

THE POTENCIAL OF INFORMATION AND COMMUNICATION TECHNOLOGIES TO IMPROVE KNOWLEDGE THROUGHOUT BRAZIL

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ABSTRACT

This paper focus on the potential value of Information and Communication Technologies (ICT) to enhance communication on Radiological Protection throughout Brazil, offering conditions for learning and improving professional skills. This initiative shall provide information where it is needed, stimulating development 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. In order to establish a Radiation Protection Plan, Brazilian facilities should take into account all procedures based on national and international guidelines and recommendations, 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). To meet both national standards and international recommendations, this project aims the informatization of the Radiological Protection Programs according to the positive tree published by AIEA in its Safety Series No. 102, considered the most generic and complete tree for an appropriate and effective radiation protection program. The project counts on concepts, definitions and theory about optimization and monitoring procedures, interrelating information, currently scattered in various publications and documents. It is our target to complete the system including other relevant issues, such as safe transport of radioactive materials, emergency response and radioactive waste management and decommissioning, among others. 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. The use of information technology for the radiological protection programs shall help greatly the Brazilian radioactive facilities, providing a complete repository for research, consultation and information in a quick, integrated and efficient way.

RESUMEN

Este trabajo tiene como premisa el potencial de las Tecnologías de la Información y Comunicación (TIC) para la difusión del conocimiento en protección radiológica en Brasil, ofreciendo condiciones para aprendizaje y perfeccionamiento profesional, llevando la información donde es necesaria en este país de grandes extensiones territoriales, estimulando el desarrollo y asegurando información de calidad para un mayor número de personas, disminuyendo costos y maximizando resultados. Para establecer un Plan de Protección Radiológica, las instalaciones brasileñas deben considerar recomendaciones nacionales e internacionales, publicadas a lo largo de las últimas décadas por diversos organismos: Comisión Internacional de Protección Radiológica, Organismo Internacional de Energía Atómica y Comisión Nacional de Energía Nuclear. Visando a satisfacer esas recomendaciones, este trabajo contempla la informatización de la protección radiológica de acuerdo con el árbol positivo publicado por el OIEA en la Safety series N° 102, el árbol más universal y completo para un programa eficaz. El proyecto incluye conceptos, definiciones y teorías sobre los programas de optimización y monitoreo inter-relacionando informaciones disponibles en diferentes publicaciones. Es nuestro objetivo completar el sistema con la inclusión de otros temas, como el transporte seguro de materiales radiactivos, respuesta a emergencias y gestión de desechos radioactivos, entre otros. El poder de procesamiento de los servidores aliados a la tecnología de los bancos de datos relacionales permite correlacionar información procedente de distintas fuentes, posibilitando consultas complejas con tiempo de respuestas reducido. El uso de las TIC para la difusión de los programas de protección radiológica debe contribuir con las instalaciones, proporcionando un repositorio completo para investigación, consulta e información de forma rápida, integrada y eficiente.

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1. INTRODUCTION

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. 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.

In order to establish a Radiological Protection Plan or a Radiological Emergency Plan, Brazilian radioactive facilities should take into account all procedures based on both national and international standards, guidelines and recommendations. This information can be found in several documents published by different organizations over the past decades, namely: the International Commission on Radiological Protection (ICRP), International Atomic Energy Agency (IAEA) and Comissão Nacional de Energia Nuclear (CNEN).

Taking advantage of the impact of Information and Communication Technologies (ICT) in modern Information Society and its institutions, this project includes the informatization radiological protection programs in a single system, according to the positive tree published by AIEA in its Safety Series No. 102 [1], considered the most generic and complete tree for an appropriate and effective radiation protection program. The potential value of ICTs shall contribute greatly to provide information where it is needed, stimulating development 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. The web-based system UNIPRORAD [2] offers unified and inter-related information in Portuguese, providing Brazilian facilities a complete repository for research, consultation and information in a quick, integrated and efficient way. In order to meet both national and international recommendations within the scope of this work, there was conducted – up to this moment – a comprehensive job of perception about each program contents as well as its real dimension, identifying and detailing the vital parts of programs. So far, the system provides answers to all reasonable questions applied to different needs, scenarios and situations related to monitoring and optimization programs.

2. METHODOLOGY

The use of information technology for the radiological protection program for human activities shall help greatly the radioactive facility that requires such use and who needs to implement the program. Taking advantage of the servers processing power added to the technology of relational databases, the web-based system UNIPRORAD [2] provides information from different sources, enabling complex queries with reduced response time. To define the best interfaces tools and resources according to our target public profile, there was conducted a research work regarding the possibilities of access to the Information and Communication Technology (ICT) in companies throughout the country, collecting quantitative and qualitative data about target public needs and possibilities.

The unification of optimization and monitoring programs implies working on a vast and complex content, identifying the most appropriate functional structure in order to develop a project that allows effective access to information and research. Therefore, this system started from optimization content [3 - 7], including concepts, definitions and theory in addition to the optimization programs, help decision making techniques, information related to protection costs, radiation doses and detriment. Moreover, the content brings interrelated information about the construction of the optimization process, its characteristics, the involvement of stakeholders, the global components to define and implement an ALARA Program, the dose distribution in time and space and collective dose matrix for decision making. In 2013 our team started the research of the monitoring policy and techniques [3, 8 - 12], with concepts, definitions and theory about monitoring procedures, integrating and interrelating elements of optimization and monitoring programs. 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 (monitoring for external radiation, monitoring for surface contamination and monitoring for air contamination) and individual monitoring (monitoring of external exposure and monitoring of internal exposure and monitoring for skin and clothing), discussing objectives, routine monitoring, task-related monitoring, special monitoring and interpretation of results for each type of monitoring program.

The radiological protection web-based system was developed using modern educational concepts and counts on last generation internet resources which enable users to see and review the content with great quantitative and qualitative achievement. Taking profit of the advantages of internet resources, and to assure a more dynamic and detailed content, besides the conventional media – texts and pictures – users may count on other learning tools such as virtual components, created exclusively for this purpose, according to their needs. In order to increase users understanding about optimization programs, there were created virtual simulators, for each one of the help decision making techniques recommended by ICRP 55 [5]. The simulators proved to be helpful, specially when there is a great amount of options and factors to be chosen, such as the decision techniques known as Multi-Attribute Utility Analysis and Multi-Criteria Analysis Outranking. Once the software is fed with appropriate data, the optimal analytical solution can be calculated in just few seconds. For monitoring content there was created an interactive virtual component presenting hypothetical problem-based situations related to workplace monitoring for air contamination and workplace monitoring for external radiation.

This Radiological Protection Program web-based system was created in 2011 and has been continually updated since then. It is our target to complete the system according to the positive tree published by AIEA in its Safety Series No. 102 [1], considered the most generic and complete tree for an appropriate and effective radiation protection program. This positive tree, published in 1990, suggests six fields of activities, to be detailed to be applied to any facility according to its characteristics and needs:

1. Effective organization and management of radiological protection, safety and ALARA principle
2. Appropriate selection and training programs on occupational radiation protection

3. Effective occupational exposure control and monitoring
4. Effective radiation protection and safety regarding public exposure
5. Effective emergency planning and preparedness
6. Appropriate quality control management procedures

Therefore, it is our objective to lead a comprehensive research work of perception about other relevant issues, such as safe transport of radioactive materials, emergency response and radioactive waste management and decommissioning, among others. The work implies to detail the vital parts of each program content, as well as identify all reasonable questions applied to different needs, scenarios and situations. Since the new international recommendations [13 - 14] should affect directly Brazilian national guidelines for radioactive facilities, the use of ICT for communication of radiological protection programs will allow the most updated information regarding radiological protection national and international recommendations.

3. DISCUSSION AND RESULTS

Google Analytics was used to the investigation of the website usage profile, collecting monthly reference data about visitors' profile. The two last reports, shown in Fig. 1 and Fig. 2, bring important data regarding audience behavior. According to Analytics monitoring reports, between 05/06/15 and 04/07/15, the website UNIPRORAD counted on 357 visits and 4.288 pageviews from 197 single users, among which 52.1% were returning visitors. Results were similar to the following month, between 05/07/15 and 04/08/15, when the website received 340 visits and 4.578 pageviews from 163 single users, among which 59.4% were returning visitors. This represents a significant quantitative increase when comparing these data to the same period in year 2014, as seen in Fig. 3 and Fig. 4.

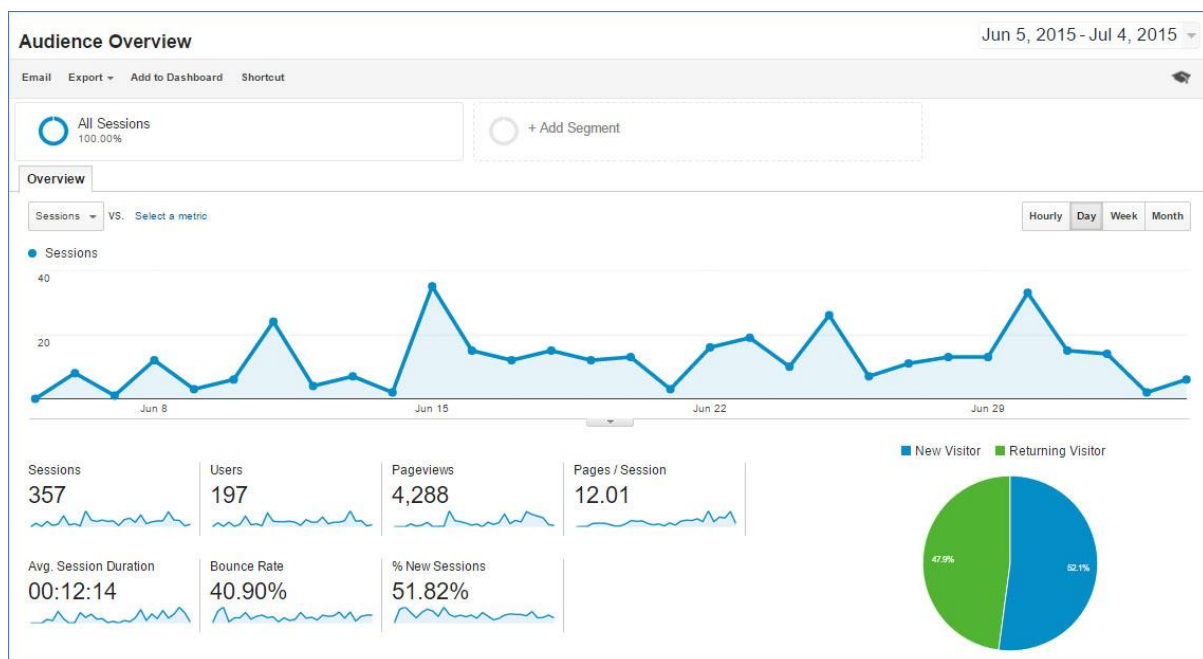


Figure 1. Audience overview from 05/06/2015 to 04/07/2015

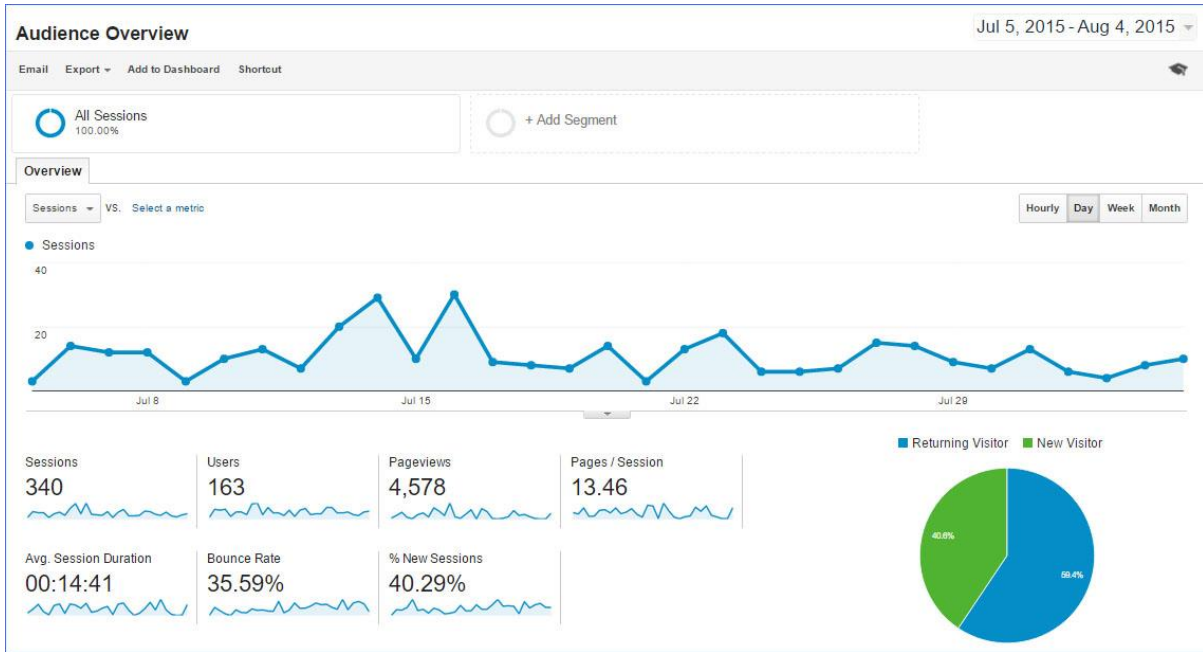


Figure 2. Audience overview from 05/07/2015 to 04/08/2015

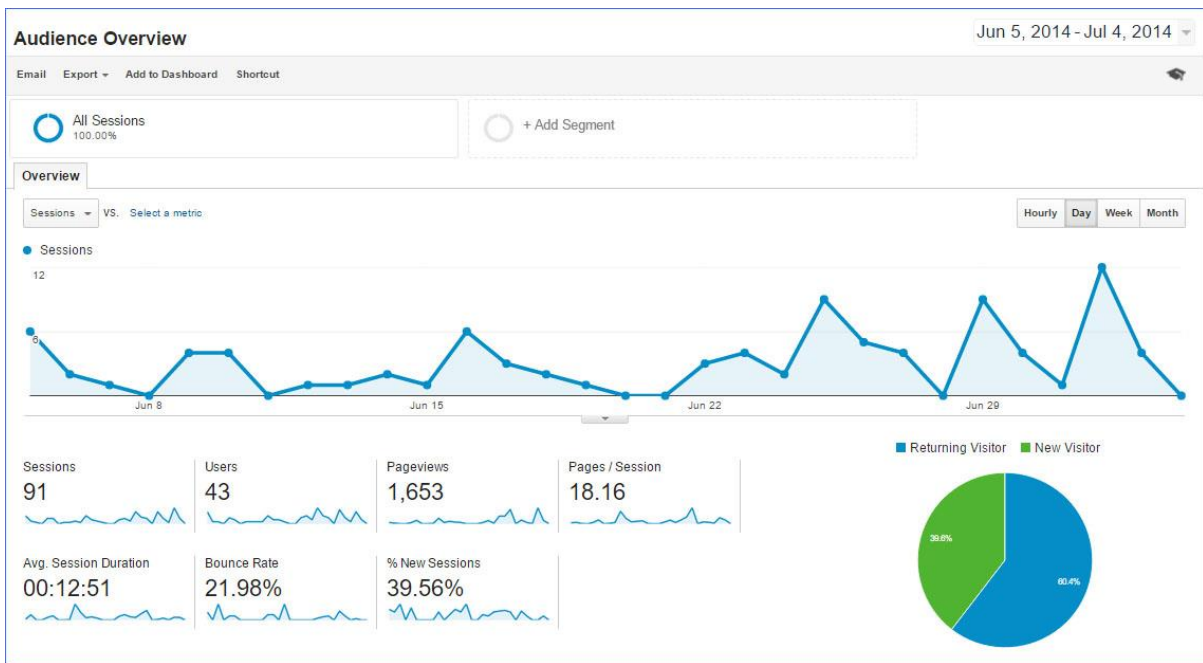


Figure 3. Audience overview from 05/06/2014 to 04/07/2014

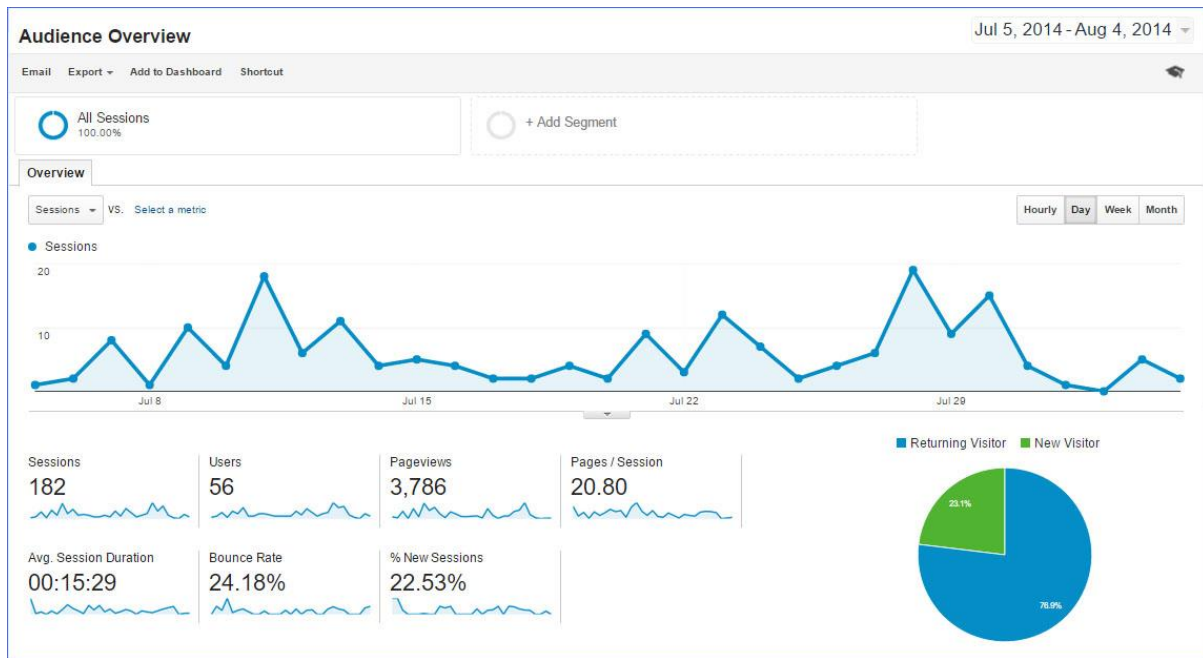


Figure 4. Audience overview from 05/07/2014 to 04/08/2014

Google Analytics reports information about users' operational systems profiles, services providers and screen resolutions, collecting fundamental information for strategic 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, mobile access, feeds of content and information sharing. Table 1 brings the resume of users' behavior, including number of sessions, number of visitors, pageviews, and operating system.

Table 1. Google Analytics reports: audience behavior

	Sessions	Visitors	Pageviews	Number of visits using Windows	Number of visits using Android
05/06/2014 to 04/07/2014	91	43	1653	90	1
05/07/2014 to 04/08/2014	182	56	3786	177	4
05/06/2015 to 04/07/2015	357	197	4288	181	71
05/07/2015 to 04/08/2015	340	163	4578	189	80

Google Analytics suggests new trends on users' behaviors, regarding mobile Internet access. 19.89% of visits in June 2015 used mobile devices to access the internet and this number is even bigger in July 2015, when Android was used in 23.53% of sessions. These data enable new perceptions of users' habits and suggest new possibilities for the development of the system.

4. CONCLUSIONS

The unification of radiological protection programs implies working on vast and complex content, identifying the most appropriate functional structure in order to develop a project that allows effective access to information and research. The computerization requires a careful research on content that refers to laws and regulations available in various publications or from different sources (ICRP, IAEA, CNEN). The task of inter-relating all that information is accomplished taking into account established criteria for the development of database relational systems and the features of the information. The relational database allows the inter-relationship of all relevant co-related information, which are not available in a linear structure or in the same publications.

For dimensioning the work of informatization and developing the WEB platform according to the needs of the target public, we have conducted an extensive research regarding the possibilities of Information and Communication Technology (TIC) access throughout the country. Still, due to constant technological innovations, our team intends to lead a constant research work and monitoring of new related technologies that may be useful for the development of this project, which uses the combination of multiple technologies, maximizing the resources available in each one of them in order to achieve our goals.

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