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WEB-BASED COMMUNICATION SYSTEMS: INNOVATE SOLUTIONS TO COMPLEX DEVELOPMENT CHALLENGES

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ABSTRACT

This research work focus on the potential value of Information and Communication Technologies (ICTs) to enhance communication and education on Radiological Protection throughout Brazil. ICTs present unprecedented opportunities to innovate solutions to complex development issues, in this large country where it is a strong challenge to ensure access to information to as many people as possible, minimizing costs and optimizing results. Therefore, taking advantage of the impact of ICTs in modern Information Society and its institutions, some research works include education for workers, researchers and the public, offering conditions for learning and improving professional and personal skills. UNIPRORAD is a research work of informatization of radiological protection programs to offer unified programs and inter-related information in Portuguese. The system provides Brazilian facilities and researchers a complete repository for research, consultation and information. The content includes the best practices for optimization and monitoring programs, taking into account that in order to establish a Radiation Protection Plan or a Radiation Emergency Plan, there must be observed all procedures based on national and international recommendations published by different organizations over the past decades: International Commission on Radiological Protection (ICRP), International Atomic Energy Agency (IAEA) and National Nuclear Energy Commission (CNEN). Other than the efforts to disseminate information to radioactive facilities and researches, it is equally essential to invest in education and communication to increase public knowledge and understanding of the benefits of Nuclear Technology, such as food irradiation and social responsibility for electric power generation, for public acceptance of Nuclear Technology depends on public understanding of radiation and its effects on individuals, workers and environment. This research work aims to present several important initiatives which take advantage of ICTs contributions to disseminate information throughout Brazil, contributing to deliver information where it is needed and stimulating development to all aspects of the Brazilian society.

1. INTRODUCTION

Information and Communication Technology (ICT) is growing in Brazil and worldwide. Making use of the Internet, as well as wireless networks, cell phones and other digital media, ICT provides a vast array of new communication capabilities, spreading information from anywhere in the world to geographically distant regions at low costs and high quality communication. Moreover, considering nuclear technlogy field, ICT presents unprecedented opportunities to innovate solutions, for it enables researchers to produce, adapt and apply huge amount of specific knowledge, improving the quality of communication and contributing to aproach regulatory organisms, workers, researchers, universities and society itself. Therefore, this research work aims to present several important initiatives which take advantage of ICTs contributions to disseminate information throughout Brazil, contributing to

deliver information where it is needed and stimulating development to all aspects of the Brazilian society. A huge opportunity to offer conditions for learning and improving professional and personal skills in this large country where it is a strong challenge to ensure access to information to as many people as possible, minimizing costs and optimizing results. Each one of the following projects was developed regarding the possibilities of ICT access taking into account the targuet public needs throughout the country. The different research works presented in this paper include education for workers, information for researchers and public communication.

The first research work refers to the informatization of the monitoring policy and techniques, providing Brazilian radioactive facilities a complete repository for research, consultation and information in a quick, integrated and efficient way. In order to meet national and international standards, the development of this project includes concepts, definitions and theory about monitoring procedures in order to interrelate information, currently scattered in several publications and documents, in a consistent and appropriate manner. The WEB platform tools and functionalities were developed according to target public needs, regarding new possibilities of media, like mobile access, feeds of content and information sharing. Moreover, taking into account this is a pioneer project with the prospect of long-term use, our challenge takes into account the development of a robust, effective, and flexible system, which can be easily adapted to future demands, this pioneer Project involves the combination of multiple computer technologies. That is a long term use Project that shell help greatly both radioactive facilities and researchers in Portuguese spoken countries.

The second research work focus on nuclear energy for electricity generation in Brazil, regarding sustainable development. There were considered for this project the concepts of sustainable development and social responsibility, principles, themes and issues related to organizational governance; human rights; practices at work; the environment; fair operating practices; the consumer and community development and involvement. This web-based research was conceived in order to approach the dialogue among the organization, its interested parties and society, focusing on public opinion and nuclear energy for electricity generation in Brazil. The results, obtained through modeling techniques by partial least square structural equations modeling (PLS-SEM), brought significant data and lead to new possibilities of research.

The third and fourth research systems are related to public education and communication. These two web-based projects were developed using modern educational concepts and count on last generation internet resources which not only replace instructor absence, but also enable the public to see and review the content with great quantitative and qualitative achievement. Thus, the trird research work cover topics related to irradiated food. Due to lack of knowledge and understanding about the difference between food irradiation and radioactive food, people fear the harmful effects of ionizing radiation to the consumers' health, workers security and environement issues. The fourth Brazilian Project presented in this paper refers to an educational project to increase public acceptance of nuclear technology. For this purpose, there were criated a great amount of web-based short courses for information transfer and communication, in order to and aproach new generations to scientific information. The web courses introduce the beneficial applications of nuclear technology in several áreas, such as medicine, art and electric power generation, and discusses different concepts related to safety and security. Information and communication are crucial to public acceptance and understanding of nuclear technology, for there is still great misunderstanding about the risks involving the harmful effects of ionizing radiations.

2. METHODOLOGY

2.1. Web based concept project for information and communication of ionizing radiation monitoring policy and techniques

In order to establish a Radiation Protection Plan or a Radiation Emergency Plan, Brazilian facilities should take into account all procedures based on national and international guidelines and recommendations. This information can be found in several documents published by different organizations over the past decades: the International Commission on Radiological Protection (ICRP), International Atomic Energy Agency (IAEA) and Comissão Nacional de Energia Nuclear (CNEN). Therefore, this project aims the informatization of the radiological protection programs in a single system in order to offer unified programs and inter-related information in Portuguese, providing Brazilian facilities a complete repository for research, consultation and information, combining computer technology and radiological protection in order to enhance the best benefits from information technology. This research work includes programs about: (i) Monitoring of Workplace (Monitoring for External Radiation, Monitoring for Surface Contamination, Monitoring for Air Contamination) and (ii) Individual Monitoring (Monitoring of External Exposure and Monitoring of Internal Exposure, Monitoring for Skin and Clothing). WEB platform tools and functionalities were developed according to target public needs, regarding new possibilities of media, mobile access, and information sharing. The servers processing power added to the technology of relational databases allow to integrate information from different sources, enabling complex queries with reduced response time. Moreover, taking into account this is a pioneer project with the prospect of long-term use, the challenge involves the combination of multiple computer technologies that allows a robust, effective and flexible system, which can be easily adapted to future technological innovations.

In Brazil facilities involving ionizing radiation are divided into nuclear and radioactive facilities. Nuclear installations cover the entire nuclear fuel cycle, which comprises nuclear materials mining, including power reactors and research, the production of radioisotopes for use in several human activities and also the reprocessing of fuel elements of nuclear reactors. Moreover, the radioactive facilities are those that make use of ionizing radiation in other peaceful applications of nuclear energy like in the industry, medicine, agriculture, environmental protection, among others. This division is due to the fact that the entire nuclear fuel cycle, including reactors, are government monopoly, while all other human activities involving ionizing radiation can be developed and used by the public under government supervision.

For operational control of exposures to ionizing radiation in any workplace, the ICRP recommends performing an initial radiological evaluation of all aspects of the operation identifying usual and potential predictable exposure in order to make realistic estimates of doses and to determine the radiological protection measures necessary to satisfy the principle of optimization. The organization also recommends establishing a program of operational radiation protection, proportional to the risk, to ensure the effective management of all necessary measures to satisfy the principle of optimization. A monitoring program for the purposes of radiological protection should demonstrate an adequate protection degree and prove that working conditions remain appropriate as time goes by.

Therefore, there were created computerized models that comprise several aspects of the monitoring policy and techniques in a consistent and appropriate manner, in order to interrelate information, currently scattered in various publications and documents [01]. The content includes concepts, definitions and theory about monitoring procedures, such as predominant factors to be considered in monitoring activities, justifications, benefits, optimization and dose limits. Moreover, developed in a modular structure, the system allows to integrate interrelated elements concerning Workplace Monitoring and Individual Monitoring [02 – 03].

In order to introduce the basic concepts of monitoring, the system presents the criteria used for control of occupational exposures, discussing normal and potential exposures, authority and responsibility, classification of work areas, practical implications and engineering controls, operational procedures, reference levels, types of monitoring and its functions. The system provides detailed information about workplace monitoring and individual monitoring, discussing objectives, routine monitoring and task-related monitoring in each case. Workplace monitoring for air contamination, for example, cover the following topics: conventional and more convenient structure, reference level for air contamination, routine monitoring, task-related monitoring and interpretation of results. Also, it was created exclusively for this purpose, an interactive virtual component presenting hypothetical problem-based situations related to incorporation of radioactive materials by workers. Besides workplace monitoring for air contamination, there are detailed information about workplace monitoring for external radiation, workplace monitoring for surface contamination, individual monitoring for external exposure, individual monitoring for internal exposure and individual monitoring for skin and clothing contamination.

The content of monitoring programs involves not only the collection and interrelationship of existing information in the publications, but also the discussions of new approaches from some recommendations, which are not developed, making it difficult to discuss information in a complete and clear way, even from the original publications [04 - 05].

In this sense, one of the subjects to be researched and expanded is about potential exposures. Even though ICRP publication 64 [04] recommend that the potential exposure should be treated together with normal exposure, in publication 76 [05] The ICRP assumes that in most situations this is not possible, since normal occupational exposure is based on dose limits, while in potential exposure there should be considered the highest doses of the scenario. According to ICRP Publication 76, in its section 62:

> *"The methods for optimization of radiation protection range from simple common sense to complex quantitative techniques (see Publications 37 and 55; ICRP 1983, 1989). Optimization of protection against potential exposure is still largely unresolved, particularly when probabilities are low and consequences are big (NEA / OECD, 1995). Although the present report conceptually equates risks from normal and potential exposures, simultaneous, formal optimization of protection against both types of exposure would be difficult. However, the use of devices for protection against potential exposures, as outlined here, already includes an element of optimization. Also, the reference risk used in this report corresponds to the risk associated with the highest occupational doses in an optimized operation, rather than to the risk associated with a dose at the occupational dose limit. Still, optimal protection against potential exposures is not necessary achieved at the same level of risk as optimal protection against normal exposures. This is because the costs of reducing risks from normal exposures may be quite different."*

Although this publication recognizes that these two issues should be treated separately, it does not provide specific recommendations. This research work promotes the discussion of this subject, developing the content and introducing potential exposures in more quantitative way than national and international recommendations and providing the notion of different scenarios involving this type of exposure.

Another issue discussed beyond publications content chosen to be researched and expanded is the auditing monitoring function. According to international recommendations, monitoring includes both tasks: measuring doses and results interpretation [03, 06 - 07]. The routine function evaluates and estimates individual doses. This task is performed by the radiation protection service, from a model that describes quantitatively the relationship between the measured doses and those to be evaluated or estimated. As this is the main function of the radiation protection service, auditing function, not rarely, becomes secondary and not emphasized as it should. Even though, neighter international nor national standards publications separate clearly the functions to evaluate and estimate from the audit function. For this reason, in a specific área for new aproches and discussions, the system brings the importance of separating routine function between: routine function (to mesure and estimate) and audit function.

Overall, the challenge of this information system is not only scatter, inter-relate and organize information from regulatory organisms. This Project aims equally to provide new aproaches based on experience instigating further questions related to workplace, its practices and possibilities. This research work is an initial core that should be extended to other fields of radiological protection, according to the positive Tree, published by IAEA [08] in 1990, which is the more generic and complete tree for an appropriate program of radiation protection. This pioneer project shell help greatly both radioactive facilities and researchers.

2.2. Web-based system regarding social responsability: electric power generation and public involvement

This research work [09] focus on nuclear energy for electricity generation in Brazil, regarding sustainable development, according to the NBR ISO 26000 norm: Guidance on Social Responsibility. According to the NBR ISO 26000 [10], sustainable development is the one that reach present needs within the ecological limits of the planet, without compromising the ability of future generations to meet their own needs. NBR ISO 26000 proposes as a starting point, that the organizations know the extent of their social responsibility, considering the economic, social and environmental impacts, direct or indirect, of their activities. Regarding these issues, according to NBR ISO 26000, Social Responsability (SR) is:

a. Responsibility of an organization for the impacts of its decisions and activities,
    - Including products, services and processes
    - In society and the environment

b. Through a transparent and ethical behavior that contributes to the sustainable development and the health and well-being of society;
   - Considering the expectations of the Interested parties;
   - In accordance with applicable law
   - And consistent with international norms of behavior

c. Integrated throughout the organization and its relations
   - Including the value chain and sphere of influence

Sustainable development expresses the broader expectations of society. This definition was inspired by the Brundtland Report [11], which deals with “Our Common Future”, and speaks of a development capable of "meeting the needs of the present generation without affecting the ability of future generations to meet theirs." The paradigm of social responsibility attaches to each organization the costs of the inputs used in their production process and the impacts generated on their chain values and sphere of influence, spanning the product life cycle, from raw material to final waste disposal. This means that the cost of negative externalities must be absorbed by the generating organization itself. The involvement of the organization with all interested parties in its activities is the most important element of social responsibility. These parties - suppliers, business partners, distributors and customers, for example - should be identified so that communication channels can be established that allow communication amongst these parties, transparently, with respect to diversity and freedom of expression.

In order to implement social responsibility of nuclear eletric power generation in Brazil, there was lead an analyzis regarding how the main features of the organization relate to social responsibility (items such as area, size, location, value chain, interested parties and impacts in general). Therefore, the first steps for this project involved:

- Identify the aspects of each of the central themes that are more important to the organization with regard to social responsibility;
- Prioritize them based on the goals and needs of the organization, as well as regarding the impacts that it generates and the interests of its Interested parties, which should also participate in the entire process;
- Evaluate the sphere of influence of the organization, and the means to use it to spread social responsibility; and,
- Always proceed diligently (Due Diligence).

The next steps include SR integration into the organization management, decisions and activities (organizational governance). Integration of social responsibility should be done through: engagement with the interested parties (context, conditions, resources and interests); focus on the issues and impacts; greater relevance for sustainable development; seek help from governmental and other organizations; act collectively with peer and industrial organizations. This is an ongoing process of practice and improvement, to maximize the contribution of the organization for sustainable development. It is essential that during this process the organization considers its inclusion in the society and environment, and also the various groups and individuals whose interests may be affected by their activities and decisions.

The incorporation of the concepts of social responsibility to the management and daily routine is the most important behavior of the social responsibility of the organization. This

involves practices such as: making social responsibility an integral part of the organization's policies, culture, strategy and operations; develop internal competencies for social responsibility; promoting internal and external communication on social responsibility; evaluate actions and practices related to social responsibility; search the commitment of employees, senior management, shareholders and other internal audiences. Education and lifelong learning are key in raising awareness and developing skills for social responsibility. Overall, the aspects involved in SR project must regard: society and the environment, organization, interested parties, social responsibility, plan of action, integration, communication, engagement, improvement, review, recognition of social responsibility (central themes, issues and expectations) and ccontribution to sustainable development. Also, there must be observed some ways to determine the direction of the organization towards social responsibility, such as: including references regarding the way in which social responsibility influences its activities in the organization's vision statement; focusing specific and clear references on important aspects of SR; adopting codes of conduct or ethics in writing specifying the organization's commitment to social responsibility; and including SR as a key element in the organization's strategy. Futhermore, it is crucial to consider the entire organization, and include the interested parties in all the steps of the process. The involvement of the organization with the people and communities that have identifiable interests in its activities is an inseparable element of SR. Therefore, it is important to identify the interested parties, establishing relationships to assess who is subject to the impacts of the activities and decisions of the organization and, finally, consider these interests when making decisions. As there are usually a large number of interested parties, it is necessary to establish comprehensive dialogue channels that allow dual, transparent, communication with respect for diversity and freedom of expression in order to achieve an engagement of the interested parties. It is necessary to set priorities, and this should be done according to the importance of the impact and of the interests involved.

Thus, the development of this project consedered the concepts of sustainable development and social responsibility, principles, themes and issues related to organizational governance; human rights; practices at work; the environment; fair operating practices; the consumer and community development and involvement. The importance of these issues were determinated by applying a questionnaire on the Internet. Its results were evaluated using modeling techniques by partial least square structural equations modeling (PLS-SEM) [12]. The content to be discussed includes the outlook for energy in the world and in Brazil, the role of nuclear energy in a low carbon energy future and nuclear energy as a sustainable source. The intention of this web-based system was to approach the dialogue between the organization, interested parties and society, focusing on public opinión and acceptance of nuclear energy for electric power generation in Brazil. It is a must nowadays to reduce difficulties of communication of the advantages and benefits of nuclear energy to society and to the interested parties, breaking barriers and prejudices. This study made special attention to the differences between the desired, reported and perceived social responsibility. The developed methodology can be used in a qualified dialogue with the interested parties and with society, since it identifies important issues, communicates evidence of service and allows for demonstrations of the sustainability of nuclear energy. The results bring paths and possibilities to evaluate and facilitate the acceptance of nuclear energy, mainly: supporting the formulation of public policies, the improvement of education and educational issues and the definition of public awareness campaigns.

2.3. Web-based system for public communication of food irradiation issues: concepts, security and possibilities

Food irradiation is a process that contributes to reduce pathogenic microorganisms and parasites that cause diseases to human health. Besides the health benefits to the consumer, food irradiation could also bring tangible benefits to the national economy: food irradiation helps to delay sprouting and ripening of fresh fruits and vegetables, extending their shelf-life, avoiding losses and waste. However, beyond these benefits there must be considered some intangible aspects: due to lack of knowledge and understanding about the difference between food irradiation and radioactive food, people fear the harmful effects of ionizing radiation to the consumers' health and environment security issues.

Indeed, a study conducted in Brazil in 2008 [13] clearly demonstrates that misinformation and preconceived ideas impact heavily on the acceptance of irradiated food. This experiment to measure the level of public acceptance considering four different groups:

- Group 1. Received information and tasted foods identified as irradiated.
- Group 2. Received information and tasted food without knowing whether or not they were irradiated.
- Group 3. Received no information and tasted foods identified as irradiated.
- Group 4. Received no information and tasted food without knowing whether or not they were irradiated.

The third group showed markedly unfavorable results, demonstrating the negative impact of misinformation and prejudice.

Another survey entitled "Brazilian Consumer Views on Food Irradiation" was conducted in 2009. The information given to participants about the benefits of irradiated food impacted positively, however participants generally still proved to be fearful about the risks and possible side effects. The research provided important data about factors which affect acceptance and purchase intention by the Brazilian consumer. In the published conclusions, the authors emphasize the importance of developing an educational program for Brazilian population, explaining the principles, purposes and benefits of food irradiation [14].

Therefore, this Project aims to take advantage of the potential value of ICTs to enhance communication and education on food irradiation throughout the country. Still in its initial core, the challenge involves a system to provide high quality information to public and researchers. Considering ICT access throughout Brazil, the platform features count on web-based short courses and a collection of scientific productions that can be easily accessed from any conventional internet point, with good performance even to not high speed conexions.

The content includes concepts, definitions and Frequently Asked Questions (FAQ) about processes, security, advantages, limitations and possibilities of food irradiation, including health issues, as well as security involved in food irradiation process and impacts on the environment. The web courses count on last generation multimedia resources which not only replace instructor absence, but also enable the public to see and review the content with great quantitative and qualitative achievement. For the moment there were created two web courses in order to explain the general content to a public with any previous knowledge. From now on researchers intend to produce specific content focusing other issues of general interest, such as processes and techniques, safety, nutrition and health issues.

Moreover, this research project intends to built in a near future a restricted area for researches, which will permit the system to collect important reference data about public profile, responding questions such as: who are these researchers, where are they located, how frequently do they visit the website and what kind of material are they interested in.

2.4. Education and communication to increase public understanding of nuclear technology peaceful uses

This web-based educational Project aims the dissemination of nuclear technology contents for teachers and students of the Elementary and Secondary Education in schools throughout Brazil [15]. Therefore, there was conducted a comprehensive job regarding the possibilities of access to the Information and Communication Technology (ICT) throughout the country. This research work has enabled the collection of quantitative and qualitative data about our target public profile. That allowed the best interfaces tools and resources for this Project. Internet access has increased strongly all over the country. According to a publication held by the Brazilian Internet Steering Committee [16 - 17] who conducted a survey in all Brazilian States, there was an important advance in the use of ICT in Brazilian intitutions. The ICT Education 2011 survey [18] comprehended interviews with 1.822 teachers, 606 directors of studies, 640 principals and 6 364 students were interviewed between October and December, 2011. This survey [18] shows a comprehensive picture of ICT infrastructure in public and private schools, considering the relationship between the number of students per school and the number of computers in working condition. There are on average 20 operational computers in state or municipal institutions and approximately 500 students per school facility, according to the 2011 School Census. Even though 93% of Brazilian public schools companies claim to have access to Internet, 32% have connection speeds between 1 and 2 Mbps for the whole facility and a further 25% have speeds below that. Wireless connections are available in only 45% of the institutions. Among private schools, there is a higher incidence of computer and Internet, which increases use of ICT with students. Private institutions have on average 29 working computers, nine more than in public institutions, and count on fewer classes per grade and 4 to 5 fewer students per class.

Regarding student access to the internet, this publication report several sample profiles. Age group results show that 40% of the interviewed students are up to 13 years old and that 14 to 15 year-old students represent 29% of the sample profile. When each region is studied separately, access to internet are led by Northeast and Southeast regions with a percentage of 34%, and 33% respectively, while South region represents 16%.The Center-West and North regions have the lowest average rate and together represent 17% of students access in Brazil. Among the predominantly activities involving the use of computers and the internet for school assignments in public schools, research activities stand in first place, with 82% of the total number of students in public schools. Overall, there is a higher incidence of computer and Internet use by teachers and students in private schools: “as well as in public teaching institutions, students in the private system also use ICT in their school assignments, particularly for school research (96%).

Given these data, there was created the system intelligence and the development of educational technology models of nuclear technology content. The pilot project was implemented in a web environment, using the Web 2.0 tools and resources that allow the entire organizational structure. We developed a platform whose range of features and functionality suits the needs of the academic public. The challenge involved the ability to

create an effective, but at the same time flexible system, which please both children and youth. The project provides different possibilities for activities according to the various contents, such as curiosities, interactive exercises and short courses. Web based short courses, cover topics related to nuclear technology and its beneficial applications in several areas, such as medicine, agriculture, industry and electric power generation. Furthermore, experience shows that this last item is particularly important, for there is still great misunderstanding about the risks involving ionizing radiations and people fear what they can not understand. Regarding this issue, different areas of this educational site bring different concepts related to safety and security, presenting some actions related to health and safety of the public, the workers and the environment. Thus, the website offers basic content on radiological protection, such as important concepts and applications, as well as unities and mesurements. In addition, there are presented different quantities for measuring radioactivity exposure, such as absorbed dose, effective dose and equivalent dose, as well as some units like Gray and Sievert. Moreover, this educational project provides pedagogical support for teachers, offering supplementary teaching support references material to develop in class. The content bank is designed to clarify and enhance teacher understanding of core in Nuclear Technology issues, providing material resources for free download, such as Power Point presentations and ludic activities.

3. DISCUSSION AND CONCLUSIONS

In modern Information Society and its institutions, ICT brings unprecedented opportunities to enhance communication and education on Nuclear Technology and Radiological Protection throughout Brazil. Even though, beyond information transfer, technology is also about results and statistics, as it permits a great amount of relevant data for further works.

The web based concept project for information and communication of ionizing radiation monitoring policy and techniques [01], design for education and information for workers and researchers was followed by Google Analythics, since its begining in 2012 [19] to investigate the usage profile. The monitoring reports, brings general information such as: number visitors, number of users, number of first visitors and returning visitors, number of secctions, number of visited pages and views, among others. Still, Google Analythics reports brings information about users operational systems profiles, services providers and screen resolutions, providing fundamental information for strategical planning of the evolution of this Project, as the WEB platform tools and functionalities must be developed according to our target public needs, regarding new possibilities of media, like mobile access, feeds of content and information sharing. Moreover, taking into account this is a pioneer project with the prospect of long-term use, the challenge involves the combination of multiple computer technologies that allows a robust, effective, and flexible system, which can be easily adapted according to future technological innovations.

The system focusing social responsability on nuclear electric power generation, designed to aproach organization, interested parties and society, brougt positive results. The purpose of this study has been achieved and can become a tool to guide and facilitate dialogue with society and with interested parties. The communication through oriented issues qualify dialogue and demonstrate the sustainability of nuclear energy for electricity power generation. The depth of research on the internet was determined to meet statistical significance requirements and deadlines for the completion of the research work, even though

it could be more representative if used for longer, or even continuously, becoming one of the channels of communication with interested parties. Despite the authors admit that this research captured the opinion of a small portion of the society who answered the questionnaire (urban and educated citizens) and does not reflect the views of other sectors (rural communities, illiterate and those who could not be reached by Internet), future works can benefit from the data and developed tools, allowing to identify the important issues for each of the interested parties, which was not possible in this project, but may be subject to future work [09].

The web-based system for public communication of food irradiation issues is still in its inicial phase. Yet, the system is designed to allow gathering quantitative and qualitative statistical data concearning (i) general public profile and (ii) professionals and researchres profiles.

The web-based educational Project [15] designed to increase public understanding of nuclear technology peaceful uses also take great advantage of Google Analythics statistic service to gather general data, such as traffic sources, pageviews, performing pages and custom visit segmentation. Yet, as it is against Google Analythics policy to track individual users, this research work count on a restricted access area for teachers, through which researchers can collect important reference data about public profile, responding questions such as: who are these teachers, how old are their students, where are they located, how frequently do they visit the website, what kind of material are they interested in and what subjects do they teach. These important data provide strategic guidelines for the development of the Project, as well as pathways and possibilities for future work.

ICT projects can bring innovate solutions to complex development issues. The pioneer research works presented on this paper contribute to disseminate high quality information throughout Brazil, stimulating development to all aspects of the Brazilian society. These research works shell help greatly radioactive facilities, researchers, private and public organizations, as well as society itself.

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