Mobile Technology and Conservation Areas: A Case Study

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***Abstract*—This article addresses the importance of mobile technologies as a method to assist in the process of denouncing environmental crimes. With the purpose of helping the citizens of Tocantins (Northern Brazilian state), by giving them means to denounce illegal practices, this work helps with environmental preservation. The research presented is relevant in helping with environmental protection.**

Keywords-mobile technologies; complaint; environment crimes; preservation; environment.

I. INTRODUCTION

This research intends to yield useful information for someone and to enable that someone to apply it. In order to receive this type of useful information on the way it is used, several factors have to be taken into consideration, for instance the relevance of the information and what the impacts and transformations will involve. Confronting with this, it is observed that one of the major concerns at present and for future generations is the environment and its indiscriminate use.

According to the law of environmental crimes, the normative act materialized in Federal Brazilian Law nº. 9.605/98, environmental crime is all use of natural and mineral resources that violates the limits established by law [1].

Hence, the protection and conservation of renewable and nonrenewable natural resources require actions beyond existing legislative instruments, leaving the theoretical field and being more effective. Thereupon, technology can help in the environmental protection of a dynamic and agile way in favor of the environment.

Historically, in Brazil, the process of denouncing crimes against the environment is accomplished in person where the citizen goes to the responsible environmental organ to complain, or uses the telephone service to communicate the illicit practices harmful to the environment. Those models of complaint are restricted by population, i.e., not always can whoever makes the denunciations reach the competent authorities, or they are attended by phone calls due to the great number of unanswered phone calls. It should also be observed that the attendance at public agencies operates at restricted hours, and is unavailable on weekends or holidays. Therefore, there are no people to receive those complaints, and forward them to the surveillance group for immediate environmental protection activities [2].

In this regard, the project presented in this article is the use of mobile technologies, allowing every citizen to carry out criminal denunciations against the environment, interacting directly from the source of the infraction, at any time, through mobile devices connected by Internet.

To this extent, the project also intends to solve the problem of the limitations in the process of carrying out criminal denunciations against the environment, allowing greater speed and efficiency, in an effort to provide assistance to the responsible agencies for environmental surveillance.

For that reason a mobile application was created for the Android operating system. Called Preserve.TO, it which simplifies and innovates the process of denouncing crimes against the environment in the State of Tocantins, and can be adapted to anywhere in the world.

This article is structurally organized in the following manner: in section I - introduction, which presents the problem, justification, objectives, and organization of the text. In section II - related research, which are studies already accomplished in this area. In section III - proposition, which describes what was done. In section IV - methodology, explains what and how it was done. In section V - results, which comprehends the data obtained in the research in relation to the mobile application. In section VI - conclusion and future research.

II. RELATED RESEARCH

This section will deal with research related to the goal of this article. Besides that, it mentions information considered relevant, emphasizing the similarities and differences among them.

A research topic that has great similarity to the work developed in this article shows the use of mobile technology to help combat sexual violence, collecting evidence through the MediCapt application that allows investigative professionals to collect evidence relating to the crimes of a sexual nature and to send this information to a database, and which can be investigated afterwards by the lawful authorities or used as criminal evidence in court. MediCapt has the same purpose as Preserve.TO, because it is a digital means for collecting information that can be forwarded to the competent authorities to evaluate those digital data, and if it involves a punishable criminal offense, to apply the appropriate penalties to those who have infringed the laws [3].

The course conclusion paper presented at the undergraduate course in Computer Science at the University of Southern Santa Catarina (*Universidade do Sul de Santa Catarina*, in Portuguese), in 2015, entitled "Collaborative System for Identifying and Denouncing Environmental Crimes" ("*Sistema Colaborativo para Identificação e Denúncia de Crimes Ambientais*", in Portuguese) presents a project for a system of environmental crimes to enable the collaboration and

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active participation of society in environmental preservation, focusing on crimes against fauna, flora and pollution. The application developed was mainly destined for mobile devices using the camera features and Global Positioning System (GPS) along with a Web version [4].

The article presented at the "VIII Brazilian Congress of Environmental Management" ("*VIII Congresso Brasileiro de Gestão Ambiental*", in Portuguese) held in Campo Grande / Mato Grosso do Sul from November 27th to 30th, 2017, entitled as "'Brigade On Line' Application: The Use of Technology to Contribute to the Combat of Forest Fires" ("*Aplicativo 'Brigada On Line': O Uso da Tecnologia para Aporte ao Combate de Incêndios Florestais*", in Portuguese) reports a very similar application to the one presented in this article. "Brigada On Line" application, as well as the Preserve.TO, are applications that have been developed for smartphones and tablets, aimed at helping preserve the environment through denunciation to the competent agencies. Both tools use geographic coordinates resources, obtained by GPS, image records, and text fields to detail the location [5].

Those projects, just as the one presented in this article, have used tools that furnish mobility information, both from a collection and availability point of view. In other words, the mobile networks along with the connectivity of devices through 3G, 4G and Wireless networks allow these solutions to go where the information is generated and bring them to the population, reaching as many people as possible. In this regard, ubiquitous access to information is offered from the moment that it is generated until the moment it is provided.

III. PROPOSITION

Our proposition with this research is to provide to citizens of Tocantins with mechanisms through mobile technology that allow them to denounce, in a voluntary way, actions of degradation against the environment in the State of Tocantins, whether the environmental crime is in urban or rural areas. To this extent, the relationship between society and public administration becomes closer. These denunciations might be directly linked to the environmental protection agencies, such as the Brazilian Institute of the Environment and Renewable Natural Resources (*Instituto Brasileiro do Meio Ambiente e dos Recursos Naturais Renováveis* - Ibama / in Portuguese) and the Nature Institute of Tocantins (*Instituto Natureza do Tocantins* - Naturatins / in Portuguese), so those agencies can investigate and if penalties apply, the lawbreaker will be punished for attacking the environment, being held liable according to current legislation.

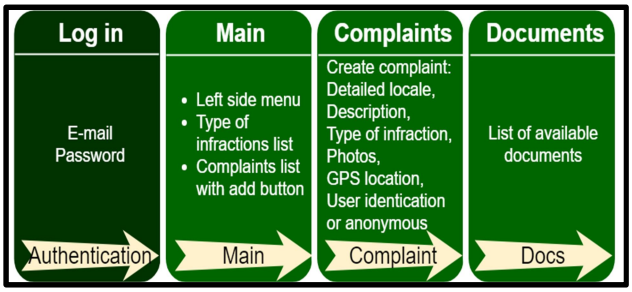

Figure 1. Solution flowchart.

As illustrated in Figure 1, a project is presented to enable assistance to society and environmental defense agencies. This is accomplished through the development of a mobile application in which the user can accomplish the denunciations, informing the detailed location, the nature of infraction, classified into types of infractions, photos of the occurrence, the geographical coordinates through GPS and identification of the person making the denunciation through user authentication, because the access in the application is initially performed by email and password, or the denunciation may be provided anonymously. After registering the denunciation via device, it can be sent to the application server, allowing the availability to the competent agencies. These accusations can be deleted from the mobile device at any time by the authenticated user.

As well as recording and sending denunciations, the project contains a document module, which is can offer links to current environmental legislation and several related materials.

IV. METHODOLOGY

This section will present the methodological steps and technologies used in the project proposed in this article.

A centralized Web structure was created containing information on the types of environmental infractions, receipt of denunciations, authentication and authorization of users. A mobile application was also developed for the Android operating system, for application of this data, generation and sending of denunciations by the project users. Communication between Web and mobile applications is done through Web services using JavaScript Object Notation (JSON).

The first stage of the development was the survey of the requirements, being made with interviews with Mr. Erivaldo Martins, an employee at Naturatins, the public agency responsible for environmental monitoring in the State. Initially, the following requirements and functionalities of the system were drawn up: list and consultation of the nature of the infraction, city of origin of the infraction, report of the occurrence, detail, photos and geographical coordinates of the place of incident, and complainant. The denunciation can be anonymous.

After the requirements were surveyed, the implementation part of the project was started. To that end, Microsoft Visual Studio Community integrated development environment was used with the C# (C Sharp) programming language and Microsoft SQL Server Express database for web application development, and the integrated Android Studio development environment with the Java programming language, extensible markup language (XML), and Realm database for mobile application development.

After the project began to take shape, part of it, the Web server, to receive and manage denunciations, which was hosted on a virtual server on Google Cloud Platform, so that the team could access the application and perform testing, synchronizing data, making registrations, testing queries, making suggestions, tracking and improving the development process.

With the application working in its beta version, mathematical formulas presented in (1) and (2) were

applied to obtain statistical data for validation of the research. Faced with such a situation, the sample, the standard deviation and the estimated error were determined. The analyzes were performed using the formula presented in (1).

$$s = \left(\sigma \, x \, \frac{1.96}{E}\right)^2 \quad (1)$$

Being:

- s: sample.
- σ: standard deviation.
- 1.96: 95% confidence.
- E: estimated error.

In a pre-sample of application ratings, with options from 1 to 5, 1 being poorly satisfied and 5 being very satisfied, the following values were found:

- Pre-sample: {4, 2, 5, 3, 5}.

With the standard deviation on this pre-sample of 1.303840481, the result shown in (2) was obtained.

$$s = \left(\frac{(1.303840841 \, x \, 1.96)}{(1.303840481 \, x \, 0.15)}\right)^2 \quad (2)$$

The result of s = 170.7377778 was obtained.

With the application of this mathematical formula shown in (2), we have the sample population size for validation of the research, from a universe of 170.7377 people.

A form was prepared this sample population to answer and evaluate the project. This form is digitally found through Google Forms, where the user of the application could answer seven questions from the researchers, to gather pertinent information for the use of the application, in order to obtain a valid result, which is in fact to know if the application will help to fight environmental crimes in the state of Tocantins.

After a usable version of the Preserve.TO project was ready, its use was put into practice by making the mobile application available on Google Play Store through the Android Package (APK) application.

One of the researchers is a Naturatins employee. He was one of the main persons for presenting the application to this institution, where all the coworkers were very enthusiastic and used the application in its evaluative test phase.

The project was also displayed to academics from the Federal Institute of Education, Science and Technology of Tocantins (*Instituto Federal de Educação, Ciência e Tecnologia do Tocantins* – IFTO, in Portuguese), Palmas campus, where the researchers explained the proposition of Preserve.TO, giving instructions about how to obtain it through their smartphones or tablets and also guiding the students that after using this application, the research form was answered, providing information to the researchers as to whether the project would be useful in the combat against environmental crimes.

V. RESULTS

The public-opinion poll was drawn up with seven questions, with each question containing five alternatives, on a scale of one to five. Rating one corresponds to poor, rating two corresponds to fair, rating three corresponds to good, rating four corresponds to very good and rating five corresponds to excellent.

In this public-opinion poll we tried to extract from people who used the project what they thought of the proposition and whether, in fact, this could help in the preservation of the environment.

The questions used, in the following order, were: Do you believe that it is really possible to help to preserve the environment through the use of this application?; In the environment in which you live, is the use of this application relevant for preserving the environment?; Evaluate the proposition of the application, in sense of helping in the fight against environmental crimes, in relation of the utility; Has the application it easy to made a denunciation?; Do you believe that the application is able to aid in the agility of environmental crime surveillance, preventing even greater disaster?; Does the use of new technologies, such as the one developed in this application, contribute to the preservation of natural resources?; Which rating would you assign to recommend this application?.

A total of 172 (one hundred and seventy-two) answers to this questionnaire were obtained. For the first question, according to Figure 2, 61.6% of the respondents answered “Certainly”, 32.6% answered “Yes”, 4.7% answered “Maybe”, while 1.2% answered “Not much”, with the estimated sampling error of 0.04886% for each response. A variance of 0.4106% and a standard deviation of 0.6408% were found.

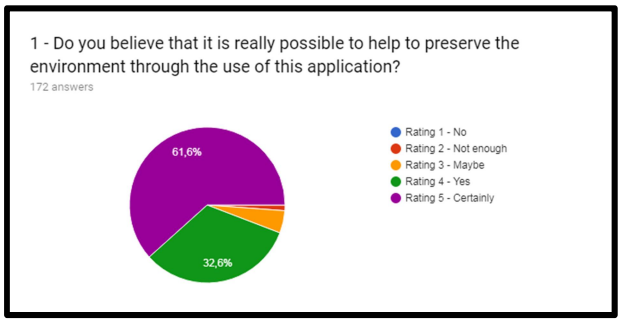

Figure 2. Answers to the first question on the form.

For the second question, we tried to extract from the application users the relevance of the technology. The percentage acquired is presented in Figure 3. The sample fractions obtained were rating 1, which represents “No”, one of the research participants attributed this rating, meaning that the majority of all who answered the public-opinion poll believe that the use of the application is relevant to for supporting preservation of the environment. Therefore, it follows that 99% of people believe that the application can promote actions in defense of the environment. However, within this universe, 0.6% answered “No”, 2.3% answered “Not much”, 7.6% answered “Maybe”, 34.3% answered “Yes” and 55.2% answered “Certainly”.

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Given this second question, which has a variance of 0.6028 and a standard deviation of 0.7764, it can be inferred that the population believes that the use of the Preserve.TO application is important for aiding environmental preservation.

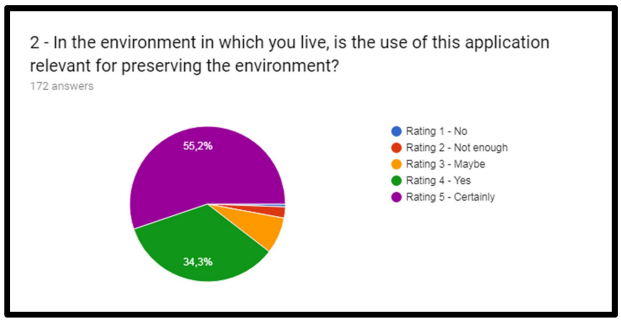

Figure 3. Answers to the second question on the form.

On the third question, rating 1 was not assigned, which has the description "Poor", so it can be seen that 100% of interviewees do not think that the application project is a bad idea. However, within this sample scenario, 1.2% answered "Fair", 13.4% answered "Good", 25% answered "Very Good" and 60.5% answered "Excellent". With a variance of 0.5844 and standard deviation of 0.7645, most evaluations have been concentrated on very good and excellent, assigning the application as an important utility tool, Figure 4.

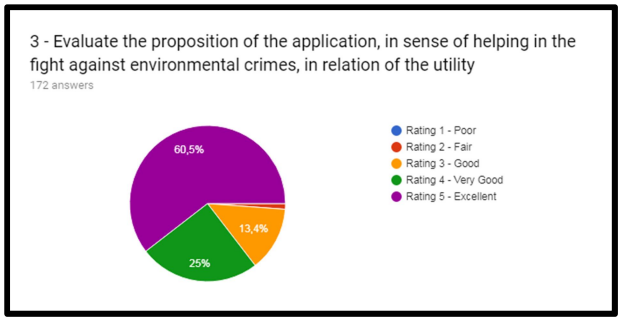

Figure 4. Answers to the third question on the form.

The fourth question attempted to verify the time taken to accomplish a denunciation, i.e., whether it would be faster in this project presented, the Preserve.TO mobile application, than in traditional methods, such as carrying out the denunciations through phone calls to the call centers, denunciation recipients, or even in person at the regulatory agencies. Thus, it was found, as shown in Figure 5, that 49.4% of the interviewed answered that the denunciation process would be fast, and only 7% of the interviewed answered that the agility in the denunciation process would be Fair, 9.9% answered "Good" and 33.7% answered "Very Good". From these results, a sampling error of 0.0684% for each response, a standard deviation of 0.98981% and a variance of 0.8066% were obtained.

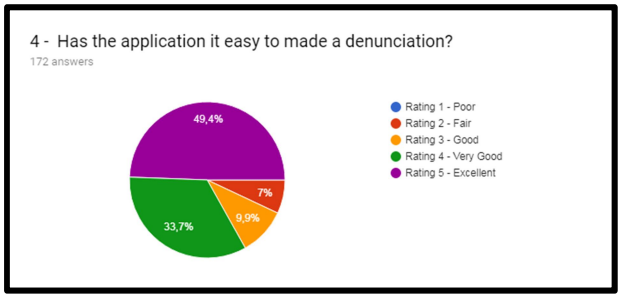

Figure 5. Answers to the fourth question on the form.

Consequently, in the fifth question 59.9% of people considered the application as a way to speed the denunciation process, so that it can quickly reach the competent authorities and avoid further damage to the environment. 33.1% answered "Yes", 4.1% answered "Maybe", 2.3% answered "Not much" and 0.6% answered "No", according to Figure 6. Regarding this, 0.0560% as sample error for each response, 0.7352% as standard deviation and 0.5406% as variance were extracted.

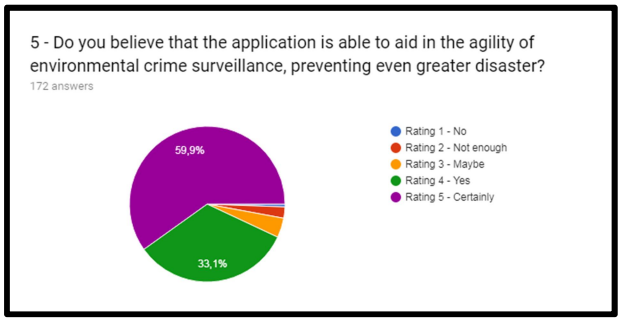

Figure 6. Answers to the fifth question on the form.

On the sixth question, 61% answered "Certainly" that technology can contribute to the preservation of natural resources by assisting inspection agencies with faster and more current information, promoting a better enforcement performance. 34.9% answered "Yes", 2.3% answered "Maybe" and 1.7% answered "Not much", as shown in Figure 7. With a sampling error of 0.0481% for each response, standard deviation of 0.6312%, and variance of 0.3998%.

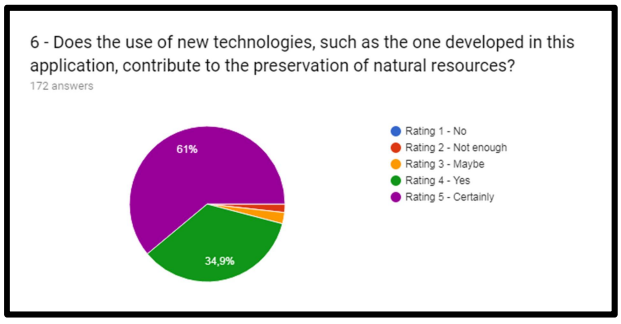

Figure 7. Answers to the sixth question on the form.

Finally, in the seventh question, Preserve.TO users were asked to recommend this project to be used by others, and 65.1% answered "Excellent", 24.4% answered "Very Good", 9.9% answered "Good" and 0.6% answered "Fair", as shown in Figure 8.

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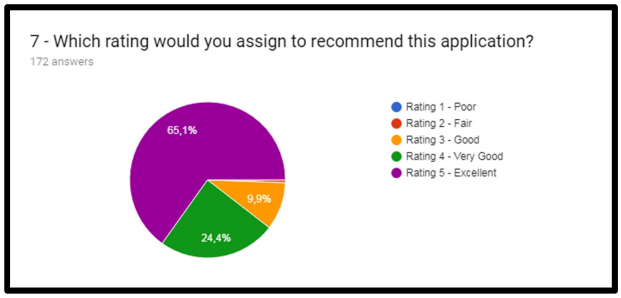

Figure 8. Answers to the seventh question on the form.

For this seventh question we have a sampling error of 0.0528%, standard deviation of 0.6934% and variance of 0.4809%.

VI. Conclusion and Future Research

This research is focused on how to develop useful data for someone and how to make this someone apply it. Bearing this in mind, we detect the need to preserve and care for something that is a well-diffused right, common to all citizens, which is the environment.

At the end of this research, through the data obtained, the researchers observed that the sample population that evaluated the application Preserve.TO believes that this tool will certainly help in preserving the environment. It will also enable a more agile reply from the public administration and will reduce bureaucracy in the current process of reporting environmental crimes.

According to the above, in the statistical data obtained in the data collection and illustrated in the above figures, it is observed that 94.2% of the sample believes that the application is capable of assisting in environmental preservation. Thus, still within the population, 89.5% of respondents believe in the relevance of the application to the environment in the current reality in which they live. These data reveal the acceptance of the application and reflect credibility that the population sample attributed to it, when they became familiar with it.

According to the data obtained in the research, on the proposition of the application to help reduce bureaucracy in the process of denouncing environmental crimes and assisting in the combat against crimes related to the environment, 60.5% of the interviewees rated the proposition as excellent, while 25% saw the proposition as very good. Therefore, it is observed that the proposition of the application was very well accepted by the population.

In the context of the easiness in conducting the denunciation process, 49.4% rated it as excellent and 33.7% rated it very good, which shows that the respondents believe in a greater efficiency of bringing a criminal complaint against the environment, using the application. So, within this process, the interviewees also believe that the application assists in the celerity of the entire procedure of reporting and monitoring environmental crimes, according to data obtained from the sample population, which indicates that 59.9% gave the maximum rating for the question, that is, they are sure that the application helps in dispatch. Still within this population, 33.1% answered “Yes”, believing also in the speed of the whole process.

The researched scenario, regarding the use of new technologies, shows that 61% of the those interviewed indicated the alternative “Certainly”, showing they believe in the use of new technologies such as Preserve.TO, while 34.9% answered “Yes”. So 95.9% of the sample population trust in the new application to help protect the environment.

Finally, it is noted in the statistical data, that 65.1% of the sample, that is, from the interviewees, checked the option “Excellent”, when asked, “Which rating would you assign to recommend this application?”, While 24.4% rated as “Very Good”.

Therefore, in this context, society believes that the Preserve.TO application meets the central goal of the research, which is how to generate useful information for someone and how to make someone else apply them.

Therefore, while it was understood that the Preserve.TO tool alone will not solve the environmental issue, it is nonetheless an important tool, which will assist environmental agencies in protecting the environment, informing environmental control actions, in order to investigate environmental infractions, increasing effectiveness in the protection of environmental resources by the public administration and society, punishing those responsible, as well as demanding compensation for environmental damage caused.

As a future study, this technological project can be used throughout the State of Tocantins, being extended to other states of the Brazilian federation, to assist in combating degradation to the environment. To that end, it will be available at the Federal Institute of Education, Science and Technology of Tocantins, Palmas campus, so that it can be continued and improved by interested parties or bodies responsible for fighting environmental crimes.

Currently the application contains a version for Android operating system, hosted in the Google Play Store. Therefore, to extend its use, other versions, for other platforms, can be developed. The popularization of this tool may also be carried out by means of communication in the media. According to the Federal Brazilian Law nº. 12.527/2011, which provides for the disclosure and publicity of actions of the independent public administration of requests, as improvements in the project, the implementation of functionalities is proposed, through which it is possible to follow-up the complaints made, so that the interested parties can accompany them, visualizing the progress made by the public administration, including the sanctions applied, whether the damage caused by the environmental crime has been repaired and other useful information [6].

References

[1] Brazil, “Federal Law No. 9.605, February 12, 1998” in Official Diary of the Federative Republic of Brazil, Brasília-DF, 17 February 1998. [Online]. Available from: http://www.planalto.gov.br/CCivil_03/leis/L9605.htm [retrieved: May, 2018]

[2] Ibama - Brazilian Institute of the Environment and Renewable Natural Resources, “How to Denounce Crimes and Aggressions to the Environment”. December 2017. [Online]. Available from: http://www.brasil.gov.br/editoria/meio-

ambiente/2014/08/saiba-como-denunciar-crimes-e-agressoes-ao-meio-ambiente [retrieved: June, 2018]

[3] R. Mishori et al, “mJustice: Preliminary Development of a Mobile App for Medical-Forensic Documentation of Sexual Violence in Low-Resource Environments and Conflict Zones”. Global Health: Science and Practice, March 2017. pp. 138–150, [Online]. Available from: http://www.ghspjournal.org/content/5/1/138 [retrieved: April, 2018]

[4] D. G. Silva and L. A. Rech, “Collaborative System for Identifying and Denouncing Environmental Crimes”. “RIUNI: Institutional Repository”, Unisul University, 2015. [Online]. Available from: https://riuni.unisul.br/handle/12345/3255 [retrieved: April, 2018]

[5] L. C. Cruz and G. A. Atahyde, “‘Brigade On Line’ Applicative: The Use of Technology to Contribute to the Combat of Forest Fires”. “VIII Brazilian Congress of Environmental Management”, IBEAS - Brazilian Institute of Environmental Studies, November 2017. pp. 1–5, [Online]. Available from: http://www.ibeas.org.br/congresso/Trabalhos2017/VI-028.pdf [retrieved: April, 2018]

[6] Brazil, “Federal Law No. 12.527, November 18, 2011” in Official Diary of the Federative Republic of Brazil, Brasília-DF, 18 November 2011. [Online]. Available from: http://www.planalto.gov.br/ccivil_03/_ato2011-2014/2011/lei/l12527.htm [retrieved: May, 2018]

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