
**NUCLEAR KNOWLEDGE PORTAL TO SUPPORT LICENSING AND CONTROL
NUCLEAR ACTIVITIES IN THE BRAZILIAN NUCLEAR ENERGY COMMISSION**

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Abstract. The Knowledge Economy is pivotal for moving the wealth and development of traditional industrial sectors -- abundant in manual labor, raw materials and capital -- to areas whose products, processes and services are rich in technology and knowledge. Even in research areas such as nuclear energy, where goods are based on high technology, the ability to transform information into knowledge, and knowledge into decisions and actions, is extremely important. Therefore, the value of products from these areas depends more and more on the degree of innovation, technology and intelligence incorporated by them. Thus, it has become increasingly important and relevant to acquire strategic knowledge and make it available to the organization. Therefore, the objective of this article is to present the construction of a Nuclear Knowledge Portal for aiding and streamlining the Licensing and Management activities of the *CNEN*.

1. Introduction

Recently, more and more organizations have realized the importance of “knowing what they know,” to be capable of taking the maximum advantage of their knowledge “assets” and adequately storing such knowledge in a way that it can be accessed in the future. This knowledge lies at various locales within an organization, such as: knowledge bases, databases, files and, especially, in the minds of its personnel. From these locales, it can be distributed throughout the entire organization. It does not matter if we call it intellectual property, intellectual capital or knowledge base, but it is certainly one of an organization’s most valuable assets. The ability to efficiently create, manage and distribute knowledge is fundamental so that an organization may place itself in an advantageous position within its area of competition. In Brazil, the nuclear area has been undergoing problems due to aging professionals and a low replacement of researchers, arising from either a lack of motivation or a lack of governmental incentive. Considering the importance of retaining, maintaining and continuing the nuclear knowledge that has already been acquired, the Board of Radioprotection and Nuclear Safety for the Brazilian Nuclear Energy Commission has begun to construct a portal with the aim of more efficiently preserving and managing the knowledge generated by professionals in the area of Licensing and Control.

2. The Preservation of Nuclear Knowledge

Until the beginning of the 1950s, Brazilian activities in the nuclear sector were limited to studies that were essentially academic and theoretical. Thereafter, the Brazilian Government assumed control of the exportation of nuclear minerals, established strategic reserves and stockpiles, and stimulated the development of national technology in the sector. That era witnessed the creation of the National Research Council, the first attempts to formulate a National Nuclear Energy Policy, and the creation of the Brazilian Nuclear Energy Commission *CNEN*

Today, the Minister of Science and Technology is the governmental body responsible for national nuclear energy policy, and which fosters the research and development of such technology, coordinates the Brazilian Nuclear Program Protection System— *SIPRON* and supervises bodies for licensing and control, research and development, and industrial sector bodies dedicated to peaceful applications of nuclear energy within the country.

As has occurred throughout the world, the nuclear area in Brazil has been undergoing problems with aging professionals and a low interest shown by college-age students to pursue that area of study. The concern for preserving and generating new knowledge in the area has led to the creation of projects designed to sustain the research and work performed by professionals in the nuclear area so as to more effectively and efficiently utilize and share such knowledge.

According to Ref. [1], even organizations that operate in more traditional and mature business segments, but that have not yet experienced dramatic or frequent changes in their knowledge needs, are recognizing the necessity for generating knowledge. This is happening because, in spite of the fact that their knowledge base is not changing, the collaborators that will have to store such knowledge are becoming fewer in number.

Renewing the number of professionals who work in the nuclear area is a slow process and the erosion of the knowledge base of an organization occurs every time a professional in the area retires. Using knowledge management for representing what people know and for making it accessible, the organization transforms individual knowledge into a transferable asset.

3. Knowledge Management

Knowledge Management is a set of procedures established to identify, systematize and develop every type of essential knowledge for organizations to reach their objectives. Whether private or public, organizations must be productive, and the main key for determining technological innovation and increasing productivity is knowledge management. Therefore, it is not enough to simply generate new knowledge or research for its own sake, or even to simply collect information and save it. Without a capacity for innovation, such as creating new products, new processes or new services, organizations will not survive in our knowledge society. Many authors have proposed models of knowledge management, such as Ref. [2], Ref. [3] and Ref. [4], pioneers in Knowledge Management. For these authors, the value of enterprises is no longer related to their *tangible assets*, such as buildings and equipment, but to their *intangible assets*. Their models emphasize the importance of keeping intellectual capital within organizations, that is, to manage the knowledge of their collaborators

In Brazil, there are many authors who discuss this concept, and in this paper we adopt the definition from Ref. [5], where the concept "*intellectual capital*" refers to the capacity, ability or experience, as well as the formal education that collaborating members have and add to an Organization. "Intellectual capital" is an intangible asset, belonging to the individual himself; thus it might be utilized by organizations in order to create value. The development and preservation of this intellectual capital occurs through implementing discussion forums, workshops or knowledge portals, wherein the organization's collaborators share their experiences. Nevertheless, to only assimilate and develop "*intellectual capital*" does not add value to the organization: it is necessary to keep it. And one way to do so is by creating desirable and encouraging work environments, promoting the sharing of management, and offering profit-sharing programs.

In an attempt to characterize the most important means by which organizations deal with knowledge management, Ref [6] adopts a classification into three groups of approaches: (1) mechanistic, (2) cultural/behavioral and (3) systematic. For the purposes of our work, which attempts to present the development of a knowledge portal, we will rely on a mechanistic approach for dealing with knowledge management, which concentrates on applying technology and resources to make what already exists even better, and we will also rely on the definition in Ref. [8] concerning knowledge management, which states that, "Knowledge management is a set of procedures established for identifying, systematizing and developing

every type of knowledge essential for an organization to reach its objectives.” We would aver that these two means add up to and furnish a sufficiently propitious context for the work.

The principal suppositions for our treatment, which must be related to the symptoms of the problem, include: (1) focusing on the best information accessibility, supported by better access methods and means for the reutilization of documents (hypertext, databanks, etc.); (2) utilizing web technology, where INTRANETS and GROUPWARE will probably be key solutions. Overall, it is supposed that technology and the availability of large volumes of information will be sufficient for our purposes. Such means are relatively easy to implement because much of the technology and many of the techniques are familiar to many and are easy to understand.

4. Knowledge Portals

According to Ref. [7], a corporate or departmental portal is a system of information geared to the user, and which integrates and divulges individual and team knowledge and experiences, thus following institutional standards based on knowledge. Perhaps a portal’s most important function is in making available the information, both from internal and external sources, that an organization’s/department’s collaborators need most, and presenting it in a simple and practical manner. Diversity of information is also a highlighting point in the use of a portal. A corporate/departmental portal should bring the benefit to the organization of facilitating the access to information distributed throughout the systems and databases of that organization, supported by two essential concepts: Usability and Utility.

Another focus of utilizing portals is in their collaborative applications. Collaboration on-line breaks down geographical and time-related barriers that limit work among organizations, internal areas of organizations and production chain personnel. Furthermore, it allows people to work together as a group, sharing virtual work space and communicating directly in real-time, with the aim of improving interdepartmental work flow, and making it possible for geographically distant teams to work together and for business partners to exchange information, etc.

The importance of corporate/departmental portals is in their assuming an ever-greater role as the “organizational/departmental circulatory system” and integrator of information. The portal environment is transported to the desktop of collaborators, a window that groups all the information necessary for carrying out work and a means of directly accessing information of other environments internal and/or external to the organization.

The issue of self-service information is something that is also facilitated by portal applications. The existence of a portal enables the collaborators themselves to take care of their needs more efficiently without impeding the flow of work from others. However, as with supermarkets, a good buy depends on the speed at which one can find the sought-after product, the positioning of the shelves and all the other purchasing support activities. In the same way, self-service within a department depends on a well-structured portal, ease of navigation and support offered.

5. The Knowledge Portal for Licensing and Control Area

5.1 Organization profile

The Brazilian Nuclear Energy Commission (*CNEN*) is a federal autarchy created on October 10, 1956 as a higher nuclear planning, guiding, supervising and inspecting agency, and also as the body authorized to establish radiological protection standards and regulations, to issue licenses (to grant permission) and to survey and control nuclear activities in Brazil. *CNEN* also develops research related to the use of nuclear technology for the benefit of society.

Its mission is “To guarantee the safe and peaceful use of nuclear energy, and to develop and make available nuclear and related technologies for the well-being of the population,” which means being concerned with the safety and development of the sector and orienting its workings to the expectations of society, the beneficiary of its services and products. The organization has three directorial boards: The Board of Research and Development, which coordinates nuclear research and applications, the Board of Institutional Management, which deals with the administration of the organization, and the Board of Radioprotection and Nuclear Safety, which mainly handles the licensing of nuclear and radioactive installations and oversees nuclear-related activities.

The people who work on the Board of Radioprotection and Nuclear Safety recognize the importance of managing and sharing accumulated nuclear knowledge as part of their job in order to maintain “nuclear safety” and to hand this knowledge over to the youngest collaborators. Therefore, the Reactor Taskforce was chosen for starting the Nuclear Knowledge Portal, whose main goal is to support the Board in its nuclear licensing and control activities.

The development and construction of the portal is being performed conjointly by two taskforces within the *CNEN*: the Reactor Taskforce and the Center for Nuclear Information. The latter has the function of supporting *CNEN* researchers and the general public with scientific technical information through its various information services. The collaborative work between the two taskforces is also part of a *CNEN* strategy to deepen the relationship and disseminate the organization’s internal knowledge.

From interviews made with select people in the Reactor Taskforce, necessary knowledge was identified and mapped in order to enable the creation of a Reactor Taskforce knowledge tree, which will be available at the Portal. The portal will be a repository of documents and information needed to support the main tasks developed in this area, such as engineering analysis, operational data, maintenance records, regulatory reviews and safety analysis report evaluations, thereby improving work, reducing search time and making the collaborative work easier.

5.2 Objectives

This portal is one of *CNEN*’s initiatives in the area of Knowledge Management and has the following objectives:

- To be a communication tool, which integrates the professionals in the areas involved in the licensing processes, including those assigned to the nuclear plants located in the district of Angra do Reis; to facilitate communication between departments and divulge results of studies, reports and documents;
- To make information and knowledge available to collaborators by means of receiving, organizing and distributing codified knowledge (databank access), and to improve access to external sources of information and knowledge;
- To improve the reutilization of knowledge and facilitate the search for previously developed knowledge;
- To promote and widen collaboration among the different geographical areas of the organization, thereby improving the global sharing of knowledge;
- To improve the management of Human Capital through training, and enable new collaborators to act quickly, reducing time spent on routine activities through storage and easy recovery of codified knowledge.

The knowledge repository is fed with documents (in various formats) generated by collaborators after approval by the administrators responsible for the trustworthiness of the information to be stored.

5.3 Implementation

Upon the decision of the Board of Radioprotection and Nuclear Safety, the portal has been prepared to support five taskforces involved in licensing and control (Reactor Taskforce, Radioactive Installations Taskforce, Nuclear Installations Taskforce, Rejections Division, and Raw Materials and Minerals Division) because these have been the most important in the process. These taskforces must actively work together with the *CNEN* collaborators who remain on site at the nuclear plants. These plants – Angra 1 and Angra 2 – are located in the city of Angra do Reis, 150 km from the city of Rio de Janeiro, and due to such a geographical distance and the lack of an infrastructure for long-distance collaborative work, nuclear plant activity reports were done manually, which created long delays in the licensing process and in communicating plant incidents. In such a context, information could not be adequately worked up within a reasonable time, which brought about the choice of this area for implementing the portal (Figure 1) and the first to have its needs mapped out. From such a premise two types of information were gathered: information of a general character, which the majority of the taskforces would be interested in; for example: legislation, rule-making bodies, regulatory bodies, etc.; and information of an individual nature, such as specific information of interest for each area. In Table 1 the identified information is presented, which brought about the structure of the portal, which will be available on the *CNEN* Intranet, with access restricted to collaborators because the information that will be available presents different degrees of confidentiality. The tool utilized for its development was Microsoft Front Page with ASP, Html and JavaScript programming.

Figure 1: The knowledge portal concept and the task force evolved

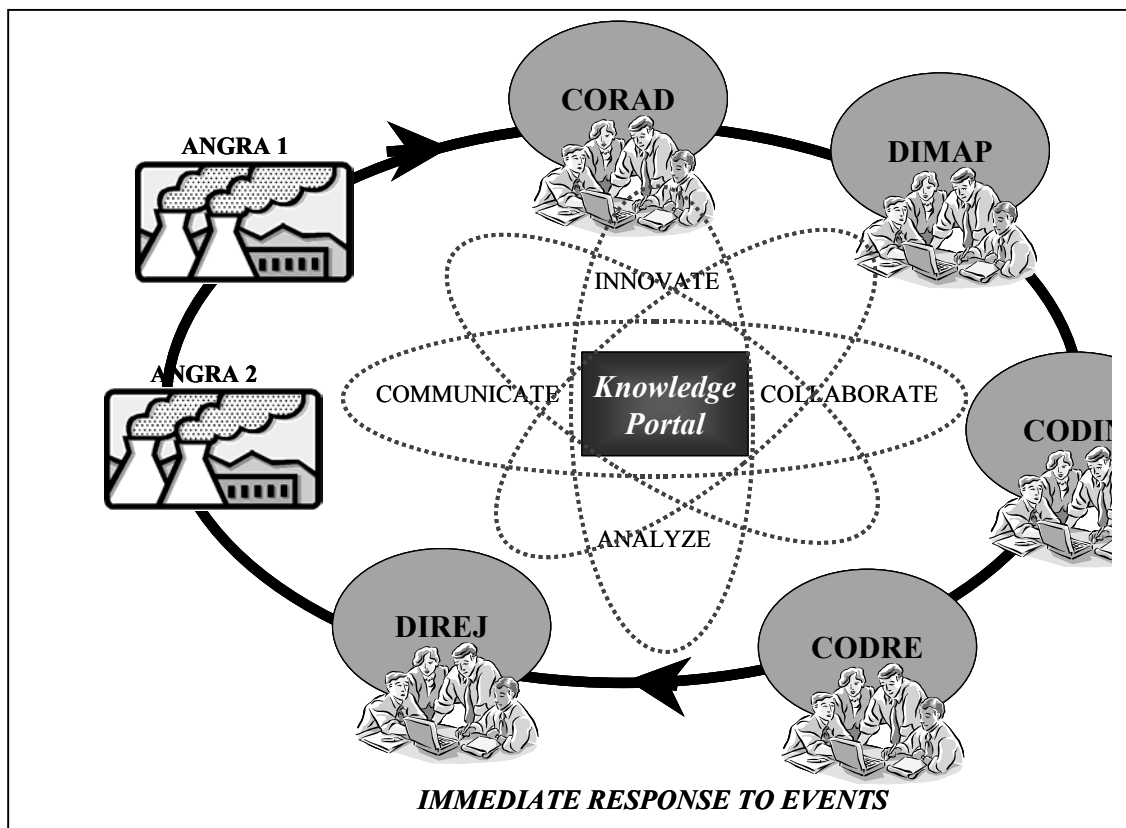


Table 1. Knowledge Tree

2.0. Licensing	
	Emergencies
	Fuel Cycle
	Installations
	Radioactive Installations
	Wastes
	Transportation
	Nuclear Power Plants
	Research Reactors
Control	
	Monopoly
	Safeguards
Legislation	
	Laws
	Decrees
	Administrative Rules
	Resolutions
	Constitution
Regulations	
	CNEN norms
	Normative Instructions
	Regulatory Bodies
	Normative Bodies
Training	
Documentation	

The Figure 2 shows one of the pop-up menu related to knowledge tree. In this screen the users can select which are the information he wants and needs to access.

Figure 2 – Initial screen with the various options

The screenshot shows the initial screen of the CNEN website. The browser address bar displays 'http://intranet.sede/cgic/inforeg/Identifica.asp'. The website header features the CNEN logo and a navigation bar with tabs: 'Página Inicial', 'Licenciamento', 'Controle', 'Legislação', 'Regulamentação', 'Treinamento', 'Documentação', 'Admin.', and 'Sair'. A pop-up menu is open over the 'Licenciamento' tab, listing options: 'Emergências', 'Instalações do Ciclo', 'Instalações Radioativas', 'Rejeitos', 'Transporte', 'Usinas Nucleares', and 'Reatores de Pesquisa'. The main content area includes a welcome message for 'FABIANE DOS REIS BRAGA' and a description of the tool. The left sidebar contains a 'REFERÊNCIAS' section with links to 'ADAMS', 'Basic referen...', 'DOCKETS', 'Documents Collection', 'NRC Release', 'Nuclear Safety', 'Nuclear Engineering', and 'Nuclear News'. Below this is a 'CIN' section with 'PEDIDOS DE CÓPIAS', 'INIS', 'MINHA ESTANTE', and 'REVISTAS'. The right sidebar has an 'ACESSO RÁPIDO' section with links to 'RASO', 'CLO', and 'PORTAIS INTERNOS' including 'CNEN', 'IRD', 'IEN', 'IPEN', 'CDTN', and 'SEDE'.

The Figure 3 shows the subjects related to Nuclear Power Plants items where the users can select the information he needs to work.

Figure 3 – Screen with Nuclear Power Plant's menu



The Operational Standings and Activities Report *RASO*, which registers the daily behavior of the plants and their operational limit conditions, and which had been created manually by the personnel so assigned at the two nuclear plants, is today completely automated within the portal (Figure 4, Figure 5 and Figure 6) and its information can be worked over by engineers for creating studies.

Since the Portal is not yet finished, it is not possible to measure its use with respect to efficiency of access and effectiveness by users. We hope that when it is completed, it will serve as a strategic tool for supporting the licensing and overseeing process.

6. Lessons Learned

Throughout the conception and developmental process of the portal model, we could observe that both feedback and the posting of information were very important. The Nuclear Information Center team quickly realized that knowledge increases to the degree in which it is applied and reutilized. The automatization of the *RASO* has already brought about much satisfaction and has made the daily work of users easier, that is, those who specifically work in the area. Furthermore, we were able to notice that one of the notable points behind the strategy of the portal was the opportunity to share information and knowledge in real time among collaborators who were some distance from each other. Thus, we learned that serious initiatives for knowledge management, focused on and aligned with the organization's strategy, can profoundly change the manner in which the organization runs.

Figure 4 – Operational Standings and Activities Report – *RASO part 1*

Links >> Endereço http://intranet.sede/cglc/infoereg/raso/RasoDadosAngra1.asp?Instalacao=1&RepetirDados=sim

Repositório Eletrônico de Informações Regulatórias
 CNEN

Página Inicial | Licenciamento | Controle | Legislação | Regulamentação | Treinamento | Documentação | Admin.

RASO - ANGRA 1
Relatório de Atividades e Situação Operacional - INCLUSÃO
 Divisão de Angra - DIANG tel(0xx24) 33629588
 Coordenação de Reatores - CODRE

Nº do Raso....589/2004 Preparado por..... **FABIANE DOS REIS BRAGA**
 Data..02/08/2004 (DD/MM/AAAA) Hora..00:00 (HH:MM) APEmergência..

1 - CONDIÇÕES DA UNIDADE

a) Reator..... 90 % combustivel falhado

b) Sistema Primário...
 P_{SRR} = 157 Kg/cm², T_M = 307 °C, C_{Boro} = 1189 ppm
 Taxa de perda inventário do primário (PI 0-54) = 12 lph
 Taxa de perda inventário do secundário: TVPS GV 1 = 2 gpm

Figure 5 – Operational Standings and Activities Report – *RASO part 2*

TVPS GV 2 = 1,3 gpm

RIM 21 A = RIM 21 B = h

Intervalo entre drenagens do poço da contenção = h

c) Sistema Secundário.....
 Turbogenerador = 520 MWe

d) Sistema Elétrico.....
 Normal

e) Sistema de Monitoração de Radiação.....

f) Alarmes atuados.....

Figure 6 – Operational Standings and Activities Report – *RASO part 3*

2 - EVENTOS SIGNIFICATIVOS OCORRIDOS NO PERÍODO

Unidade em aquecimento para partida. Terminaram as inspeções de conservação preventiva, com o objetivo de retirar materiais de parada.

3 - PREVISÃO PARA AS PRÓXIMAS HORAS

Sincronizar a unidade às 14:00 h de hoje e elevar potência para 100%.

OK Cancelar

7. Future Directives and Conclusion

The real power of Knowledge Management has only begun to be seen as a strategy by organizations. Knowledge Management is surfacing as a new discipline and will take some time until we have the methods for general acceptance to objectively assess and evaluate how this discipline and its processes are contributing to the competitiveness of the organizations that utilize it. The portal project shows enormous benefits that a project of this type can bring to large organizations, and also reinforces the idea that incentives for knowledge management have a greater chance of being successful if they grow organically through careful planning and with a technical infrastructure and local support. For the future, we believe and recommend that this project be replicated in other organization areas. Whether we have been witnessing the beginning of a golden revolution, or if it is only a new flash in the pan, only time will tell.

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