iOS platform, on the other hand, was considered preferable in terms of providing the appropriate financial return versus the investments required for developing the application and when considering the application's distribution security.

Figure 17: Platforms features and functionalities



Source: Bain Developer Survey

Figure 18: Comparison of platform features



Source: Bain Developer Survey

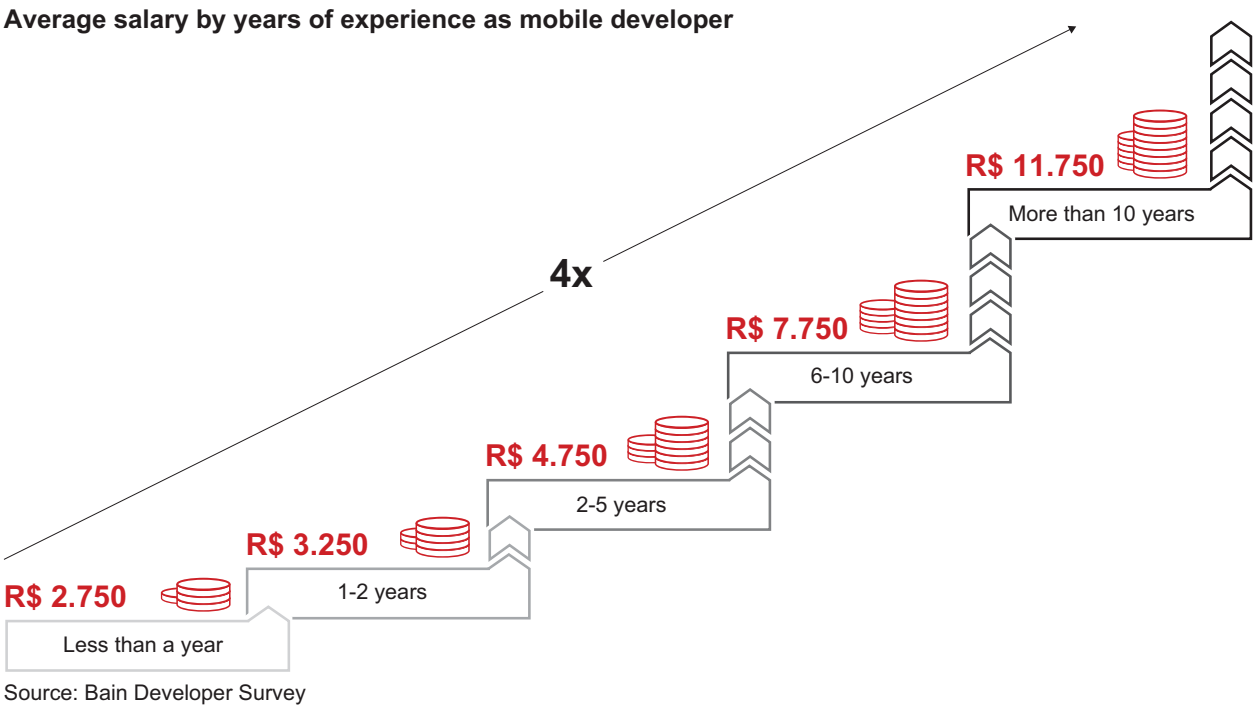
Economic impact

The demand for qualified developers is growing and the transition between companies is frequent. Around 35% of developers with up to 2 years of experience have already worked in more than one company. Among developers with up to 5 years of experience, this number reaches 50%.

According to the developers, the market is attractive both due to financial and life-quality reasons. An average gross monthly salary of approximately R$2,750 is expected in the first year of work. This salary increases to an average of approximately R$4,750 in the fifth year. Among professionals with more than ten years of experience, the average salary is approximately R$11,750, with 30% of professionals having an average monthly compensation between R$10,000 and R$20,000 and 25% achieving a compensation greater than R$20,000.00 *(Figure 19)*.

Alongside the compensation, developers evaluated well other career aspects. Among the main ones, are the growth opportunities, both in the mobile developer career and in the software developer career, as well as the large demand for labor. As a counterpoint, developers reinforce the need for affinity with logical programming reasoning in order to succeed in the careers.

Figure 19: Salary by years of experience



Source: Bain Developer Survey

Developer's comments about how the career has contributed to their quality of life:

"The developer salary allowed me to have access to a better quality of life, consumption and entertainment, very differently from what I had before."

- 35-year-old Android developer, social class C

"My job had a great impact on my quality of life, showed me what is it like to work with a smile on my face without worrying about my paycheck."

- 24-year-old Android developer, social class D/E

"I used to earn a small scholarship, while my family's income was very low, as my parents are unemployed. The scholarship was only enough for my university expenses. When I started my career, I was able to earn more money and support my family financially, in addition to having more opportunities for fun."

- 27-year-old Android developer, social class B

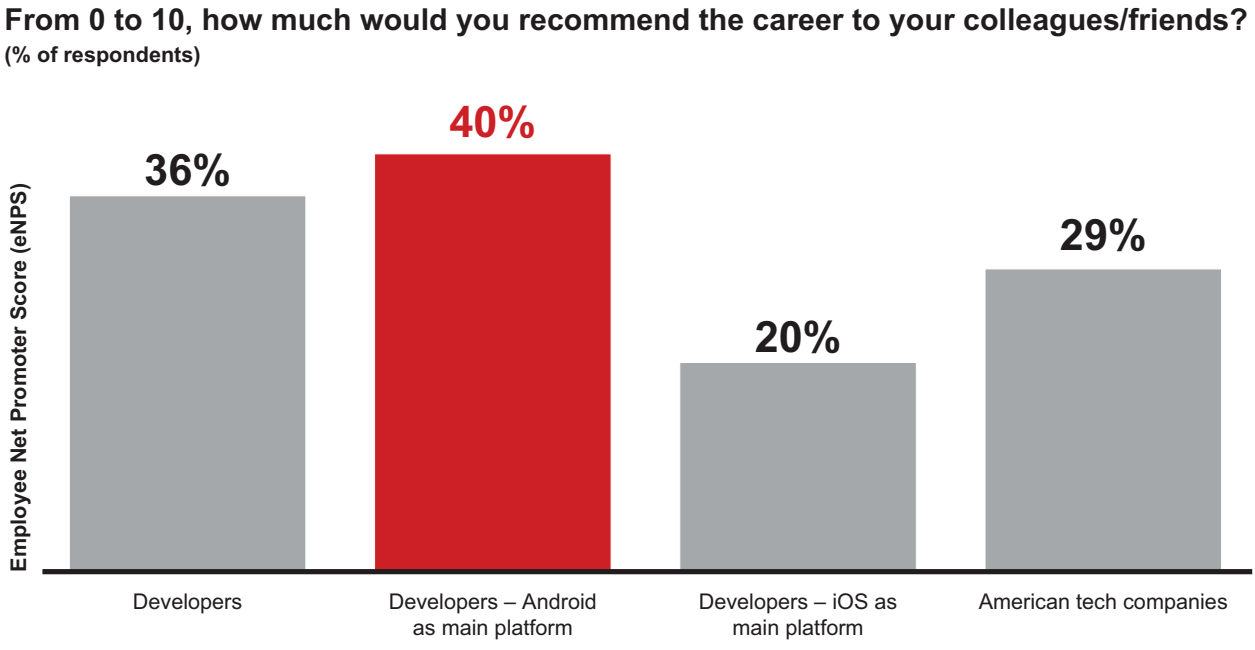
In general, developers are satisfied and evaluate the career very well. This can be seen through the Employee Net Promoter Score, the eNPS. When asked about how much they would recommend the career to a friend or colleague, 49% of the developers said they would recommend it and 12% replied

that they would not recommend it, resulting in an eNPS of 36 versus an average of 29 for major American technology companies. The eNPS rises to 52 when we consider only those who have been in the career for a long time.

Another interesting finding is the differences in the eNPS between development platforms. For developers who prefer Android, the eNPS is 40, while for those who prefer iOS the eNPS is 20 *(Figure 20)*.

In addition, professionals from other fields are migrating to the developer career. Today, approximately 30% of workers transitioned from other activities. Among them, 80% indicated improvement in their quality of life and growth opportunities, while 50% would recommend the career to their friends.

Figure 20: Degree of satisfaction by developer profile



Source: Bain Developer Survey

4. Methodoly

This report used primary and secondary data sources, surveys with smartphone users and mobile application developers (to extrapolate the data collected to the broader population) and interviews with leaders in the Brazilian telecommunications and technology market, who helped build the numbers and the future trends.

Digital Inclusion

For the Digital Inclusion session, an online survey was conducted with smartphone users in Brazil, complemented by a sample who responded to the same survey by phone.

We interviewed 4653 people through the online survey. The sample included people from various gender, social class, region and age. The number of people who identify themselves as women was slightly higher than those who identify themselves as men: 56% versus 44%.

More than a third (41%) of respondents are under 25 years old. Individuals between 25 and 39 years old represented 26% of the sample, and individuals between 40 and 55 years represented 23%. The remaining is 55 years old or older.

About 12% of respondents are from social class A, followed by 34% from class B. Individuals from class C represented 36% of the sample, and from classes D/E 18%.

The sample was weighted and extrapolated to represent the Brazilians over the age of 16 who access the Internet by smartphone, using the TIC Survey of Household/Users. This is a survey conducted by NIC (Ponto BR Information and Coordination Center) about the use of Information and Communication Technologies at Brazilian homes. Residences are randomly selected as well as respondents. The survey had approximately 20,000 valid responses in 2019 and can be extrapolated to the 180 million Brazilians over 10 years old.

Specifically for the new habits adopted during the pandemic, an online survey was conducted in July 2020 with 1658 Brazilian consumers, including a diversity of respondents in terms of gender, social class, region and age. The sample was weighted and extrapolated based on demographic data to reflect Brazilian consumers. The same survey was conducted in April, May and June of 2020 with other groups of respondents and pointed out to similar results and trends.

Social and economic impact

For the economic and social impact calculations, the smartphone ecosystem was segmented into industries associated with the hardware, software and connectivity. Each of these industries was analyzed starting from a market segment, which indirectly contributes to the development of several other businesses.

In the hardware industry, for example, the design, manufacturing and assembly of smartphones

were considered as the starting point of the analysis. This segments create needs fulfilled by the smartphone sales (retail), smartphone services (insurance and repair), and accessories businesses. These, in turn, are responsible for enabling other businesses in the value chain, and so on.

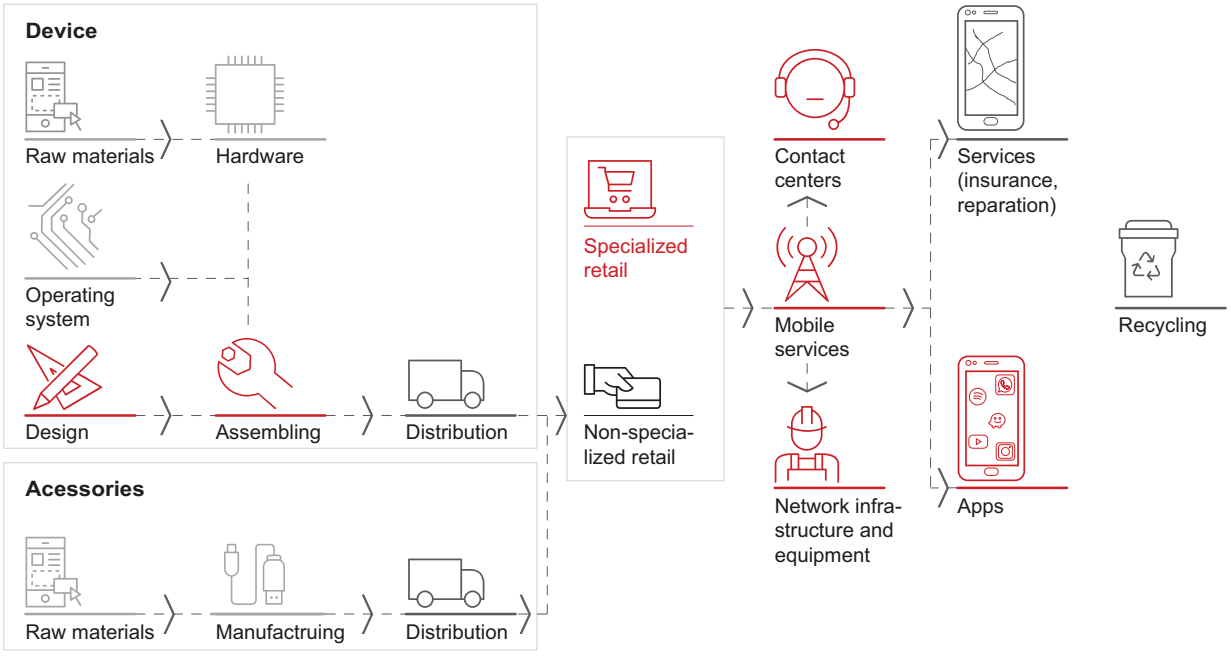
In regards to the software industry, the starting point was the application sales and development services. Subsequent businesses are in-app sales and in-app advertising. Then, there is a whole range of businesses enabled by this chain, such as transportation applications and delivery applications.

In the connectivity industry, connectivity services provided by telecommunications companies were considered as the main activity. These services enable the infrastructure and network maintenance businesses.

The broad Android impact map was designed based on these definitions and shown in Figure 8 of this report. The closer to the center, the more direct is Android's influence in economic and social aspects of the chains represented. External layers include a wider range of businesses, but their impact are less attributable to Android. Thus, the direct attribution of the economic and social impact of the platform (revenues and jobs) considers levels 1 and 2 of Figure 8.

Within levels 1 and 2, the direct revenue and job figures were calculated considering the value chain below *(Figure 21)*.

Figure 21: Android's direct ecosystem value chain



Source: Bain Developer Survey

The chain starts with the smartphone manufacturing, including activities like the extraction of raw materials, an activity not carried out in Brazil, the assembly and distribution of the devices. In parallel, there is the mobile phone accessories manufacturing chain.

Then, the products go to the retail, specialized or not. The device and its accessories receive one of the following destinations: sale to the final consumer, the enterprise customers, the government, or even to exportation. Once the end user has access to the smartphone, in the next step of the chain there are the connectivity services, as well as infrastructure and network equipment and contact centers for customer service.

The smartphone allows for the use of applications and enables several businesses around them, which include freelance mobile developers and mobile software companies, known as Software Houses. Finally, there are the hardware services, such as repairs and insurance or even device recycling.

The Android ecosystem's impact in terms of jobs is calculated considering the whole smartphone value chain. On the other hand, revenues were calculated considering only the sales to users in the final stages of the value chain for each product or service, in order to avoid double counting.

To calculate the direct economic impact of Android (revenues), various primary and secondary sources were used. The calculation considered four main buckets - revenues from the smartphone sales, revenues from accessories sales and services, revenues from mobile connectivity services, and revenues from mobile applications.

Device sale revenues were estimated using the following sources: Ministry of Economy, Ministry of Industry, Foreign Trade and Services, IDC - International Data Corporation, Mobile Time and Open Box. Accessories sales and services were estimated using the following sources: GSM Association, Mobile Time and Open Box.

For revenues associated with mobile connectivity services, we used financial reports of telecommunications companies (Vivo, Tim, Claro, and Oi) and data from Anatel, in addition to Mobile Time and Open Box. Last, for mobile applications revenues, we used data from eMarketer and 42 Matters.

To calculate the social impact (number of jobs), in addition to primary and secondary sources, we conducted interviews with experts in the telecommunications and technology industries. The calculation was performed considering three main buckets - jobs in the hardware industry, jobs in the connectivity industry and jobs in the software industry.

To calculate the number of jobs in the hardware industry, we used data from IDC - International Data Corporation, CAGED - General Register of Employees and Unemployed, reports from retail companies and interviews with experts. For the number of jobs in the connectivity industry, we used reports from telecommunications companies (Vivo, Tim, Claro, and Oi) and interviews with experts. Last, to calculate the number of jobs in the software industry we used data from Apptopia, Linkedin, Stack Overflow and interviewed experts.

Developers profile

For the Developers Profile session, an online survey was conducted with professionals involved in the development of mobile applications in Brazil.

We interviewed 844 people through the online survey.

The sample included people from various gender, social class, region and age. The number of people who identify themselves as men was greater than the number of people who identify themselves as women: 69% versus 29%.

More than a third (34%) of respondents are under 25 years old. Individuals between 25 and 39 years old represented 53% of the sample, and individuals between 40 and 55 years represented 10%. The remaining is 55 years old or older.

About 4% of respondents are from social class A, followed by 19% from class B. Individuals from class C represented 42% of the sample, and from classes D/E 35%.

In our study, we used the "Employee Net Promoter Score" - the employee NPS. The NPS is a metric to measure people's satisfaction and loyalty to a service, product or even their workplace. By using this metric, it is possible to quantify the perception of a career among its professionals based on how much each participant would recommend their activity to friends and colleagues. In this study, we asked employees who work with mobile application development to indicate, on a scale of 0 to 10, the likelihood that they would recommend someone close to them to work in this field. Based on the responses, respondents were split into three groups:

- Promoters (9 or 10): the ones considered loyal to their careers, who generally stay in the profession longer and tell good things about it to friends and colleagues.
- Neutral (7 or 8): reasonably satisfied, but not loyal. They rarely speak well about the career and, when they do, it is usually with reservations or without much enthusiasm.
- Detractors (0 to 6): individuals who do not recommend the profession to friends or family. In general, they are dissatisfied with the career. They often say bad things about the profession and are likely to transition to another career if they have an opportunity.

The eNPS is calculated by subtracting the percentage of responses that would recommend (promoters) - scores 9 and 10 - from those that would not recommend (detractors) - scores less than or equal to 6.

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