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# Assessment and structuring knowledge of the organization for the strategic alignment of knowledge management: an application to the radiopharmacy center of ipen

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## ABSTRACT:

For almost 20 years, Knowledge Management projects have been predominantly focused in the methods for knowledge capitalization, sharing, preservation and creation with approaches mainly aimed to the operational needs of the organization. Nowadays, it has been observed a change of focus towards in solving problems of strategic nature. In this objective, this paper presents a methodology to organize, to classify and to assess the knowledge resources portfolio of an organization for Knowledge Management implementation, aligned to the strategy. This methodology shows an innovative integration of the following elements: (a) a representation map of organization strategy; (b) the identification of relevant knowledge through process analysis; (c) the reconfiguration of the identified knowledge in domains and its representation by maps; (d) a combination of critical analysis (importance and vulnerability) and of strategic analysis (strategic knowledge) to assess knowledge.

This methodology was applied to the Radiopharmacy Center of Nuclear and Energy Research Institute resulting in a very rich vision and understanding of the knowledge domains that are crucial to that Center. This kind of analysis has allowed a sharp perception of the knowledge problems of the Center and has also made visible the needed connections between Strategic Management and Knowledge Management.

## RESUME:

Depuis presque 20 ans, les projets de Gestion de Connaissances ont été essentiellement axés sur la capitalisation, le partage et le développement de la connaissance limités aux besoins opérationnels de l'organisation. Actuellement, une nouvelle vision se concentre sur la résolution des problèmes stratégiques. Dans cette optique, ce travail présente une méthodologie pour organiser, classer et analyser le portefeuille des « ressources connaissance » d'une organisation. Cette méthodologie propose une intégration innovante des éléments suivants: (a) une représentation graphique de la stratégie de l'organisation, en utilisant une technique cartographique; (b) l'identification du patrimoine de connaissances grâce à l'analyse des processus opérationnels; (c) la reconfiguration de la connaissance identifiée dans les domaines et la représentation sous forme de cartes; (d) une combinaison d'analyse critique (importance et vulnérabilité) et d'analyse stratégique des connaissances et une comparaison entre les deux analyses.

Cette méthodologie a été appliquée au Centre de Radiopharmacie de l'Institut de Recherches Energétiques et Nucléaires et a abouti à une vision et une compréhension très riche des connaissances qui sont cruciales pour le Centre. L'analyse a permis une perception affinée des problèmes de connaissances du Centre et a mis en lumière les rapports entre Gestion Stratégique et Gestion des Connaissances.

**KEY WORDS:** Knowledge Management, Knowledge-based Strategy, Strategic Alignment of Knowledge Management, Strategic Map, Knowledge Mapping, Knowledge Assessment, Critical Analysis, Strategic Analysis.

**MOTS CLÉS:** Gestion des connaissances, stratégie base sur les connaissances, alignement stratégique de la gestion des connaissances, carte stratégique, cartographie des connaissances, évaluation des connaissances, analyse de criticité, analyse stratégique.

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## 1. Introduction: strategic management and knowledge management - resource-based view and knowledge-based view

In the 1980's, the influence of Michael Porter (1980) was remarkable and the strategic management models tackled the strategies of organizations in terms of competitive differentiation for high aggregate value segments, and low cost through economy of scale for the mass market. Using either one of the choices (differentiation or cost) or a segmented combination of these approaches, companies defined their strategies in terms of which products to offer for which market segments. Thus, strategic planning was an activity almost completely aimed at external environment analysis. In the past years, the so called Resource-based View - RBV and Knowledge-based View – KBV approaches have built momentum as standalone approaches or combined with other strategic analysis methods. The main focus in these approaches is to value the organization's own internal resources, the tangible and intangible assets, to define their strategies and develop new products and services that are hard to copy. Since then, several authors have pointed examples and studies in which companies, with particular skills, capacities and knowledge, were able to surpass their competitors and survive situations of fierce competition because they incorporated this type of approach in their strategies.

In a Knowledge-based View model, knowledge is considered the most important strategic resource, likely to be transformed in strategic value and the organization is viewed as the means for the creation, interaction, storage and application of knowledge. The capacity and vitality to create knowledge is linked to a strategic choice aimed at the appreciation of this knowledge according to its potential to generate value.

Even considering knowledge resources, not all of them have equal strategic value. The list of knowledge resources in an organization can be lengthy, and, clearly, not all of them are equally important or potentially a sustainable source of advantages. In this sense, there is use in mapping, measuring and assessing knowledge, so the more valuable knowledge resources can be identified, and thus, managed and used. To facilitate this identification, some authors as Barney (1991), Grant (1991), Collings e Montgomery (1995), Amit e Shoemaker (1993) propose criteria that the knowledge should possess to be strategic. The table 1, organized by Ricciardi, Barroso and Ermine (2006), summarizes the requirements proposed by them.

CRITERIA	BARNEY (1991)	GRANT (1991)	COLLINGS – MONTGOMERY (1995)	AMIT – SCHOEMAKER (1993)
Value	X			
Rareness/scarcity	X			X
Inimitability	X		X	X
Substitutability	X		X	X
Durability		X	X	X
Transparency		X		
Transferability		X		
Replicability		X		
Appropriateness			X	X
Competitive superiority			X	
Complementarity				X
Low tradability				X
Overlap with strategic industry factors				X

Table 1: Criteria to identify the strategic knowledge chosen by some authors

Therefore, it is essential for organizations that this knowledge capital that is deemed strategic be managed the most efficient way for their business. Knowledge management includes managing the organization's business process knowledge, in order to promote constant improvement using their own human and structural capital, continuously increasing their organizational competence. According to Murray (1996), Knowledge Management is the strategy that converts the organization's intellectual assets, information, knowledge, and also their employees' skills, into better productivity and improved competitiveness. For Garvin (1993), a knowledge-based organization is a learning organization that acknowledges knowledge as a strategic resource and creates knowledge that can be internally processed and externally used, taking advantage of their intellectual capital, where the knowledge worker is the main component.

The challenge imposed for knowledge intensive companies is to find out how the organizational knowledge can be managed in order to meet, from a managerial point of view, their strategic needs. According to Ermine (2008), if knowledge is managed aligned with the organization's strategy, it can initiate better decisions

and actions to achieve goals. Knowledge Management must be aimed at supporting the achievement of these goals, and its processes must be planned for this end. Currently, the general opinion seems to be that it is not possible to discuss Knowledge Management without directing its use to Strategic Management; thus, it's clear that they both must go hand-in-hand. Otherwise, there's a loss of synergy and waste of knowledge. Therefore, Knowledge Management is not seen as an isolated process (or parallel), but a supporting process to business Strategic Management.

## **2. Implementing knowledge management: operational vision of knowledge (bottom-up approach) and strategic vision of knowledge (top-down approach)**

### *2.1. Investigating Knowledge Workers (Bottom-up Approach)*

The knowledge organization's manager's main task is to employ techniques to capture knowledge wherever it can be found, so that they can have at hand the necessary knowledge for the work and decisions at the moment they're needed, and also to encourage the ongoing production of new knowledge resources.

According to Davenport and Prusak (1998), new knowledge acquired by the employees, their personal experiences (in form of tacit knowledge), knowledge sharing in the work team are factors that improve the organizational processes. In general, Knowledge Management is applied to enable these factors and to facilitate the appropriate knowledge access to all the actors in important decisions and actions.

Often, an organization already has the knowledge resources it needs to be competitive. However, access to such knowledge can be difficult and slow. Similarly, many new knowledge resources must be developed according to the needs of each business, which requires agility. Both the knowledge spread throughout the organization and that which must be developed and acquired, are often not available at the moment they are needed, which compromises the development of some operational activities, and also runs the risk of not contributing for the improvement of some work processes. The use of knowledge occurs when it is incorporated to the organization's procedures, generating productivity or competitiveness gains and must be used and employed to aggregate value to every operational activity or procedure.

The main concern of Knowledge Management, in this case, is the use of techniques, so that the companies acquire knowledge, wherever it can be found, so that knowledge workers have the knowledge needed for their operational work at hand. Such policy guides the definition of goals intended by Knowledge Management and, therefore, the diverse solutions that correspond to its needs in each case (acquisition and preservation; sharing or transmission, appropriation and creation of knowledge, etc. referred in the Nonaka and Takeuchi (1995) famous KM model of knowledge conversion cycle and transfer processes that occurs within the organizations), at the same time the knowledge body is disseminated and fit in the practices of the workers. These goals focus mainly on solving operational problems and tend to manage knowledge, optimizing its uses due to an operational view.

From this point of view, Knowledge Management will be oriented according to the interests of the company's operators (workers). This bottom-up view or operational view can only be perceived among knowledge workers and will elucidate the perception of critical knowledge status and the reasons they are critical for the development of operational tasks. Therefore, part of the processes of Knowledge Management will be aimed at managing knowledge that is directly connected to operational procedures and remedy its possible usage difficulties.

### *2.2. Understanding the Organizational Strategy for the Alignment of Knowledge Management (Top-down Approach)*

So that the strategy of Knowledge Management can be defined in consonance with the strategic goals and aims of the organization, there must be a clear understanding of the organizational strategy.

The business strategy is elaborated to create value for investors, clients, employees, the society, and other interested parties. Through its strategic goals and aims, it is portrayed how the company intends to achieve that. In other words, it's the image the organization projects of itself and that guides the coordination of plans and how to make it feasible, creating new markets, products and services, and solving problems and overcoming foreseen mishaps.

Among the four perspectives that guide the strategy formulation suggested by Kaplan and Norton (1996) in the book *Balanced Scorecard*, "learning and growth" perspective highlights the role for aligning the organization's intangible assets to its strategy. This perspective contains the objectives and measures for three components of intangible assets essential for implementing any strategy: "human capital, information capital and organizational capital". As emphasized by them (Kaplan and Norton – 2004), no such alignment, decision makers cannot gain a competitive advantage from their intellectual capital, especially human capital (strategic competencies) and information capital (strategic information), and thus implement new strategies to position themselves in a changing and competitive environment.

*“The intangible assets must be aligned with the strategy, in order to create value. Intangible assets take on value only in the context of strategy, what they are expected to help the organization accomplish.”* (Kaplan and Norton – 2004, p. 201).

Every organization must perceive itself accordingly and the resources it has (particularly its intangible assets) to accomplish these goals, and these resources must be mobilized and aligned with the goals and aims described by their strategies; that means the organizations must know clearly their strategies and internal capacities (besides several conditions imposed by the external environment) and employ resources in areas and assets deemed strategic. It is very difficult to assess what knowledge / skills / capacities should be developed or emerged to define a strategy for knowledge management. As Ermine (2008), there is a strong risk of misalignment between corporate strategy and strategy of knowledge management guided only by the business actors. This can result in knowledge management actions not recommended by the organization's strategic direction and therefore return on investment is not guaranteed.

From this point of view, the first step in managing resources of an organization is to undertake a strategic review to highlight the proposed objectives and goals. Kaplan and Norton (2004) present three action components to the successful implementation and results of a strategy, they are: *“describe, measure and manage”* the strategy; the first component is connected to this point of how to describe clearly the strategy:

*“The philosophy of the three components is simple:*

- *You can't manage (third component) what you can't measure (second component),*
- *You can't measure what you can't describe (first component).”* (Kaplan and Norton – 2004, p. xiii).

Analyzing the formalized strategy, it is clear how to identify knowledge that is essential to achieve the strategic goals. This top-down vision of knowledge capital, that is, the vision of the strategic relevance of their knowledge, is aimed at their directors (top-manager), those who plan, formulate and make strategic decisions.

In this case, Knowledge Management, aligned with the strategy, will manage knowledge that contributes to the achievement of goals and / or aims proposed by them in order to create value (clearly, other knowledge resources that can aggregate value are also developed, acquired and used).

### *2.3. Planning Knowledge Management*

As has been noted, both views, from the perspective of Knowledge Management discussed in the previous sections, are relevant for a successful Knowledge Management strategy, as well as for its implementation. Within this logic, the Knowledge Management strategy must enable the identification of knowledge capital that actually aggregates value and that assures the achievement of the proposed goals aimed at the accomplishment of its future vision (strategic view), and this capital must be employed for this end. Similarly, it is equally important to manage those forms of knowledge that impose difficulties to its use for operational tasks (operational view). The choice of effective Knowledge Management actions must be shared with everyone in the organization, including managers, and, at least, a representative sample of operational personnel, considering that they are the most involved ones with the daily work, and actually know the needs that must be taken care of.

## **3. A methodology for knowledge management alignment**

The main goal of this study is to propose a methodology, aligned with the organization's strategy, that provides a highly consistent and aggregate view of the organization, where every sector or department and everyone in the organization, both managers and workers, be represented and agree on what a Knowledge Management project must be. We propose a methodology that follows a series of 6 processes, represented in figure 1, that aims to assess the knowledge property from both top-down and bottom-up points of view, discussed in the previous sections, and compare them to achieve a middle view, or middle-top-down. Moreover, this approach provides a method to identify and structure this property. From the integration of both views, the Knowledge Management strategy is defined and the suggested actions will be aligned to the organization's strategy. This must be the first phase, or Knowledge Management planning, and will provide a truly real prospective view to be adopted and implemented.

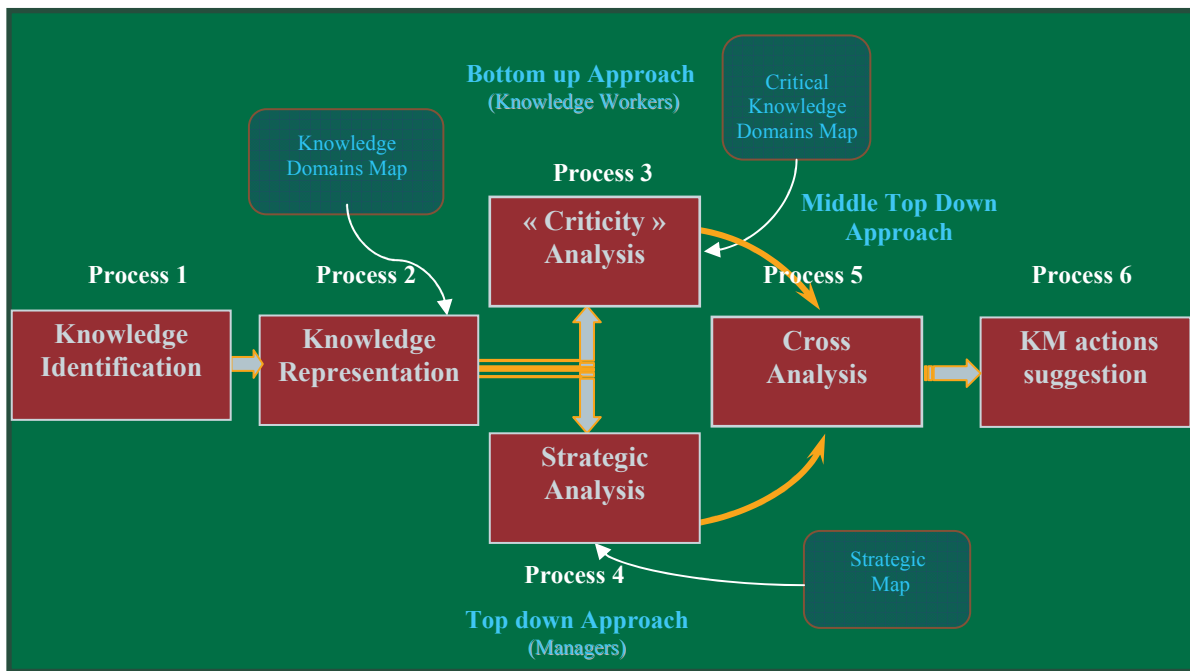


Figure 1: Processes of the Proposed Methodology

The key elements resulting from processes 2, 3 and 4 are: Knowledge Map, Strategic Map and Critical Knowledge Map, shown in figure 1. Each methodological process is detailed in the following sections.

### 3.1. Process 1 - Knowledge Identification

This task must be the beginning of the whole process, because it aims to know the existing knowledge property in the organization and will elucidate its current status. Any resource management process can only be effectively conducted when the resources to be managed are accurately known in terms of interests, repositories and other characteristics that might influence management.

The identification of the organization's body of knowledge is achieved by understanding the company's activities. There are several approaches that can be use for this end, the most conventional of all is the **departmental** (or operational), based and dependent on the organization's flowchart. Currently, this view is very static and dissociated from the way modern organizations operate (multifunctional teams that cross the boundaries of units); also because the same knowledge resource can be found in different functional units within the organization, resulting in excessive repetition.

The **process** approach, used by Silva, Cernic, Barroso, Ricciardi (2002), relies on the study or analysis of every process in which you aim to identify its capacitating knowledge, providing a highly complete view of knowledge resources in a company. However, this approach is rather complex for analyzing an organization in a global way, because, depending on the organization's size, there are a high number of processes to be analyzed. Moreover, as in the departmental approach, the same knowledge resource can be found in different processes, resulting in repetition.

Another approach if based in knowledge **domains**, adapted by Ermine (2003), in which knowledge is analyzed according to global subjects or areas, which are detailed until specific knowledge resources are identified, and then classified and presented hierarchically within the areas. What distinguishes it from other common approaches is that people who have knowledge in a certain domain are not necessarily part of the same organizational area, putting in evidence knowledge and those who have it in his/her specialization fields or domains, and reducing the problem of repetition. This approach requires an overall understanding of the organization to identify the group of wide areas, which must be connected to the organization's work.

### 3.2. Process 2 - Knowledge Representation

The graphic representation of this property aims mainly at viewing knowledge to facilitate its assessment, because handling these data and the way to construct or represent them are directly linked with what is to be conveyed, highlighted or analyzed.

#### 3.2.1. Representing Knowledge in Maps

The main concern in this process is the graphic transcription of cognitive information, which is, representing different knowledge resources that exist in each area or process in a clear and easily understandable way. For that, we utilized the mapping technique, or cartographical method. Geographic maps are well known, and provide a physical and spatial representation of both concrete and abstract phenomena that occur in a given environment, or an invisible object in a real situation. These maps have constituted a rich form of representing cognitive information (thoughts, experience, knowledge, etc.), that is, not spatial or numeric, in order to convey or share them so they can be viewed and interpreted correctly.

The approach we use here is the Mental Map representation, developed by Buzan (2005), which is mainly applied to organize knowledge and ideas. The structuring starts from a core or main concept (map heart), around which ideas associated are added (map axes), producing a growing organized structure (arboreal type), composed of key words or images, that progressively becomes more and more detailed. The knowledge map, key element of this methodology, facilitates the evaluation of this property, because it provides a clear way to visualize each existing form of knowledge.

### 3.3. Process 3 - “Criticality” Analysis

For each identified form of knowledge, its “criticality” is evaluated, performed at first by knowledge workers, providing an operational or bottom-up view of the critical status of knowledge and the reason why it is critical. “Criticality” of knowledge reflects the evaluation of opportunities that it presents to the company and also the risks of maintaining it at an adequate utility level for operational tasks. It is important to find out the knowledge resources that are critical and point out why they are considered so. There might be, for instance, a risk of knowledge loss which might lead to considerable consequences; there could be interest in developing knowledge to obtain market gains or advantages, productivity among others. Critical Knowledge can be easily be highlighted in the Knowledge Map, leading to, as a key element, the Map of Critical Knowledge.

### 3.4. Process 4 – Strategic Analysis

In this process, an organizational knowledge strategic analysis is performed in order to have a top-down perception of this capital, that is, a managerial view of the strategic relevance of knowledge. For that, it is essential the interaction with its directors / managers (top-managers), in other words, those who plan, formulate and make decisions regarding strategy. This interaction must be conducted in order to make emerge the existing strategic knowledge in the organization, that is, knowledge that contributes to the achievement of the strategy and of proposed strategic goals, and, possibly, other knowledge resources or capacities absent in the organization, that are necessary to achieve those strategic goals, and that must be developed or acquired.

So this task effectively works, two important points are required: (a) comprehension of the business strategy, that is obtained through the analysis of existing documentation in the organization (Business Plan, Strategic Plan, etc.) and complemented by insight from the directors (or managers); and (b) arrange and represent the strategic goals so that there is truly clear view of what the organization aims to accomplish, to facilitate the analysis.

#### 3.4.1. Strategy Representation in Maps

The strategy is succinctly represented equally using a graphic representation through mental maps (Buzan – 2005). This strategic representation model in maps is inspired in Kaplan and Norton (2004), where the strategic map describes the strategy displaying the goals or aims related to each of the four perspectives suggested by them in *The Balanced Scorecard* (Kaplan and Norton – 1996): *financial, clients, internal and learning and growth*.

In general, each organization has its own pre-defined perspectives, besides their own strategic goals within each one of them, that will be graphically represented in the Strategic Map, key element of the methodology, will be used, mainly, to facilitate visualizing the relationship between the components of the strategy (strategic goals and aims) and the organization’s sectors, and will help relate these components to the necessary resources that create value to achieve these goals and aims (in this case, knowledge resources).

#### 3.4.2. Impact of Strategy over Knowledge

The evaluation of the impact the strategic goals will have in certain knowledge resources is more easily obtained using both Maps: Strategic and Knowledge. These maps are useful for the evaluation, because they will serve as visual tools: the first to understand what the proposals, objectives and future goals are, and the second to understand what currently is available in the company in terms of knowledge. For each objective or strategic goal represented in the Strategic Map, the impact on each knowledge resource represented in the Knowledge Map is analyzed, to identify which ones are more relevant (or essential) to accomplish the strategic goal under review.



We also aim to understand some characteristics of the nature of knowledge deemed strategic, as well as their susceptible (vulnerable) character and status in the context of the organization. Such subsidies enable us to evaluate the consistency between managerial and operational views, under which the “criticality” analysis was conducted. This will also help the preparation of guidelines for a Knowledge Management Plan and the actions to be suggested.

### *3.5. Process 5 - Cross Analysis*

In this process a cross / integrated analysis is performed, which consists of comparing the results of both analysis, the strategic one (performed with the directors) and the critical knowledge one (performed with knowledge workers), proceeding a comparison between the knowledge deemed strategic and that considered critical. Finally, we find both strategic and critical knowledge, and obtain a middle-top-down perception of knowledge.

### *3.6. Process 6 – Knowledge Management Actions*

The last process is the suggestion of Knowledge Management actions, which consist of taking action mainly over knowledge deemed critical and strategic, utilizing means or methods that aim at valuing knowledge and reducing its “criticality”. The choice of an optimal group of methods depends primarily on the “criticality” evaluation results that identified, for each form of knowledge, its peculiarities and risk factors. The reasons for “criticalities” will provide concrete information to suggest Knowledge Management actions, the strategic relevance and higher or lower “criticality” levels of each knowledge resource indicates the priority level of the action.

The possible actions are connected to the “criticality” characteristics of knowledge. For instance, supposing that a certain form of knowledge is vulnerable, due to difficulties to be acquired and capacitated, this case suggests Knowledge Management actions in order to accelerate the learning curve for this knowledge resource. Depending on the case, this might require the use of coaching, mentoring etc. If knowledge is scarce, it must be preserved in databases or shared with other people and so on. Moreover, other necessary knowledge resources might be identified. In this case, the organization must develop the means to create new knowledge resources in order to assure the achievement of its strategic goals within a vision of future, and therefore, assure the continuity of work.

## **4. The case: the study of the radiopharmacy center (cr)**

This methodology was applied to the Radiopharmacy Center – CR, a business unit supported by the Nuclear and Energy Research Institute – IPEN, and comprehended all of its functional areas: Quality Assurance Management, Infrastructure and Support Management and three technical management areas: Production, Quality Control and Research and Development; including the radioprotection team, subordinate to the Radiation Protection Service of IPEN, that provides support to the activities of CR.

### *4.1. The Center Profile*

The production and sales of radioisotopes and radiopharmaceuticals in Brazil is executed by the National Nuclear Energy Commission – CNEN, through their Institutes, and currently, IPEN, through their RadioPharmacy Center – CR, accounts for 98% of all products. The CR coordinates radioisotope production activities, raw material used in the production of radiopharmaceuticals, which are divided in four classes: Primary Radiosotopes, Labeled Molecules, Molibidenium–Tecnecium Generator, Liofilized Kits, and concentrate the production of pharmaceuticals, for use in vivo, provided for Brazilian clinics and hospitals that offer nuclear medicine services, at a total of nearly 350 units. The CR maintains the Quality Management, complies with national and international Radiologic Protection norms for radioactive materials and Environmental Protection, and Technical Regulations for Good Manufacturing Practice (GMP), for injectable drugs.

### *4.2. Methodology Application at CR*

#### **4.2.1 Processes Mapping and Knowledge Identification**

We have opted for conducting, in the CR, the processes study and mapping for knowledge identification, following the technique used by Silva, Cernic, Barroso, Ricciardi (2002), considering that the CR’s Quality Management is well consolidated and its processes, with the required flowcharts, are described and documented. An internal analysis of the CR was the first step and aimed to identify which are the organization’s core business processes (macro processes) and their interfaces, besides some mandatory procedures that must be done during the execution of processes; they are described below.

*Product Order*  
*Production Planning;*  
*Production;*  
*Quality Control;*  
*Shipping and Logistic;*  
*Quality Assurance;*  
*Research and Development.*

Mandatory procedures:

*Radiological Protection;*  
*Good Manufacturing Practices - GMP.*

The analysis of the CR's macro processes points out the main operational processes involved. After, we got to the analysis of operational processes, which were subdivided into smaller processes until we could understand more systematically every activity they go through, in order to recognize which are enabling knowledge of every activity and of every process, and how they are allotted (Barroso - 2001). We have analyzed every operational production process of each radiopharmaceutical and radioisotope produced in the CR, as well as mandatory procedures, and identified every knowledge resource essential for the conduction of these processes.

#### 4.2.2. Knowledge Representation

The knowledge identified through the analysis of processes have been restructured and regrouped in domains or common areas, and underpinned the construction of de CR's Knowledge Domains Map.

The knowledge domains map structure follows the model adapted by Ermine (2003) and first used by Peil, Albertin, Ermine and Matta (2001). The **core point** (or the heart of the map) corresponds to the organization's main purpose or reference. From the core point, knowledge **axes** originate defining broad knowledge areas, which generally correspond to the mission components of the organization or its core operations. From them, knowledge **themes** branch out, where knowledge **domains**, final classification elements, are grouped according to a common purpose under the same theme or axis. Due to the level of detail with which we aim to represent a certain form of knowledge, the themes may also be broken into **sub-themes** and the domains into **sub-domains**.

In this paper, studying and mapping processes facilitated the systematic understanding of the CR's operational processes fundamentals, which underpinned the definitions of the Center's main knowledge domains (or areas), which represent the main axes in the Map. They include:

*Production Technology*  
*Quality Control;*  
*Pharmaceutical Processes and Good Manufacturing Practices - GMP;*  
*Planning;*  
*Research and Development;*  
*Radiation Protection;*  
*Norms and Regulations.*

From the indentified knowledge, a terminology was developed (taxonomy) to be used in the map construction. We tried, in this study, to use technical terms that better represented the concept or idea, within the radioisotope and radiopharmaceutical areas, aiming to consolidate the jargon within its categories or domains. The development of adequate terms, as well as their validation, was accomplished with the participation of field professionals (radioisotope and radiopharmaceutical professionals) and with CR managers, until they came to a consensus.

#### 4.2.3 Knowledge Domains Map of CR

The knowledge representation, as Knowledge Domains Map, from the axes up to the domains/sub-domains level (or higher knowledge detail), offers a more accurate view of the existing knowledge domains. The representation, in this study, was arranged in twelve diagrams using the "MindManager" software; one of them shows an overall view of all knowledge axes and the others show each axis in details. The figures 2 and 3 show the representations of the general vision and the axis *Production Technology*

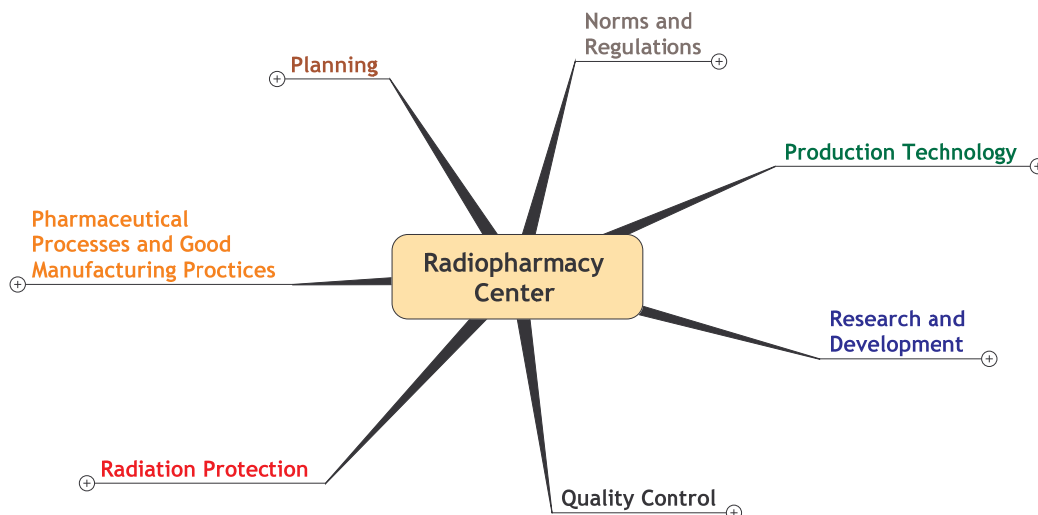


Figure 2: Knowledge Domains Map of CR (general vision)

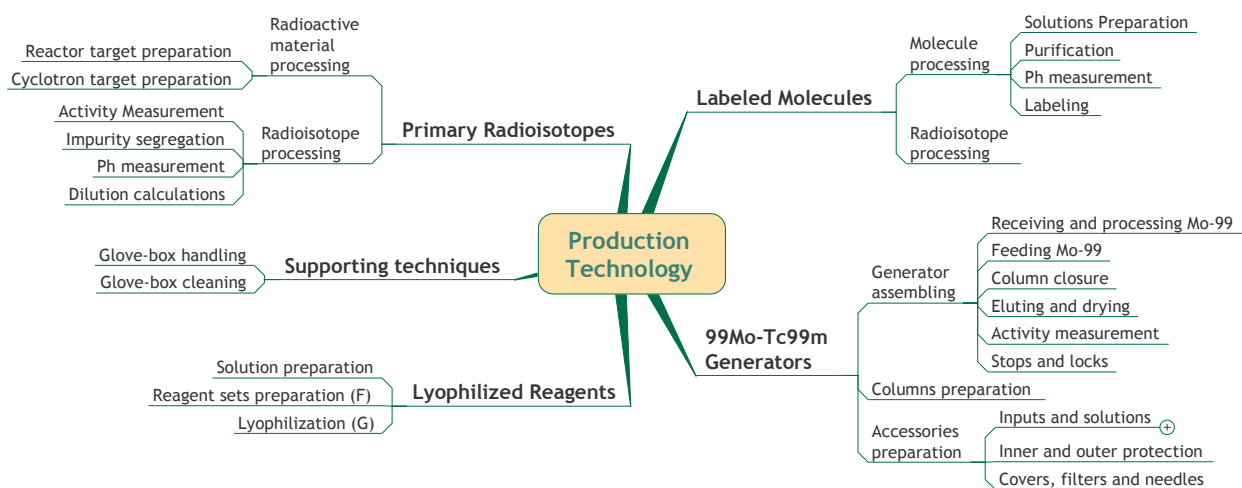


Figure 3: Axis Production Technology of the Knowledge Domains Map of CR

#### 4.2.4 “Criticity” Analysis

We used, for this study, a recently developed and efficient method for the “criticity” analysis of knowledge, using evaluation criteria. This approach is inspired in the *Capability Maturity Model – CMM* developed by Software Engineering Institute – SEI (1986), the Club Gestion des Connaissances de Paris studies (2005), and criteria used to identify strategic knowledge within the “RBV and KBV” approaches, among other authors: Barney (1991), Grant (1991), Collings e Montgomery (1995), Amit e Shoemaker (1993), as shown in table 1.

We utilized a simplified methodology, applying 5 categorized evaluation criteria, in order to analyze two main knowledge dimensions: its nature and vulnerability. These criteria, described below, were chosen for fitting the CR problems and due to the reality and necessity of the context in the Center: Nature of Knowledge (technical content), knowledge vulnerability (and scarcity).

##### ***Nature of Knowledge:***

1. ***Technical content***
2. ***Relevance/utility***

##### ***Knowledge vulnerability:***

3. ***Acquisition and capacitating difficulty***
4. ***Difficulty of knowledge captation and sharing in the context***
5. ***Rarity/scarcity***

With the exception of the “*Norms and Regulations*” axis, which was not evaluated for dealing with knowledge connected to support activities, and not to the organization’s main purpose, every knowledge

resource in the Knowledge Domains Map was analyzed by means of interviews and questionnaires, involving 15 CR workers. The selection criteria for the participants aimed to obtain the closest representativeness and fidelity to the operational view to be achieved. For that, we decided to opt for two workers from each CR functional unit: the leader, in charge of the functional unit, and another one, the most representative or experienced worker in the unit, to whom the map axes that were closest to the activities they performed in their departments were directed.

Outcome analysis: the knowledge evaluation regarding each criterion was based on a 3-point ordinal scale associated to the qualitative words: **High** (3), **Average** (2) and **Low** (1), numbers were assigned to the words only for the averaging. The result for each criterion follows the rule of table 2.

AVERAGE OF EACH CRITERION	RESULTS	
1	Low	L
1 to 2	Low-Average	L-A
2	Average	A
2 to 3	Average-High	A-H
3	High	H

Table 2: Results for each criterion

The questionnaires were handled, for each knowledge domain, according to the rules below:

- Individual criterion evaluation: an average of each criterion was calculated;
- Dimensional evaluation (Nature and Vulnerability): an average of each dimensional criterion was calculated;
- Outcome: the average of all criteria was calculated. (It is presented ahead in accordance with the rule of the previous table).

We opted to deem critical knowledge domains that achieved equal or above **average** results in the evaluation for both dimensions, and scored **high** in at least one individual criterion.

4.2.5 Strategic Analysis

The first step was the study and graphic representation of the CR strategy. We used the CR Action Plan and tried to identify and classify its main strategic functions; the strategic goals were grouped according to their common purposes and listed within these functions, which were thus classified:

- Products;***
- Clients;***
- Regulatory requirements;***
- Quality Control;***
- Society and Environment;***
- Human Resources;***
- Teaching;***
- Research and Development.***

4.2.6 Strategic Map of CR

Utilizing the Norton and Kaplan (2004) model, the CR Strategic Map, shown in figure 4, was constructed using the “MindManager” software and consists of the strategic function identified in the CR, which represent the Map’s main axes, and, from them, sub-axes originate describing the strategic goals related to each function. The content of the maps was certified by the CR management, which is responsible for the preparation of the Center’s Strategic and Action Plan.

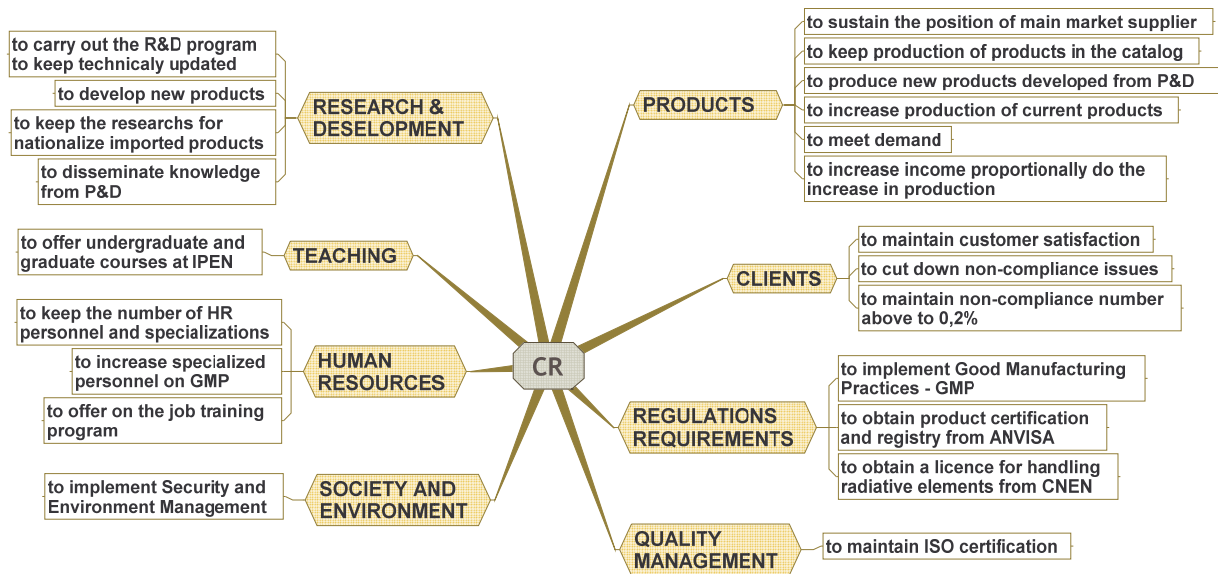


Figure 4: Strategic Map of CR

#### 4.2.7 Identification of Strategic Knowledge in the CR

This step was conducted by means of interviews with two CR managers, carefully selected so that we could achieve a truly managerial and strategic view of the organization. The manager of Research & Development and Innovation area evaluated the strategic axis *Research and Development* because of his deep knowledge of all research projects of the Center, and the manager of Quality Assurance area, which evaluated the other strategic axes, was chosen because of his participation in the CR Strategic Plan formulation and has deep knowledge about the Center in general.

We used two Center Maps: Strategic and Knowledge Domains. For each strategic goal within each strategic function (Strategic Map sub-axis) we performed a check-list of existing knowledge for each Knowledge Domains Map axis, in order to identify knowledge deemed strategic, and grade its importance in order to contribute to achieving the goal. We have also identified knowledge that does not exist in the Center, which is considered strategic and must be either developed or acquired.

To assess the strategic importance of the identified knowledge domains (for both existing knowledge and knowledge to be developed or acquired), we use a 3-point scale associated to words: **High (H)**, **Average (A)** and **Low (L)** strategic relevance. The knowledge domains assessed with **H** and **A** were considered for the cross analysis. Some results are presented ahead.

#### 4.2.8 Cross Analysis

The CR's strategic and "criticality" analysis outcomes were crossed, revealing knowledge that is strategic for the CR, and at the same time, was considered critical for the development of its processes and operational activities.

To demonstrate the results, we have used a color code (table 3), considering that the "criticality" and strategic evaluations were performed interviewing different people and different quantities, it doesn't make sense the definition of one aggregate index to compose them.

#### 4.2.9 Results: Critical and Strategic Knowledge of CR

We have found 56 for a total of 211 critical knowledge domains, accounting for nearly 26% of the knowledge resources analyzed in the Center.

We have found 64 strategic and critical knowledge domains. Moreover, we've found a list of 20 inexistent strategic knowledge resources.

Table 3 shows some results; it shows both strategic and critical knowledge that impact the achievement of the strategic function goals: *Research and Development*, separated by knowledge axes or even by knowledge domains, with the "criticality" and strategic relevance coefficients, and the final results using the color code (shown in table 4).

AXIS	STRATEGIC AND CRITICAL KNOWLEDGE	“CRITICITY” RELEVANCE COEFFICIENT	STRATEGIC RELEVANCE COEFFICIENT	FINAL RESULTS
Research and Development	Ga-68 Generator	H	A	Yellow
	Sr-90 – Y-90 Generator	AH	H	Orange
	W-188 – Re-188 Generator	AH	H	Orange
	Anexine V – Tc-99m	A	A	Green
	Bombesine – Lu-177	A	H	Yellow
	Bombesine - In-111	A	H	Yellow
	Anti CD-20 (In-111, Lu-177, Y-90)	AH	H	Orange
	I - 131	A	H	Yellow
	F - 18	AH	A	Blue
	Sm - 153	A	H	Yellow
	Lu - 177	AH	H	Orange
	Y - 90	AH	H	Orange
	Mo-99 – Tc-99m Generator	H	A	Yellow

Table 3: Critical and Strategic Knowledge

“CRITICITY” RELEVANCE	STRATEGIC RELEVANCE	
	HIGH	AVERAGE
HIGH	RED	YELLOW
HIGH/AVE	ORANGE	BLUE
AVERAGE	YELLOW	GREEN

Table 4: Color Code

#### 4.2.10 Setting up of a KM plan of action for CR

Based on the results, we have formulated for the CR a list of suggested knowledge management actions, which act directly on knowledge deemed strategic or critical:

- Extranet for Clients;
- Mentoring / Coaching;
- Audiovisual database (of relevant facts, peculiarities or critical phases of processes);
- capacitate personnel on fundamental Radioisotopes and Radiopharmaceutical concepts through online courses;
- internal training for Good Manufacturing Practices – GMP and an Incentive Program for contamination control;
- Management Courses for Managers, Bosses and Leaders.
- Community of Practices on Good Manufacturing Practices – GMP and Products Certification;
- Knowledge Portal (“yellow pages”).

## 6. Conclusion

While analyzing an organization and suggesting actions to adequately manage it, it is essential to have a global view of its knowledge property. Knowledge capital mapping and representation is a new issue, whose relevance has increased as much as the need to manage knowledge. Moreover, a methodology that articulates techniques and instruments that enable the evaluation of such property, integrating both top-down and

bottom-up views is extremely useful. From the comparison between both views, it is defined the Knowledge Management strategy to be adopted, and actions related to and aligned with strategic objectives and goals that also suit the different interests of the organization's knowledge workers, are suggested.

Applying the methodology to the Radiopharmacy Center has shown its suitability to a knowledge-intensive organization and the feasibility of its application. The outcomes provided important insights to suggest Knowledge Management actions, which were intended to focus its critical and strategic knowledge. However, in order to succeed, such actions rely on other aspects, such as organizational culture, players, technological infrastructure, etc. Besides, it is important to look at the results of this application and turn information into subsidies for formulating the strategy in the CR, in terms of development of knowledge and skills.

We can highlight several new contributions this study offers. The context of the research is a fresh approach. The formulation of strategies based on resources and knowledge has gained momentum in the past decade. Furthermore, Knowledge Management has been processed within a new point of view, a fresher approach, aligned with the strategy of the organization. Researches in the Knowledge Management field had been focusing primarily on acquisition, transference, formalization, preservation and development of knowledge, with approaches oriented to the operational needs of the organization. An explanation for this orientation lays in the fact that early Knowledge Management practices were motivated mainly by the need to remedy or alleviate operational problems resulting, in general, from knowledge loss due to retirement, personnel transferences, downsizing, etc. Currently, it is clear that it has been turning into an approach that is concerned with dealing with strategic problems, whose theme has been developed in this study.

The methodology used several methods and techniques. It is innovative, because it articulated these techniques into a single strategy, bringing new elements such as: strategic representation in maps; knowledge representation in domains, identified through the study of processes. The application was totally new both in the CR and IPEN. The identification and representation of knowledge in the CR and the a vocabulary structured for the radioisotope and radiopharmacy areas were specially developed for use in the Center and had not been done before; the criteria chosen for the "criticality" analysis are exclusive for the CR and were selected due to the Center's context and needs, and may serve as reference for the creation of new criteria and its application to other organizations.

The methodology developed here, if adapted, may serve as a model for application to other research centers of IPEN or CNEN, and even other organizations of similar nature. Its applicability, however, requires some premises so that the methodology suits them accordingly. In case the organization doesn't have its processes mapped, it is advisable to use other approaches to identify it, as discussed in section 3.1 of this study. Besides, the organization must have a well-structured Strategic Plan or documentation referring its objectives and strategic goals.

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Other References and Tools:

Action Plan of Radiopharmacy Center of IPEN

MindManager Pro X5 - the virtual tool for brainstorming and planning – Mindjet