

# Virtualizing Attendance and Reducing Impacts on the Environment with a Mobile Application

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**Abstract**—Information technology has been gaining more and more space whether in industry, commerce or even for personal use, but the misuse of it brings harm to the environment and human health as a result. Contribute to the sustainability of the planet is to compensate the environment, all or part of what withdraws it. The green computing also came to propose practical for use in IT in an environmentally correct way in aid of strategic management and communication. This work focuses on showing how a mobile application can help businesses reduce costs and reduced environmental impacts caused by its processes, through a case study of a public company in Brazil.

**Keywords**—E-government, green computing, information technology, mobile computing, sustainable development.

## I. INTRODUCTION

**P**ARALLEL to business development, sustainability gains prominence from the 1980s with the Brundtland Report [12] because rapid population growth has led to a great human dependence on fossil fuels, which harm the environment of such that the damage caused by human activities over the years are practically hopeless today. Therefore, the concepts of sustainability and economic development are recurring and are included in all segments of society. With the active participation or as a spectator of the changes, everyone participates directly or indirectly in actions named as Green IT. This topic has gained great prominence in the world because of the importance for business, society and the future of the planet. This concept seeks to minimize waste and improve the efficiency of technologies related to information and communication processes [15].

Environmental and economic aspects are leading corporations to think more efficiently and sustainably with respect to the use of your IT resources. The Green IT covers a set of practices aimed at reducing carbon emissions and greenhouse gases, reduced costs and better utilization of the computational resources for companies to maintain sustainable economic and environmental growth. The main reasons that influence organizations to adopt Green IT measures are reducing costs and improving the company's image [11]. The importance of Green IT in the business, society and the future of the planet attracts more and more the interest of the

technical community that, through research and development, will act directly on the success and technological innovation assist sustainable development. Symantec Corp® [4] reveals that 45% of the executives surveyed think in the Green IT as an essential part of the planning of companies. The data reveals that there are initiatives in Green IT implementation, mainly for the reduction of energy consumption and cooling costs of equipment.

A concern has been the energy usage in mobile devices, since its use also causes a generation of CO<sub>2</sub>. Siebra et al. address this issue in their study. We know that today's mobile applications are already part of our daily life and that they can become an ally of the companies to reduce cost and conducting information exchange with their customers in a more sustainable manner. The authors treat about techniques for creating more energy-efficient applications, by managing the hardware and control modules executed [5].

This paper explores how a mobile application can improve the KPIs of a company while promoting sustainability through green computing. A case study is done in a Brazilian government company where your customer service process is redesigned thinking on sustainability. Thus, the purpose of this article is to serve as guide and inspire more companies and researchers to explore this subject.

The organization of the remainder of this paper is as follows: Section II presents what motivated the creation of the new process and how it was conceived; Section III shows how it was planned and executed; Section IV shows some results and Section V gives the conclusion.

## II. MOTIVATION AND THE PROBLEM

Currently the companies of basic sanitation in Brazil and in the world have been increasingly concerned with sustainability and the responsible use of water resources. Because of this, these companies have invested in the search for solutions that can help public awareness and satisfaction. At this point, the technology has been a great ally providing means of communication more agile and direct with clients and the general population, large and cohesive manner.

The Cagece (Water and Sewerage Company of Ceará), is one such company, part of the public sector. Today, operating throughout the Brazilian State of Ceará, providing water, and collecting sewage for the 263 municipalities and 72 cities, serving more than 8 million people. In its second biannual meeting of the strategic planning of the year 2012, through the SWOT analysis of the company, performing the intersection of threats and weakness were identified the most significant risks to the business.

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A SWOT analysis (alternatively SWOT matrix) is a structured planning method used to evaluate the strengths, weaknesses, opportunities, and threats involved in a project or in a business venture. A SWOT analysis can be carried out for a product, place, industry, or person. It involves specifying the objective of the business venture or project and identifying the internal and external factors that are favorable and unfavorable to achieve that objective. The concept of strategic fit expresses the degree to which the internal environment of the firm matches with the external environment.

- Strengths: characteristics of the business or project that give it an advantage over others.
- Weaknesses: characteristics that place the business or project at a disadvantage relative to others.
- Opportunities: elements that the project could exploit to its advantage.
- Threats: elements in the environment that could cause trouble for the business or project.

In the SWOT analysis, the problem of shortage of water resources that the state has passed in recent years was identified. This happens because of drought and low rates of precipitation that has consequently decreasing the levels of water reservoirs and drying rivers and streams. Added to the problem of drought, there are also the problems that occur in the water distribution network, such as leaks and fraud. Another problem identified was the need to improve customer service and thereby reduce the complaints index by the same.

The result of the process was identified the need to develop a systematic practice where it was possible to gain agility in identifying problems of leaking water and sewage, fraud in the distribution system and problems related to lack of water, considering its strategic goal of acting with environmental responsibility. Is still identified the need for greater awareness of the population in the use of water resources, aligned with practical information and easy access to all. In the context of performance of sanitation on public health, spread the conscious use of water resources and ensure sustainability is one of the fundamental principles of public service, which become the major management challenges and demand innovations and practices guided by the excellence, achieved by through a management directed to the results, thus bolstering the universal service.

The opportunity analyzed by Cagece to disseminate information provide means of interaction of population and mitigate environmental impacts caused by the problems of leakage and fraud by acting as social agents of the population, can be replicated to other companies providing sanitation services that have a vision focused on results-oriented all stakeholders and seek excellence in management.

### III. A NEW SUSTAINABLE PROCESS

The Cagece, based on its strategic objectives "Improving information and modernization of business processes", "Improving customer satisfaction", "Promoting social and environmental actions", has formed a Working Group (WG) for multidisciplinary to study possible solutions that could help in the challenge proposed by Cagece. Thus, the WG tried

to perform benchmarking with sanitation companies in Brazil to search for the best practices in customer service and management processes occurrences. Cagece made various surveys such as strengths and weaknesses of each solution adopted by the company, technologies used, feedback obtained by the population, and measurement methods. At last, we did a literature search to find previous studies on this subject that could generate inspiration to create a new internal process [2], [6], [9], [14], [15].

The WG put all the collected data in a repository. The data was interviews, links of companies and systems, images, meeting reports, brainstorm reports, and recorded chats of interviews. After that, the WG try to filter and organize all the useful information to analysis this again in a new meeting.

Despite of Cagece have found some great ideas, had not yet been detected something that would be innovative for the market and for the company.

The Cagece opted for the creation and implementation of a new way of managing the problems reported by the population and simplify the process. In January 2013, the WG began conducting a study in ways that could make this possible within the reality of the sanitation industry. Through the idea of information, agility raised in the SWOT matrix has been thought in using a mobile application to improve channels of communication. Extending this, were thought still in satisfaction of the population and how to add new features to modernize the application or attendance, eliminating the known delays. After the conception of the idea, the WG makes the presentation in the weekly meeting of the executive board, where he obtained its approval. This new management practice was placed within the flow of the office of organizational projects, where had its Project Charter, which consists of listing the steps, considering those responsible, interfaces, resources, timelines, impacts on results, as well as criticism, verification and validation of analysis steps, according to the need, created and approved by portfolio management. The methodology used to manage the project was the Agile PDD methodology and PM5 approach [1], [13]. Fig. 1 shows the execution of the project.

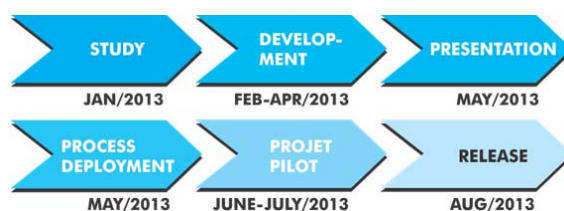


Fig. 1 Project Planning

Initially, Cagece had the need to develop the application for Android and iOS devices. One problem is that there was within the company a team with expertise in language specific to iOS. However, there were people trained in java development and knowledge in Android. After an analysis, the Cagece considered that training for iOS development was not viable. The total cost of training would be of five thousand US dollars. There was a web development team within the

company. This team set out to conduct a study of alternatives and presented a solution for cross-platform development using HTML 5 and Phonegap [3]. The WG and the board of Directors approved the solution presented by the web team. Table I shows the resources and costs of the project.

TABLE I  
QUANTITY OF RESOURCES USED

| Parameter                          | Quantity | Total       |
|------------------------------------|----------|-------------|
| <b>1 – Software</b>                |          |             |
| Apple developer license            | 2 years  | \$ 198.00   |
| Google developer license           | 2 years  | \$ 50.00    |
| <b>2 – Hardware</b>                |          |             |
| Mini Mac CPU                       | 2 units  | \$ 800.00   |
| Tablet and smartphone with android | 2 units  | \$ 600.00   |
| iPad e iPod                        | 2 units  | \$ 798.00   |
| <b>3 - Human Resources</b>         |          |             |
| Development training in Phonegap   | 7 people | \$ 3.000.00 |
| <b>4 - Grand total</b>             |          |             |
| Final amount                       |          | \$ 5.446.00 |

TABLE II  
QUANTITY OF FEEDBACK FOR TYPE AND ROUND

| Parameter            | Quantity |         |
|----------------------|----------|---------|
|                      | Round 1  | Round 2 |
| Errors and bugs      | 5        | 14      |
| User Interface       | 2        | 13      |
| New Functionalities  | 1        | 8       |
| Changes in Functions | 1        | 9       |
| Just opinion         | 10       | 27      |
| Total                | 19       | 71      |

The first version of the application was initially an idea where the users would be able to inform a several different problems like leakage of water and sewage, frauds, holes in the streets, denounce services not completed and other general occurrences. The application needed to work in smartphones and tablets.

The projection of payback of the investment in the table one was in six weeks with the economy generated by the reduction of the time needed to find and solve problems the company's losses.

During development, has also drawn the design of the new process for agile attendance of these requests, and after its approval, the business area implements the new process and the WG conducts the team training in the process.

For the pilot project, the company invited 12 largest corporate clients to use the new application and give the opportunity to provide feedback on its functionality, usability and utility for daily use. The duration of the pilot was two weeks. One sector of the company (called Gerem) were responsible for collect the client's feedback. They received the feedback using a simple form in the Cagece website. The clients could send suggestion of improvement, report bugs and errors, suggestion of changes or just give the opinion about the app.

After receive the feedback of pilot in round one, the Gerem performs a round of test, this time, with employments that had

the experience in the use of android devices. This time, the Gerem chosen 60 people to use the app for and give the feedback. This new round had the duration of three weeks. Table II shows the quantity of feedback that Cagece received in the both rounds, but it does not consider the duplicate feedback (likes a same error or same suggestion).

After the treatment of all collected feedbacks, the development team performed the necessary adjustments for the first version and in August 2013, the company released the application to the population. In this version, the team makes the approved suggestion of function changes and in the user interface. The team also corrected all errors and bugs. The application is available for the whole country, in this way, the state visitors and other interested parties, can check the tips, the functionalities and perform a benchmarking.

Now the population could assume the role of a social agent, reporting problems encountered, thereby decreasing the time that the company would need to find the problem and fix it, and consequently decreasing losses with water leaks and fraud and reducing the environmental impacts caused by sewer leaks.

The intention of use the app to report the problems was that the population could make this the most practical and quickly as possible, by simply choose the type of occurrence that will register (water shortage, water leaks, sewage leak, fraud, services not completed, water holes and sewage, other events). After that, he will need to enter the address (which can be automatically obtained by the GPS position, if any), a message describing the situation (minimum 10 characters) and a point of reference, if one point of difficult access or localization. Finally, the customer still has the option to send a picture related to the occurrence that can be beat at registration or chosen from the gallery (if the person does not send the occurrence at the time the view for reasons of lack of access to the internet).

The mobile application has integration with the commercial system of the company, making all registered occurrences are treated in a more agile manner and that the information presented to the people are generated in real time according to the system upgrade occurs, the accompaniments of occurrences, updates information and status of invoices.

In the app, there is an option to see the historical occurrence divided by status (opened, in execution, closed). In this feature, the user can also perform a tracking and questions about the execution of the occurrence, which the attendant will view the in the company commercial system and he can quickly give a feedback to the user. With the app, the people do not need to go to a store service or call to customer service anymore. When the finish solve and close the occurrence, the user can still give a grade and do a review about the attendance and the occurrence solution, providing the company a chance to enter the continuous improvement cycle.

Once that the occurrence was open, one assistant in the Central of Operation receives the occurrence. And the assistant starts the treatment of the occurrence, visualizing and analyzing the picture (if has one), checks if there is already another occurrence opened to the same problem, and if not, he

opens a service order for the business unit corresponding to the region of the service. In Fig. 2, we can see the process flow created for mobile use.

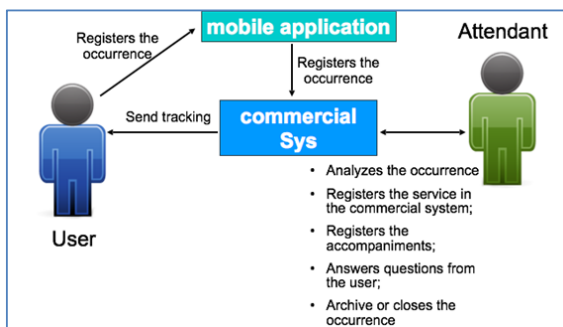


Fig. 2 Illustration of the Process Created

In the application, the population can also access the news that are on the company's website, he can find different tips (the system are some tips on avoiding leaks, cleaning of water tanks, water and sewage treatment, disseminating knowledge on sustainability). Another information that the population can access is: list of services and their prices, frequently asked questions from individuals and companies, and direct contact with the company channels.

When Cagece launches the version 1.0 of the app, the company also stated to plan the version two to implement the suggestions collected in the feedback of new functionalities. Cagece released the version two in the April 2014.

As a part of version two, the company created a web version of app that the population can access and saw the same information of the mobile app using a unique login. With this login, the person can access the same account in different devices too, and give always the same and updated information.

The new features implemented had the focus in the company client. In Fig. 3, we can see the system screens, which is the language pt-BR (Portuguese Brazil). Some examples of features are listed below.

- Consult the registration last 12 water service bills;
- Request invoice of unpaid bills;
- Review old invoices and request a copy by the email;
- Water consumption history;
- Locate a service store nearest;
- Change the web-service from SOAP to REST;
- Improve the data security;
- Improve the UI and usability;
- Change colors of the app.

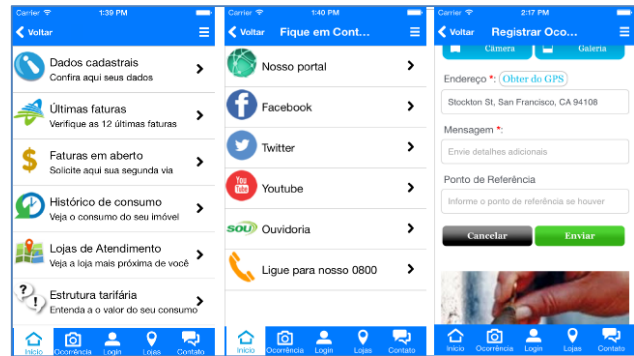


Fig. 3 System Screen-shots

#### IV. RESULTS

The population has a large participation with respect to ability to inform places of water and sewers leaks or holes in the streets using the mobile app. Since the launch in August 2013 until the day 09/31/2014 were opened 2,387 occurrences through the mobile devices, with 50.25% of water leaks and 10.02% over sewage leaks. These data only reinforce that the population has been concerned with the environment, helping the company to identify problems and resolve them quickly. Fig. 4 illustrates this data and the division of occurrences by type. This data represents an increase of 1% in the KPI "Reduction of water losses" and 0.5% in the KPI "EBITDA margin". These data show the application's success.

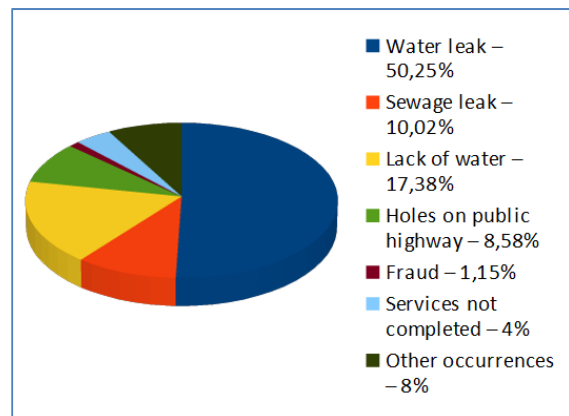


Fig. 4 Percentage of Occurrences Types

Other analyzed data are those relating to the requests and emission the new clients bill's copy in service stores. During the period April-September 2012, the service stores generated 37,905 emissions of bills throughout the state. In 2013 where 169,311 attendances and in 2014 were 282,485 for the same period. In 2014, the company launched the version 2 of the app with the new feature to see the invoice and request a new bill's copy by email. With this functionality, the app received and generated 156,582 emissions of bills and this number represents 55.43% of the total. This is an excellent number that represents the attendances not realized in person, improving the flow in stores and reducing the waiting time of



customers. This number also represents the amount of eliminated prints. This is another way to reduce costs and represents an increase of 0.7% in the KPI “EBITDA margin” and 2.3% in the KPI “EBITDA margin”. Another impacted KPI are the “Index of customer complaints” that had a reduction of 12%. Fig. 5 represents the number of bill’s emission.

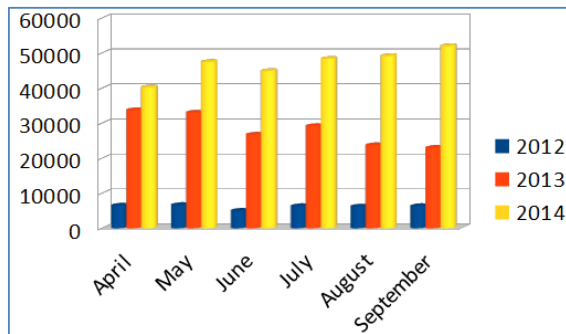


Fig. 5 Totality of Bill's Emission by Month

According to [10], the number of 156,582 (the bill's emission totality in mobile app for six months) also represents that seven trees have left be “consumed”, noting that a eucalyptus tree can produce from 20,000 to 24,000 sheets of paper. According to [7], this amount of unprinted paper represents the non-emission of 3.12 tons of CO<sub>2</sub>. The company calculated that there was an average reduction in monthly energy consumption of 1800 KWh, caused mainly by the decreased flow in stores and decrease in impressions, which represents the reduction of CO<sub>2</sub> emissions by 1.05 tons/month [8].

As a part of the app and the new process, the commercial system receives the feedback at the end of the occurrence. Always in the end of the month, the Gerem analyses all the feedback to found positive and negative points in the process to make the necessary adjusts. This transfer of management, leading the customer the ability to control their demands, creating, verifying, and evaluating brought benefits to the environment and the company concerning adding the manager team of the company in the execution of goals with greater efficiency and quality incorporating the figure of the social agent. The instant that the company focuses its efforts on correcting and optimizing their processes, sharing responsibility in the administration of occurrences, there was a timesaving used to detect problems, needing to meet the demands set by the population, reducing the strength of work used for troubleshooting. This delivery of event management to the population resulted in a decrease in the number of complaints, leading to the observation of improvement in the company's image in the society. Finally, this bidirectional channel management, created a narrowing in Cagece-society relationship, evidencing as a dynamic, interactive and critical practice to the achievement of the strategic objectives of the company.

## V.CONCLUSION

The rise of technology and its intense utilization have brought the process agility of large and small organizations, occurring an automation of these companies. However, the misuse of its resources has also brought serious consequences for our daily life, where their main effects affect nature and health.

This paper presented an initiative whose main results are of the improvement of KPIs (Key Performance Indicator), costs reduction, of the improvement the client proximity and the preservation of the environment and consequently the life of man on Earth though of the reduction of the CO<sub>2</sub> emission. Quantitative data were able to become more palpable the gains of the company, the people, the state and the world came to get.

As conclusion, the creation of sustainable processes inside the company could collaborate extensively with the preservation of the environment, especially for companies that work directly with the provision of services, looking to reduce costs and impacts caused by the high demand of communication and impressions. For companies that provide sanitation services, the impact may be even greater and more positive when it brings the customer into the company, so that it will help in the detection of problems so the company can focus on the solution and prevention thereof.

The hybrid mobile application could be a good low-cost alternative to companies that would like to virtualize their process like the Cagece's example.

As a future work, we suggest the application's use in other companies in the world, as well, we suggest the evaluation of payback with other indicators. The new indicators will create the possibility to do more evaluation using other representations of the data, like the Scatter Chart on the Location Map. With this kind of map will be possible to check areas of higher incidences and with this information, will be possible to direct the investments. One other suggestion is to do a deeper research about hybrid development as a solution of process virtualization of small and medium enterprises.

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