

Can't live without it – When the cell phone is no longer superfluous¹

Não vivo sem ele - Quando o celular deixou de ser supérfluo

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ABSTRACT

The past ten years have witnessed a technological revolution, thereby causing the manner in which information is gathered and communication is made to undergo massive transformation. Before that, sources of information and forms of communication were different things. Today, there are cell phones with access to the internet. Previously, the population would gather information from the traditional channels (such as radio, TV, newspapers, and magazines), whilst a computer and a broadband connection - accessible to a few - were necessary for internet access to be gained. The cell phone moved on from an item regarded as superfluous to become essential due to its having become not merely a tool to facilitate access to information but, fundamentally, for changing the way people relate to each other. In a period of major economic growth and of increase in the available income, the cell phone passed on to be one of the items of basic necessity of the Brazilian citizen, featured side by side with items such as water and sewer, supermarket expenditures, electric energy, and cooking gas, as one of the things the Brazilian citizen cannot live without. Whilst resorting to a big data technique known as Basket Analysis, this work follows the increase in importance of the cell phone over the latest years. Seeking to understand how an asset, first regarded as superfluous, has made that path is following, live, the transformation of the basket of assets, not just of the Brazilian citizen, but of the modern consumer as well.

KEYWORDS: Cell Phone; Economic Growth; *Big Data*; *Basket analysis*.

RESUMO

Os últimos 10 anos presenciaram uma revolução tecnológica, fazendo com que a maneira de se informar e se comunicar também sofressem grande transformação. Antes, fontes de informação e formas de comunicação eram coisas diferentes, hoje existe o celular com acesso à internet. Antigamente a população se informava a partir dos canais tradicionais (rádio, TV, jornal e revista) e eram necessários um computador e uma conexão de banda larga, acessíveis a uma minoria, para acessar a internet. O celular passou de um item considerado supérfluo para se tornar essencial, por ter se tornado não somente uma ferramenta para facilitar o acesso à informação, mas fundamentalmente por mudar a maneira como as pessoas se relacionam. Em um período de grande crescimento econômico e aumento da renda disponível, o celular passou a ser um dos itens de necessidade básica do brasileiro, aparecendo ao lado de itens como água e esgoto, despesas de supermercado, energia elétrica e gás de cozinha, como uma das coisas sem as quais o brasileiro não vive sem. Utilizando uma técnica de *big data* conhecida como *Basket analysis*, o presente trabalho acompanha o crescimento da importância do celular nos últimos anos. Buscar entender como um bem, antes considerado supérfluo, fez esta trajetória é acompanhar, ao vivo, a transformação da cesta de bens, não só do brasileiro, mas do consumidor moderno.

PALAVRAS-CHAVE: Celular; Crescimento econômico; *Big data*; *Basket analysis*.

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1 INTRODUCTION

The definition of that which is essential to life necessarily includes water, food, energy, and cell phone - at least, that is what is shown by a careful analysis of the market basket of Brazilians: the cell phone which, for years, has been regarded as a superfluous product, that which the use and the very existence are a dispensable excess, climbed positions in order to become an item of first necessity.

Behind that movement lies a change - not in the way the cell phone is used but, fundamentally, a transformation in the way we communicate with each other. After all, the main purpose of telecommunications is that of providing for the human need of communicating at a distance.

The development of the information technologies has given rise to significant changes in the social relations and the history of worldwide telephony illustrates that evolution: from the simple devices of interpersonal communication to the modern platforms for the transmission of contents, the telephones may be regarded as a reflex of the development of information and of communication. The behavioral changes which are enabled by these devices in the human society are intense (Ehrenberg, 2010).

The evolution of the processing capability of the cell phones and the ease of access to the internet have provided the user with greater interactivity, apart from new functionalities which have been associated to them, thereby promoting the cell phone to a basic item of the consumption basket of the population, in all of the social classes.

The use of telephony through the internet, whilst using VoIP (Voice over Internet Protocol) and Voice over Frame Relay, has brought about a reduction in costs. In parallel, a number of applications have been and are being developed, thereby allowing for the most varied needs to be catered to: instant messaging, transfer of photos and files, use of social networks, finances, GPS, transport request, delivery of food, music, travel, entertainment, and so much more (InfoMoney, 2015).

Today, after having dominated the smart phone industry, giants such as Apple, Google, and Samsung are set to compete for another market: that of payments, also known as mobile payment - a technology which allows for the services of banking operations in real time. Whilst combining operations that involve a mobile device to initiate, activate or confirm a payment, they allow for the transference of financial amount and services among participants without a contact based on facts (Hu, Lee, & Kou, 2005).

That type of service not only magnifies the relationship among consumers, suppliers, and products but it also promotes convenience, as the mobile payment intends to replace plastic cards, passwords, and signatures with a touch on the cell phone screen. In other countries, the technology is also being used in access turnstiles of trains and subways, soft drink vending machines, movie tickets, restaurants, and convenience stores (Barbosa & Campos, 2008).

In Brazil, the use of smartphones for other types of transaction is still emerging, but the culture of payment via the smartphone is already being created around here as well, and the scenario is expected to change upon the rapid advancement in the offer of services (Matsuura, 2016). With the adaptation of Brazilians to the mobile on equal footing with other countries, a new transformation is yet to come about, whilst opening the doors of the world of credit to the “bankless” - a population estimated in 55 million Brazilians who do not have bank accounts - a system which transforms a person’s phone number in a bank account (Matsuura, 2016).

After its being superfluous, becoming a basic and indispensable item, the cell phone strives to take on the same importance as the CPF [Brazilian National Cadastre of Natural Persons], to be a record which attests the condition of an individual as a citizen. In the future, before those countless transformations, the corporations will have to be prepared for the unexpected; the challenge will be in managing the uncertainties - not as obstacles to success but, rather, as a source of opportunity for business (Little, 2002).

2 PURPOSE

The aim of the study has been that of identifying the evolution of the importance of the cell phone throughout the years by the Brazilian population whilst using the Basket analysis, a tool of analysis which allows uncovering the associations between products in the purchases carried out by the consumers.

From the analysis of the consumption basket over the last 10 years, the trajectory of the cell phone has been traced up to its integration into the set of basic items consumed by the Brazilian population.

3 A BRIEF CHRONOLOGY OF THE CELL PHONE IN BRAZIL

The telephone emerged in order to allow for the communication between individuals, thereby narrowing the distance among people. With that, since long ago, it has become essential in the daily lives of the citizens, transforming the way through which people communicate.

In Brazil and in the world, the sector of mobile telephony has shown exponential growth. Here, the area of telecommunications has had to undergo major changes in order to follow the curve of the world - factors such as the abolition of the monopoly of the sector, the globalization, the economic changes, and, mainly, the changes in the very society have been fundamental for the introduction of the cell phone in Brazil.

In accordance with data from Teleco (2016), as shown in Figure 1, in 2002, the quantity of mobile phone lines surpassed the quantity of land lines and, in 2014, there were 16 times more cell phone lines than land lines in Brazil.

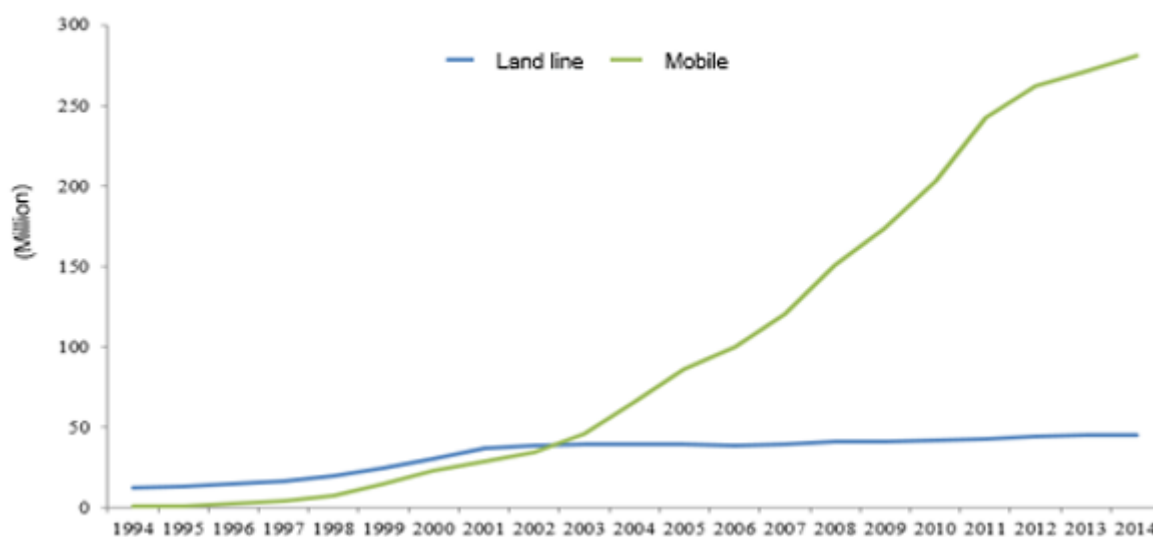


Figure 1 –Evolution in the number of land telephone lines and cell phone lines in Brazil (1994-2014)
Source: Teleco, 2016.

In 1990, Rio de Janeiro was the first Brazilian city to have cell phones with the launching of TELERJ [the Rio de Janeiro telephone company]. A year later, the first transmission of the new digital format has taken place - the 2G which, besides conversation, allowed for text messages to be interchanged.

In 1993, the IBM Simon launched that which would be the first smart phone, which became popularly known as the palmtop: a cell phone with reduced dimensions and endowed with a touch screen. Already, in 1998, in Finland, the first contents were made available for download.

In the following year, Japan introduced the first full service of access to the internet. From that point on, due to the high demand for internet services, in May, 2001, the 3G technology network was launched. In Brazil, the third generation of cell phones appeared in 2007.

Perhaps the great milestone has taken place in that same year, when Apple launched their smart phone device, the iPhone, which caused the appearance of the devices to change definitively. In 2008, Google appeared as the main competitor in that new technology, introducing the Android, an operating system for cell phones which, today, is the most widely used in the world.

The evolution of the technology of the cell phones has occurred in a slightly different manner than that of the other correlated categories, such as the mobile systems of audio and computers. In those categories, the evolution has taken place from an improvement in quality / performance, in storage capacity, always seeking for a reduction in size, as illustrates in the Figure 2.

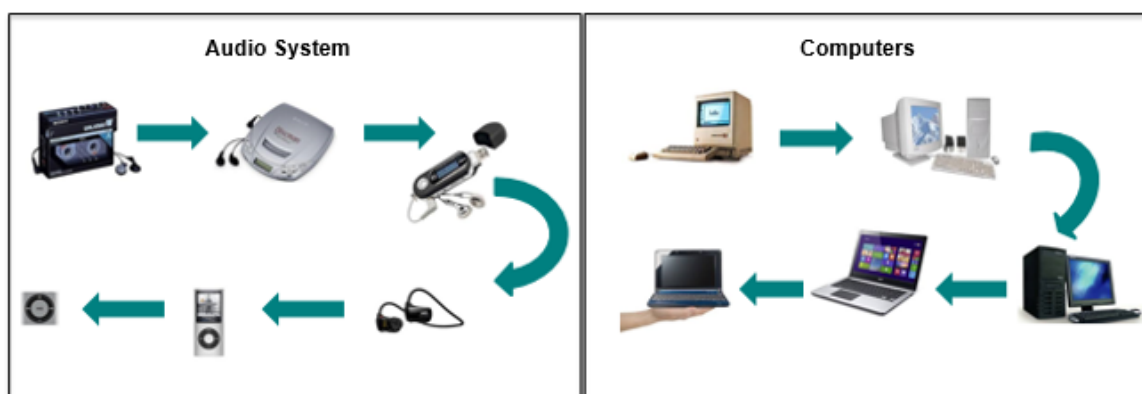


Figure 2 –Evolution of the mobile systems of audio and computers
Source: Data provided by the author.

Initially appearing as a mere device of interpersonal communication, what we call a cell phone today is, in fact, a hybrid device which aggregates the functions of a telephone, a computer, a photographic camera, a video recorder, a word processor, and GPS, among others; a modern platform for the transmission of content. All of those features have placed the “making of calls” in a second plane and opened an array of functionalities offered, which brought about a number of needs and which have ultimately placed the cell phone among the products of first necessity.

When the cell phone was idealized and introduced in the market, its main purpose was that of connecting individuals as from voice calls and, with the passing of time and the evolution of the technology, the reduction in its size, the improvement of performance, and the increase in storage capacity were made possible - as had already happened to the mobile systems of audio and computers. However, the ongoing addition of functionalities has caused that reduction in size to stop and, so, the cell phone grew up again, as illustrated in the Figure 3.



Figure 3 – Evolution of the cell phone devices
Source: Data provided by the author.

4 METHODOLOGY OF BASKET ANALYSIS – A BRIEF REVIEW OF THE LITERATURE

Along the years, with aims at obtaining a competitive edge over the competitors, the interest on the part of the corporations in understanding the purchase behavior of the consumer is rampant.

The so-called analyses of consumption baskets have been introduced by corporations in the retail industry which, in order to boost their sales, started to perform studies in their databases.

The most widely known case of success in the effective analysis of the rules for the association of purchases is that of the Wal-Mart retail chain which, by studying the behavior of their consumers, found out that the individuals who went to their stores on Thursdays, to buy diapers of the Huggies brand, were prone to purchase, in average, nineteen unplanned additional items. Thus, until today, every Thursday, Wal-Mart changes the layout of the products in their stores, with aims at ensuring that the buyers of diapers for the weekend find, at least, the said nineteen additional products (Menconi, 1998).

Other studies on database for the retail sector started to emerge, as, for example, the study of Semaan, Graça, and Dias (2006), who used the DCDB (*descoberta de conhecimento em bases de dados*) process [knowledge discovery in databases] on a standardized database used by retail corporations, through the use of a genetic algorithm (AG) for the extraction of rules of association. The AG proposed considers the dependence among the different items present in the database and subject to the process, for the purposes of obtaining the most interesting rules of association.

In spite of its widespread use, the application of the technique of rules of association is not limited to studies focused on the area of retail. Tavares (2012) has made a segmentation of credit card clients from the survey of transactional information of consumption, as from the application of the techniques of analysis of purchase basket and the analysis of associations with the databases. The model of segmentation identified, as from the transactions of the clients, the offers which should be made known, with aims at increasing the perceived value of the products and services offered to the clients, associating the assertiveness of the offer, and ensuring even lower costs of communication to the credit card industries.

Ribeiro (2008) has resorted to the basket analysis in order to provide support to two types of medical systems: the systems of Content-Based Image Retrieval – CBIR, and the systems of Computed Aided Diagnosis – CAD. In the content-based retrieval, the rules of association have been deployed in order to reduce the dimensionality of the vectors of characteristics which represent the

images and to reduce the semantic gap that exists between the characteristics of low level of the imagery and their semantic meaning.

The telephone companies carry out studies by means of the database of clients which they have, in order to understand the profiles, to measure the satisfaction of the client, to establish strategies of retention and loyalty. For example: Andrade (2007) introduced a methodology of data mining for the churn analysis in mobile telephony, which allows for the identification of the clients who pose the greatest probability of evading the operator, so that the corporation may take the appropriate measures to retain those clients. Pitombo (2002) has investigated the factors which influence the perceived quality in the services of mobile telephony in the city of Salvador, by modeling the levels of satisfaction of the consumers and their subsequent behavioral intentions of change in plan and operator.

Berry and Linoff (1997) and Herrmann, Golendziner, and Santos (1995) have listed a number of other areas for the application of the rules of association, such as, for example:

- Services of telecommunication, which may group the services which are most commonly acquired as a bundle - the so-called combos - with aims at maximizing sales;
- Unusual combinations of insurance claims, which could indicate a signal of fraud;
- Banking services, whilst assisting in the discovery of the preferences of the client.

5 METHODOLOGY OF BASKET ANALYSIS

The mining of data is aimed at the discovery of knowledge as from a large database (Burkle, 2006). In general, the knowledge gathered is expressed in the form of rules and standards.

Basket analysis is a technique very much used in data mining, especially in the analysis of purchase transactions. For example, as from a database which stores products purchased by clients, a strategy for the mining of rules of association could generate the following example: $\{beans\} \cap \{kale\} \Rightarrow \{sausage\}$ (the one who buys beans and kale also buys sausage) (Gonçalves, 2005).

In the rule of association, there are two basic measures that are mostly used: support and confidence. Support consists in the probability of an item or a rule occurring in a given database. Considering, as an example, the rule $\{rice\} \Rightarrow \{beans\}$:

$$Support (rice \Rightarrow beans) = P (\{rice\} \cap \{beans\})$$

Confidence, the second measure used in the rule of association, represents the probability of a consequent transaction taking place, provided that a previous transaction has occurred:

$$Confidence (rice \Rightarrow beans) = P(\{beans\}/\{rice\})$$

The equation may be re-written in the following manner:

$$P(\{beans\}/\{rice\}) = \frac{P(\{rice\} \cap \{beans\})}{P(\{rice\})}$$

For a better understanding of both measures, let us consider the example below, as described in the Table 1, in which there are 10 hypothetical baskets simulating a situation of purchase of rice, beans, and kale; where 1 means item purchased, and 0 (zero) means item not purchased.

Table 1

Example with 10 tasks of purchases of Rice, Beans, and Kale

Case	Rice	Beans	Kale
1	1	0	0
2	1	0	0
3	0	1	1
4	1	1	1
5	1	1	1
6	0	0	0
7	1	1	1
8	0	0	0
9	1	1	1
10	1	1	0

Source: Example created by the author.

In this example, there are the following values for the measures of support and confidence:

$$\begin{aligned} \text{Support}(\text{rice} \Rightarrow \text{beans}) &= 50\% \\ \text{Confidence}(\text{rice} \Rightarrow \text{beans}) &= 71\% \end{aligned}$$

Apart from the rule which involves rice and beans, it is possible to think of rules which involve more items, such as, for example, what is the probability of purchasing kale, given that rice and beans have been bought? And what is the confidence of that rule?

$$\begin{aligned} \text{Support}(\text{rice} \cap \text{beans} \Rightarrow \text{kale}) &= 40\% \\ \text{Confidence}(\text{rice} \cap \text{beans} \Rightarrow \text{kale}) &= 80\% \end{aligned}$$

Or else, what are the probability and the confidence of purchasing beans, hence rice and kale have been bought?

$$\begin{aligned} \text{Support}(\text{rice} \cap \text{kale} \Rightarrow \text{beans}) &= 40\% \\ \text{Confidence}(\text{rice} \cap \text{kale} \Rightarrow \text{beans}) &= 100\% \end{aligned}$$

Based on that Support / Confidence model, for a rule to be deemed as strong, it is necessary for it to present good values of support and confidence.

The model of Basket analysis generates a huge amount of rules, which makes it difficult for the analysis of data. Because of that, new measures have been adopted with aims at verifying rules that are more relevant and useful. Those new measures are classified as objective measures and subjective measures.

The objective measures are statistical indexes to assess the strength of the rule, whilst the subjective measures regard the opinion of an analyst to have the strength of a rule established.

An example of an objective measure of interest is the *Lift* (or *Interest*).

$$\text{Lift}(\text{rice} \Rightarrow \text{beans}) = \frac{\text{Confidence}(\text{beans})}{\text{Support}(\text{beans})}$$

$$\text{Lift}(\text{rice} \Rightarrow \text{beans}) = 1: \text{independence between \{rice\} and \{beans\}}.$$

$Lift(rice \Rightarrow beans) < 1$: {rice} and {beans} have a negative dependence.

$Lift(rice \Rightarrow beans) > 1$: {rice} and {beans} have a positive dependence.

In the example of the Table 1, the $Support(beans) = 60\%$, as the $Confidence(rice \Rightarrow beans) = 71\%$, we have a $Lift(rice \Rightarrow beans) = 1.18$, that is, the purchase of rice increases the chance of purchase of beans.

The subjective measures use the knowledge of the user in relation to the matter studied, incorporating that degree of subjectivity in the choosing of the values of support and confidence used as a cut-off criterion for the model.

The ideal criterion must regard both objective and subjective measures, for a rule may have high values for a certain objective measure and, nevertheless, fail to be subjectively interesting for the analyst who examines the same.

The quantity of rules grows exponentially from the increase in the number of items that are to be a part of the basket of products analyzed, which renders the basket analysis unviable as from the complete listing of its rules. The Equation 1 establishes the relation between the quantity of rules and the quantity of items, within a basket analysis.

$$Qty\ of\ Rules = \sum_{i=1}^{n-1} i C_{n-i}^n \quad (\text{Equation 1})$$

Where n is the number of items which are a part of the rule.

A basket with 12 items produces more than 100 thousand rules, whilst a basket with 17 items generates more than 1 million rules. The Figure 4 illustrates the quantity of rules as from the size of a basket.

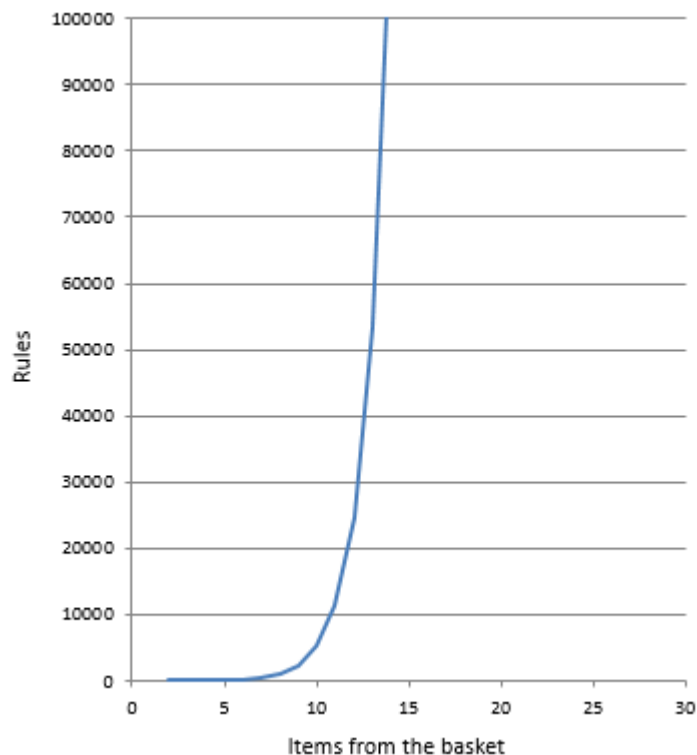


Figure 4 – Quantity of rules versus the quantity of items within a *basket analysis*.

Source: Data provided by the author.

For the article, free software named KNIME has been used for the basket analysis; further detail on the software may be found at <https://www.knime.org/>.

6 DATA OF THE PROJECT

This article has been made whilst using a survey performed by Ipsos Public Affairs (2005), termed *Pulso Brasil* [Brazil pulse], in which 1,200 monthly interviews in 72 Brazilian municipal units are carried out. This survey is being performed as from April, 2005. All of the survey quotes are bound by the distribution of the Censo [census] from the IBGE (*Instituto Brasileiro de Geografia e Estatística* [Brazilian Institute of Geography and Statistics], 2010) and follow the real proportions of Brazil (Figure 5).

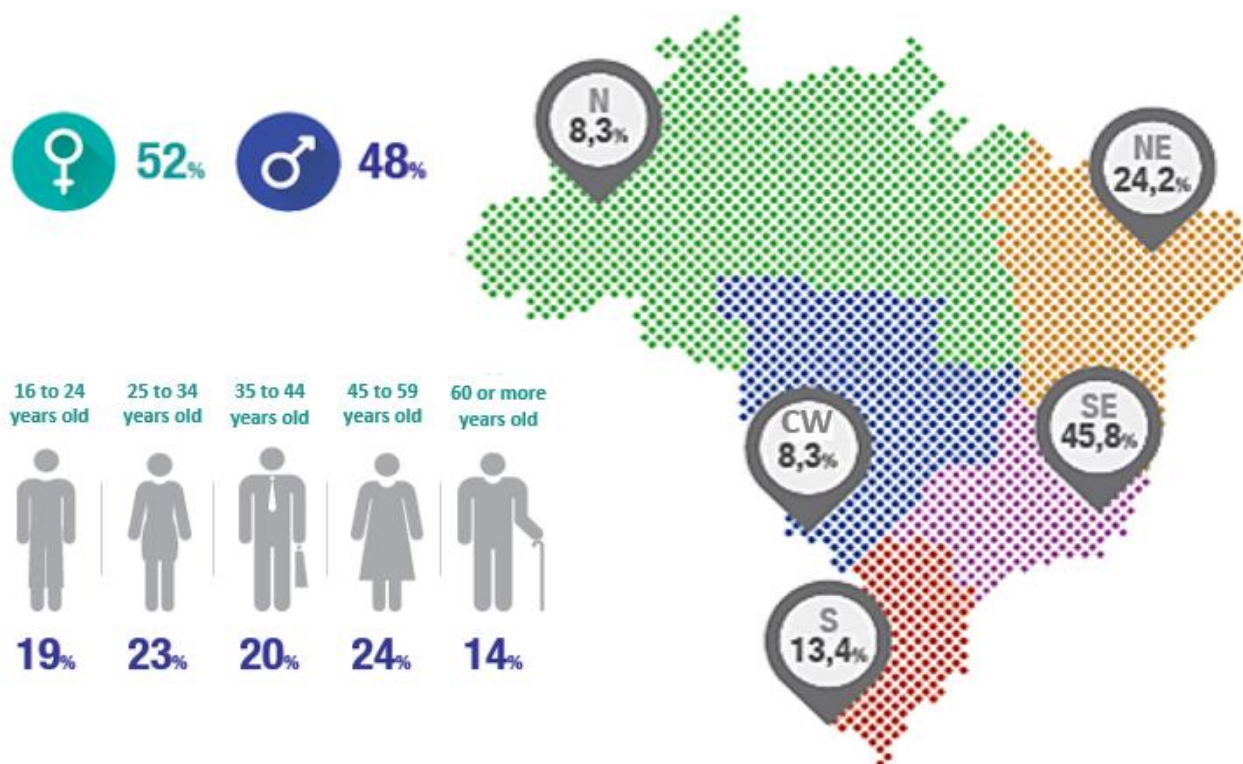


Figure 5 – Distribution as per gender, age, and regions of the data
Source: Ipsos Public Affairs, 2005.

The questionnaire applied in the *Pulso Brasil* survey is quite extensive and addresses a number of subjects, such as the confidence of the population in the economy, in politics, as well as a minor survey on family budget and the property of items.

For this study, it has been resorted to the information from a question pursuant to the expenditures of the population within the previous month. As from that information, the model of basket analysis has been developed, with aims at finding the market basket of the interviewees. The items which were a part in that question are listed in the Figure 6.

Installment / Mortgage of the domicile
Rent
Condominium fee
Electric energy
Water and sewer
Gas utility or bottled gas
Land telephone line
Cell phone (either pre-paid or post-paid)
Education (tuition of school)
Subscription of internet, satellite, cable TV
Insurance policies (personal, automobile, home)
Medical insurance / Health care plan
Private pension
Supermarket expenditures (food, cleaning, personal hygiene, bakery, butchery)
House maid hired in a monthly or a daily fashion
Public transportation
Fuel
Leisure (movies, restaurant, night clubs, CDs and tapes, etc.)
Clothing - men, women or children (clothes, shoes)
Cigarettes
Medicine
Payment of installments / Financing contracts
Toys
Payment of installments for financing contracts with stores
Payment of installments for bank credit (current account overdraft, credit card and/or financing contracts)
Other

Figure 6 - List of items which have been used in the model of Basket Analysis
Source: Data provided by the author.

7 ANALYSIS OF RESULTS

Many professionals are becoming aware of the fact that human beings are not machines void of emotions. On the contrary, they act in conformity with values, attitudes, and reasons which have their own logic in all of the aspects of the economic life, from work to consumption (Bueno, 2002).

Abraham Maslow has classified the human needs in a pyramid, as from the purpose of the same. These are classified as basic (physiological) needs, needs of safety, of belonging and love, of esteem, of self-realization, of knowledge, and aesthetical needs (Sampaio, 2009). Among the basic (physiological) needs, we can name hunger, thirst, sleep, sex, excretion, shelter, etc.

Whilst using a Rule of Association of basket analysis, it has been observed that the cell phone was entered as one of the items of basic need, together with water and sewer, supermarket expenditures, electric energy, and gas utility or bottled gas, which could be associated to the basic (physiological) needs defined by Maslow. The Figure 7 provides the pieces of information which were a part of the market basket of the Brazilian population.

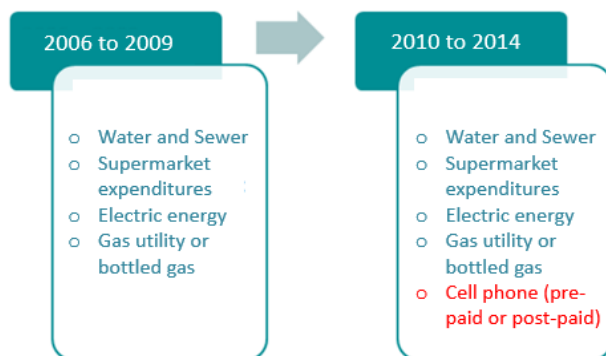


Figure 7 – Basket of the Brazilian population whilst considering a cut-off of 70% and 80% for support and confidence
Source: Data provided by the author.

From 2006 to 2009, the cell phone has been increasing its share in the expenditures of the Brazilian population, surpassing items such as: expenditure with medicines, telephone land lines, public transportation, and the payment of installments of credit.

In the year 2010, the cell phone passed on to become a part of the basket of the Brazilians and has not left that position ever since.

Such movement is behind the quantity of cell phones sold in Brazil, which increased immensely within the past years, having a growth of 61% between the years of 2009 and 2014 (Teleco, 2016). The Figure 8 provides information on the quantity of cell phones sold between 1998 and 2014.

In the same fashion, secondary data would also indicate that the interest for the land line telephones decreased within the period from 2008 to 2012 by 13% (Exame, 2012).

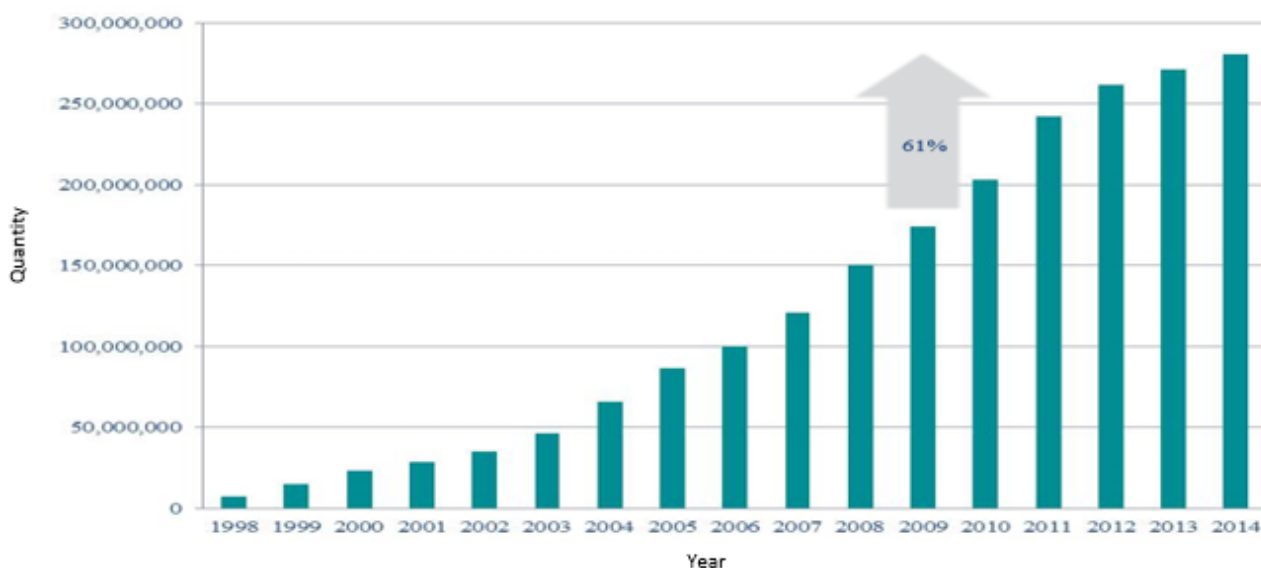


Figure 8 – Quantity of cell phone lines sold between 1998 and 2014
Source: Teleco, 2016.

Historic data from the survey by Ipsos Public Affairs also showed that there has been a drop from 52% to 32% (between the years of 2006 and 2014) in the share of the land telephone line in the expenditures of the population. The Figure 9 provides information on the percentage of people, within the Brazilian population, who have had some expenditure with land line telephony and with mobile telephony in the years from 2004 to 2014.

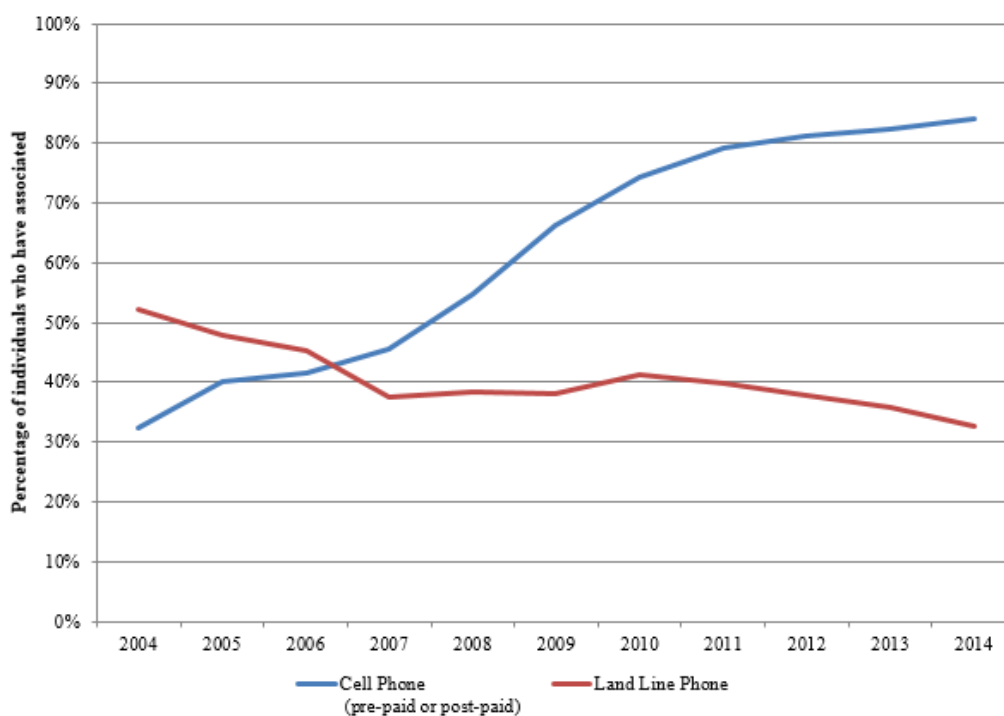


Figure 9 – Percentage of individuals who have had expenditures with Telephony (land line or mobile) in Brazil
Source: Ipsos Public Affairs, 2005.

That same phenomenon can also be observed in the public pay phones. From 2004 to 2013, there has been a reduction of nearly 33% in the number of public phone booths on the streets (four for every one thousand inhabitants). The expectation is for that number to decrease even further (one for every one thousand inhabitants) until the year 2020 (Globo.com, 2014).

8 CONCLUSIONS AND RECOMMENDATIONS

Basket analysis is a technique still little explored within the universe of market research. Nevertheless, its applications could range from the creation of more alluring product combos for the population to the analysis for the creation of promotions of products. The study has demonstrated the power of that technique to uncover relations, to understand choices, and to point out tendencies in consumption.

The latest 10 years have experienced a transformation in the manner the Brazilian citizen speaks - the cell phone has left from being superfluous to become essential. In a period of major economic growth and of increase in the available income, the cell phone passed on to be one of the items of basic necessity of the Brazilian citizen, side by side with items such as water and sewer, supermarket expenditures, electric energy, and cooking gas.

That increase in the need for the cell phone has taken place as a result of the new functionalities, apart from changes in its design and in the materials which comprise the same. Those new materials will allow for the cell phone to be “worn” by its users.

In a world where the consumer of tomorrow is different from the consumer of today, who is different from the consumer of yesterday, what will the new changes be that shall transform the cell phone into an even more essential item? What else can be done with the cell phone, which is still not being well explored today?

In the future, perhaps a better tapping of the smart alerts is made when something is deserving of attention - for instance, a promotion in a nearby shopping mall or a concert by an artist who is of

interest for the user. All of that can be accomplished as from the use of Big Data. It is worth to point out that the cell phones are sensors in all places; perhaps there will be an improvement in the traffic reports, based on the density, the speed, and the direction of the cell phones stuck in traffic jams. At last, it suffices to think of something to, then, realize that it already exists or that it is possible to develop an application in order to have that need catered. Now, really hard will be “teaching” the cell phone how to do your laundry...

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