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Knowledge Evaluation for Knowledge Management Implementation - the Case Study of the Radio-pharmaceutical Center of IPEN

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ABSTRACT

In recent years organizations are using multiple methods and approaches to design their strategic and action plans. In this context, Resource-based View (RBV) and Knowledge-based View (KBV) frameworks are receiving increased attention as instrumental to strategy formulation. The synergy of these approaches with Knowledge Management initiatives is intuitive and their use are in a common framework is discussed here to show the importance of methods and instruments to mapping and assessing the knowledge assets of the organization.

The application of such methods to the Radio-pharmaceutical Center of IPEN is discussed in this paper.

KNOWLEDGE BASED STRATEGY INPUTS AND KNOWLEDGE MANAGEMENT FEEDBACK

Strategic planning during the 60 and 70s were mostly based on SWOT analysis, Andrews (1971), but from the 80s on such planning began to rely more and more on the "five-forces" framework proposed by Porter (1980). As a consequence, strategy was basically formulated on considerations of the products and services that the company provides and of the markets it supplies. During the 90s resource-based approaches, for strategy formulation, came on to the arena, recommending an emphasis on the company's own resources and competences to define the strategy of products and services.

The starting point for strategies based on resources is that since the capacities and knowledge of an organization were developed along a learning path of many years, they ought to have a good dosage of singularity, in other words, they are ingrained in the "DNA" of the company. For this reason, competitive advantages paved on these resources would be, in principle, more difficult to be copied or mimicked by the competitors.

Obviously, not all resources have equal importance or possess the same potential as source of sustainable competitive advantage. This true also for the knowledge resources. This makes essential, for the strategy definition, that the resources be identified and, specially the core knowledge, that has the greatest potential to generate a competitive differentiation.

To facilitate this identification, many criteria and questions have been proposed and justified by different authors. Noting that some degree of freedom has been used to equalize terms that have substantially the same meanings, table 1 summarizes the requirements proposed by Barney (1991), Grant (1991), Collings and Montgomery (1995), Amit and Shoemaker (1993).

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

CRITÉRIOS	BARNEY	GRANT	COLLINGS - MONTGOMERY	AMIT - SCHOEMAKER
value	X			
rareness/scarcity	X			X
inimitability	X		X	X
susbstitutability	X		X	X
durability		X	X	X
transparency		X		
transferability		X		
replicability		X		
appropriability			X	X
competitive superiority			X	
complementarity				X
low tradability				X
overlap with strategic industry factors				X

In the context of the RBV (Resource-based View) strategies, the approach of the “Core Competences" of Hamel and Prahalad (1990) is probably the most notorious example. This model proposes that an organization can leverage its competitiveness using the ability to identifying, cultivating and exploiting its knowledge and core competences to create new markets through the introduction of new products generated by these competences.

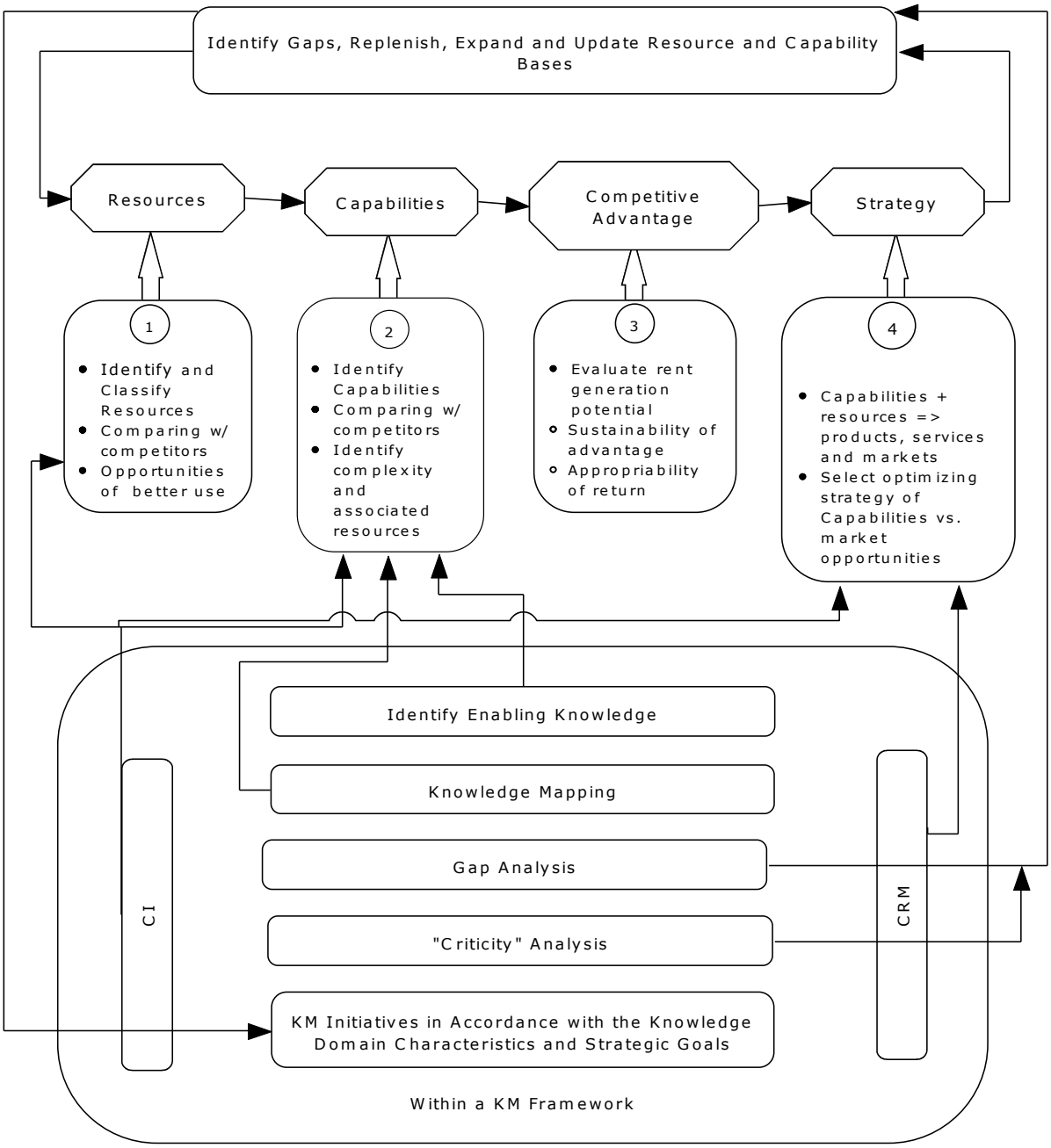
On one hand, most of textbooks on Knowledge Management take due care to emphasize, as a keystone requirement, the alignment of KM processes with the enterprise strategy and goals. On the other hand, it is important to consider how KM processes or initiatives can provide feedback to the strategy formulation. Let us see how these links fit together considering the “Resource-based or Knowledge-based View” approach is being used, alone or in combination with other methods. As recommended by these approaches, after the identification of the organization’s most relevant capacities and knowledge (internal analysis), they are ranked most of, if not all, the criteria embody a comparison with those of the concurrency. In doing so, an external analysis is included in the strategy framework. Based on the resources and knowledge for which the organization has a clear comparative advantage, strategic plans to develop, improve and/or leverage products, services and markets are formulated. An optimization analysis of these propositions uncovers the “best” strategy for the organization.

It becomes apparent, from the formalized strategy, what are the required strategic objectives and goals for the management of the capacities and knowledge upon which the strategy was based.

Once these objectives and goals are set, then Knowledge Management initiatives can be launched to achieve them and also a set of directives can be passed to the Competitive Intelligence (CI) and Customer Relationship Management (CRM) processes to monitor how those anchoring capacities and knowledge are evolving outside the organization.

A graphical representation of what was described in this section is presented in figure 1, where the framework proposed by Grant (1991) has been adapted and complemented to include the ideas here discussed.

Figure 1: The Framework to Coupling Resource-based Strategy Formulation and Knowledge Management Initiatives



FROM STRATEGY TO KNOWLEDGE MAPPING AND ASSESSMENT

As it can be seen the identification of organization's capabilities is critical for the successful design of the strategy as well as for its implementation.

From a KM perspective, this means the identification of the knowledge that enables the processes, that make up the firm's capabilities. Further this knowledge has to be assessed to select those that are really distinctive or critical. Usually a twofold process is applied, first by screening the processes and considering only those that make a difference in the company's competition for the market, then assessing the enabling knowledge with respect to its gaps or its "criticity" state. "Criticity" analysis assesses the knowledge domains combining criteria of relevance, maturity and vulnerability.

This work is concern with knowledge mapping and "criticity" analysis, but it also touches the subject of gap analysis derived from the framework proposed by Bohn (1994), as adapted by Tiwana (2000). There is a brief description of the methodology that has been used and applied to the Radio-pharmaceutical Center - RC of IPEN - Instituto de Pesquisas Energéticas e Nucleares (Energetic and Nuclear Research Institute), but more space is dedicated to the case description and findings than to the underlying theory.

THE RADIOPHARMACEUTICAL CENTER AND ITS CONTEXT

In Brazil, the activities of the nuclear area are still part of the State monopoly, exercised by CNEN - Comissão Nacional de Energia Nuclear (Brazilian Nuclear Energy Commission) and three government's companies (INB, NUCLEP and ELETRONUCLEAR) that are in charge of nuclear-based electricity generation and fuel cycle. The institutes of CNEN have the responsibility for research and development, as well as for the activities of radioisotopes and radio-pharmaceuticals production.

With respect to the radioisotopes and radio-pharmaceuticals, the necessary production to supply 97% of the domestic market is done at Radio-pharmaceutical Center of IPEN, the largest research institute of CNEN. This center supplies routinely about 300 hospitals, what made possible the execution of about 2,3 million medical procedures in 2004. The distribution network covers the whole country, with the following demand profile: 64% concentrated in the southeastern region, 14% equally in both the southern and northeastern regions, 6% in the center-western region and 2% in the northern region.

The radio-pharmaceutical production, mainly in the last ten years, has grown a lot to match the demand expansion that, from 1996 to 2004, has shown a growth of more than 135%. The principal product responsible for almost 50% of

the demand, the technetium-99m generator, had a growth of 9% in 2004, in relation to 2003, other products, such as Iodide-131 in solution 19%, and in capsules 14%. It is foreseen a sustained annual market growth around 10% for the next five years. A larger increase is expected for the case of new products, such as Fluor-18, that had experienced a growth of 100% in 2004, due to the accelerated progress of the nuclear medicine in the areas of the oncology, cardiology and neuropsychiatry.

The degree of the customers' satisfaction, as measured by the last years surveys carried out by the commercial Division, showed an overall satisfaction index above 90% (91,6% in 2002, 90,2% in 2003 and 90,3% in 2004). Analyzing the various indexes of the survey, one can note that results attest the high quality of the Center, but they demonstrate, in addition, that the Center has surpassed by a good margin the established goals for the Federal Government, by the "Quality Program in the Public Service". With respect to the image transmitted by IPEN in relation to its competence and technical excellence, 98,8% of the customers agreed with this impression and only 1,2% disagreed. It should also be pointed out the customers' interest as manifested by the large amount of suggestions for the development of new products in the future.

The possible legislation modification flexibilizing the monopoly and bringing the possibility of competition and the emergence of substitute products, like new image techniques that don't make use of radioisotope, can constitute threats to the future of the Center. However, even if such changes don't occur, it is of prime importance for the Center to continue improving and enlarging its technical capacity for the several reasons. The existence of the monopoly imposes some indispensable ethical principles to assure that: (a) the absence of competition can never be a cause of repressed or not unattended demand; (b) the products be supplied with a quality level similar to that available in the developed countries; (c) the introduction of new products follow closely with only eventual short lags the releases of the international market, in accordance with the interest manifested by the medical community. In addition to this, the high quality standard reached by RC, according to their customers, is a source of sustainable advantage that should be nourished and further developed as a preparation for the case of changes in the market conditions.

KNOWLEDGE ISSUES AT CR

It is a fact that there is a vast body of knowledge of high technological content relative to the research and development phases of the current products. Although some part of it has been structured and codified, because of the ISO 2001 certification, in the processes and procedures description of the Center, a very significant part of this knowledge is only documented in a fragmented way or remains tacit in the mind of the people, which have developed such products.

The OCDE classification of 1996, described by Lee and Gibson (2002), with small adaptation for the context of CR, was used to give a panoramic vision of the knowledge problems of this Center. This classification distinguishes four knowledge categories:

(a) *"Know-what"* that includes the knowledge of the facts relative to a given phenomenon or activity. Applied to a process, this means to know the inputs, the operations and the results.

(b) "Know-how" that means to know how to perform the need activities, so that certain phenomenon or activity happens. Applied to a process, this involve to know how to operate the available facilities and what to control so that the process evolves, under the desired conditions, yielding the planned results. This can involve special abilities such as, for instance, to know how to operate complicated equipment etc.

(c) "Know-why" that means to understand the first principles and the scientific laws that explain why the facts related to a given phenomenon or activity evolve in a certain manner. This involves to understand the causal relationships among the several factors and agents that participate in the process, in order to be able to explain how and why the desired results are obtained and to know the several influences that can affect them. It can involve, also, the knowledge of alternative routes and the reason why the present route was chosen.

(d) *"Know-who"* means to know who possess *"know-what"* and *"know-how",* in other words, who knows what to do and who knows how does that. It can be extended to include to know who possess "*know-why*", in other words, who knows the reasons. In practice, this can involve a great directory of experts and/or large personal network of "knowers" that some people possess and the ability to mobilize these experts.

Considering the four categories above described relative to the overall body of the knowledge in the Center, an interview was done with the current manager, which has been responsible for the production division for more than 10 years. The interview sought just a global qualitative assessment of the components of each category, to get a feeling for their respective levels of availability, actuality and explicitation. The result can be seen in the table 2.

Table 2: Glancing the Knowledge Issues at the CR

	AVAILABILITY	RECENTLY UPDATED	EXPLICITATION
(a) ***Know-what***	4	4	4
(b) ***Know-how***	4	3	4
(c) ***Know-why***	2	2	2
(d) ***Know-who***	3	3	2
1 - poorly (available/updated/codified) 2 - partially (available/updated/codified)		3 - satisfactorily (available/updated/codified) 4 - excellent (available/updated/codified)	

As it can be seen, *know-what* and *know-how* are in excellent shape and the RC manager is very confident about that. The only small remark that was made concerns the fact that a few procedures are not yet so up-to-date when compared with other world class production centers. The situation change though, when discussing about the *know-why* category, the knowledge that is needed when unforeseen deviations from the normal production conditions or parameters occur. Very few people have comprehensive diagnostic abilities and very little information is available in a easily retrievable form, to help to cope with these situations.

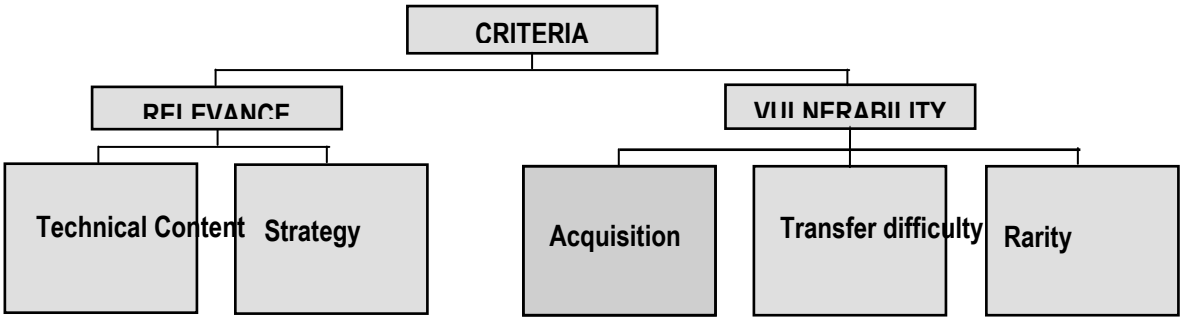
This generic upfront assessment and discussion was insightful to helping to understand the results obtained in the "criticity" analysis of some knowledge domains.

THE EVALUATION METHODS

Based on the existing processes description and mapping, an identification of the processes enabling knowledge was performed using the local semantics to labeling them. Then, tables showing processes, activities and enabling knowledge were constructed and validated with the people responsible for the processes. It must be noted, that these tables showed that some knowledge domains appeared in more than one process.

Two routes were used to assess this body of knowledge, the first was based on a knowledge "criticity" analysis, adapted from the Paris Knowledge Management Club (2005), using a set of 5 criteria, which were chosen based on the indications of the strategic plan of the Radio-pharmaceutical Center.

Figure 2: Knowledge Evaluation Criteria to CR



In the present evaluation, the first two criteria were used to assess the relevance and the last three the vulnerability. The specific purposes of each criterion are described below:

- ***Technical Content***: characteristics of the knowledge with respect to its: quality, extension and technical complexity.
- ***Strategy***: the knowledge leverage potential from a strategic point of view, in terms of its value aggregation and contribution towards the accomplishment of the strategic goals.
- ***Acquisition***: difficulty in recruiting and developing people that are proficient and resourceful in the knowledge domain.
- ***Transfer difficulty:*** difficulty in captation and sharing of this knowledge because of its context (knowledge format, owners and organizational environment).
- ***Rarity***: characteristics of the knowledge with its low availability in the organization and in the market place.

Before proceeding with the "criticity" analysis, the identified and tabulated knowledge, as described before, were reorganized (rearranged) in a 3 level hierarchical classification and represented on a cartographic map according to axes, themes and domains, displayed in a ordered scheme from the more general to the more specific. The cartography resulted in 7 axes, 27 themes and 159 knowledge domains. In a few special cases, sublevels were used.

The knowledge analysis, in this proposal, was done through interaction with some previously chosen people, that answered to interviews and questionnaires. They were selected, taken into account the following criteria:

- Management position (leadership and functional responsibility);
- Experience (background and on the job);
- Knowledge proficiency (for the domains being assessed);
- Representativity (as recognized by its peers).

A second and more superficial analysis was performed using Bohn's scale (1994), adapted by Tiwana (2000) and further adapted by the authors, to classify the present stage of some knowledge "groups". The objective of Bohn's scale is to assess the stage of knowledge that is needed to operate the processes of the organization. It allows the organization to better appraise the needs of the more important processes as well as to envision what is the desired stage for process knowledge. Although this of kind analysis can be done as detailed as one wishes, here it was opted to perform it more superficially (course granularity).

Table 3 presents a simplified description of the modified Bohn's scale. During the interviews, however, some examples and checklists were also used to facilitate the interviewers to identify the knowledge stage.

Table 3: Process Knowledge Classification Scale

STAGE	DESIGNATION	DESCRIPTION / DIAGNOSIS
0	Complete ignorance (it makes the process unfeasible)	There is not knowledge at least to distinguish what is good or bad in terms of results.
1	Practical ignorance (there is not reprodutability	Practically there is not knowledge; decisions are made somewhat blindly based of trial and error.
2	Intuitive conscience (it looks like art)	There is just some tacit knowledge, possessed by few people.
3	A certain measure (pre-technological)	There is reasonable tacit knowledge, that was used to create some empirical "rules" that usually work.
4	Control of the means (it is viable to describe it technically)	Some knowledge exists on explicit form, but it is not widely used.
5	Process capacity (there is an effective local recipe)	There is a good amount of explicit knowledge that is normally used. Eventually, when conditions get out of normal, there is still need of tacit knowledge (experience) of some people.
6	Process characterization (ability to compensate for most variations)	There is enough explicit knowledge that is always used and continuously validated and / or complemented. There are only very few special circumstances in which it is necessary to appeal to the tacit knowledge (experience) of somebody.
7	Through understanding of the causal relations (it assumes form of science)	There are tested models and experienced people in using them. It can simulate a variety of conditions and to analyze what if questions in complex circumstances. The existent knowledge is always validated with the use. The company has a strong capacity for recontextualize the knowledge. The existent culture promotes sharing and synergy. Employees' turn around doesn't affect significantly the competences in this process.
8	Complete knowledge (Nirvana)	Difficult to characterize, but if your company reaches it you will know. Actually it is a sliding goal for the continuous improvement

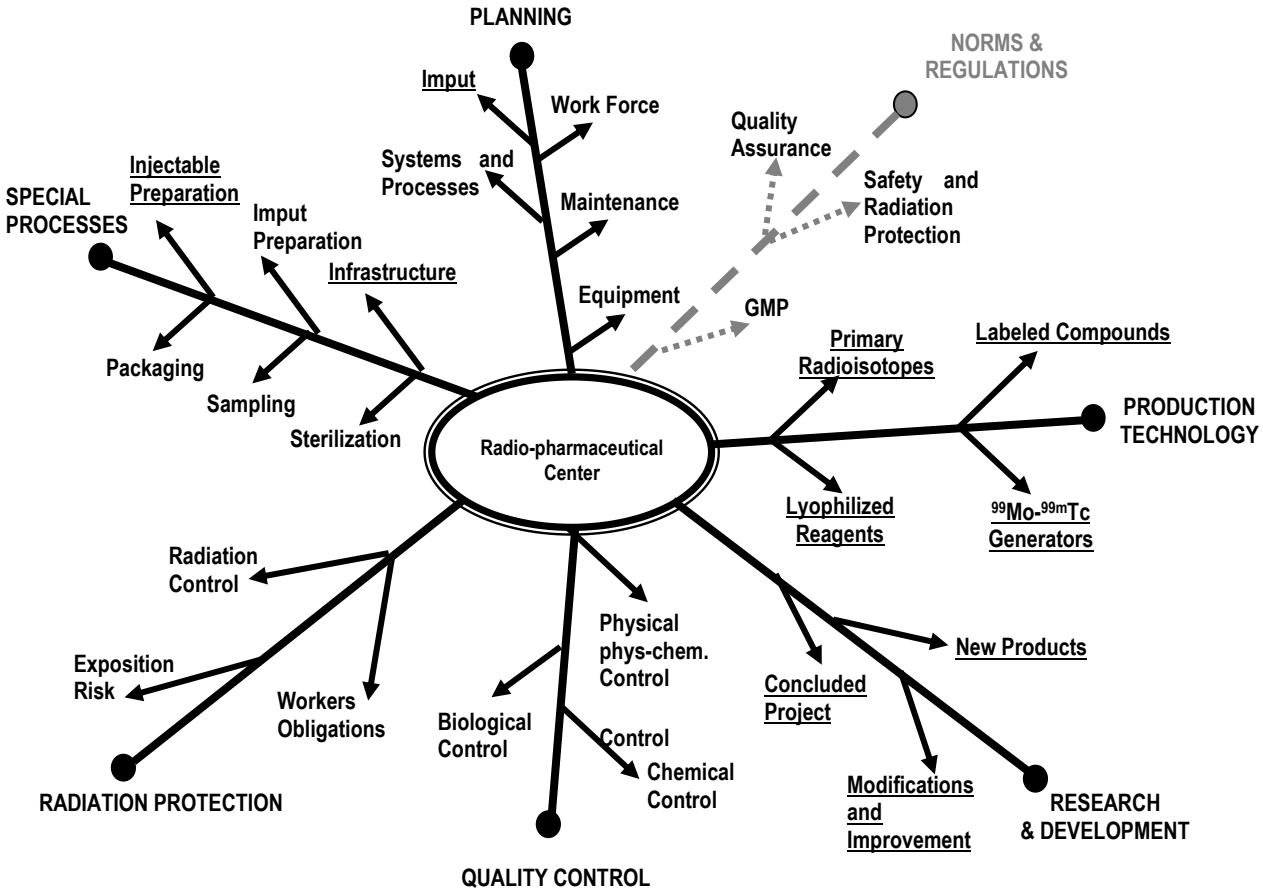
RESULTS E CONCLUSIONS

The knowledge evaluation in the first approach, using the chosen criteria, was made for the knowledge domains represented in 6 axes and 24 themes. The knowledge domains of one of the axes (Norms and Regulations) were not appraised, because they refer to knowledge related to support activities and this work was concentrated on those related to the main purpose of the organization.

For effect of quantification of the results in this evaluation, the following calculation was used: the compound grade for relevance was an average of its individual criteria grades and the same was done for vulnerability. The notes are 0 (not relevant/vulnerable), 1.5 (relevant/vulnerable) and 3 (very relevant/vulnerable) and a knowledge domain was considered critical if the global note is superior or equal to 1,5 and presents a grade 3 in at least one of the criteria.

Figure 3 shows the general vision of the Critical Knowledge Cartography of CR. To avoid a very dense drawing only the axes and themes have been shown. The axes of the Cartography that have critical knowledge domains were: Production Technology, Planning, Special Processes and Research and Development. The knowledge themes underlined are those where one or more critical domains have happened.

Figure 3: Critical Knowledge Cartography of RC.



From 153 analyzed knowledge domains, 24 (15%) were found critical. Relevance criteria were the dominant reasons for assigning a critical tag to these doimains: 18 knowledge domains (or 75%) were considered critical because had the maximum notes on a relevance criterion; 3 (or 12,5%) on a vulnerabilility one and 3 (or 12,5%) on both.

For the second analysis, the work was performed at a less detailed level as compared to the first approach. Based on process considerations, knowledge domains were rearranged into groups, of about the same granularity as those of the knowledge themes and 16 of these were chosen to be evaluated. The result was that 25% of the groups were graded with 3 or 4, 62% with 5 or 6 and 12,5% with 7.

After this assessment, a further one was made to estimate what is the desired stage for each knowledge group, however it was decided that this information should not be published.

The correspondence between the themes and the axes from the cartography of the first analysis and the knowledge groups of the Bohn's scale evaluation (from the other assessment method) is very clear, although sometimes more than one theme was included in one knowledge group. From the 16 knowledge groups, 9 of them coincide with themes and 2 groups correspond to axes. For these 11 groups, table 4 shows the results of Bohn's scale evaluation and how many (x) critical domains there are in the cartography among the total of (y) domains correspondent to the group.

Table 4: Coincident Knowledge groups and themes/axes and the results

Knowledge Groups / Knowledge Themes or Axes	Stage of Bohn	Critical Domains (x/y)*
Imput Acquisition	4	(2/2)
Production Planning	6	none
Resources and Equipments Maintenance	6	none
Primary Radiosotopes Production	5	(2/7)
Labeled Molecules Production	5	(1/6)
Technesium Generator Production	5	(3/11)
Lyophilized Reagents Production	5	(3/4)
Solutions Preparation (Special Processes)	6	(2/24)
Quality Control	6	none
Research and Development of New Products	4	(3/10)
Processes Modifications and Improvement	3	(1/1)

*(x critical knowledge domains from y domains that belong to the themes/axe)

It is interesting to note that all groups graded in the range 3 to 4 were coincidental with themes that contain critical domains. On the other side of the scale, 3 of the 4 groups graded with a 6 correspond to themes without critical domains. It makes sense because in groups with low grades it is natural to expect that there should be some critical domains. By the same reasoning, one would not expect to find critical domains in highly graded knowledge groups. For the other group graded with a 6, "Solutions Preparations/Special Processes", one should note that in this case the knowledge group was very broad because it corresponds to a whole axis of the cartography and with such a course granularity the evaluation using Bohn's scale lacks precision. However it should be noted that only 2 domains of the 24 from this axis were considered critical. Furthermore those 2 domains were tagged critical because of relevance criteria, showing therefore no inconsistencies in the cross comparison of the two approaches.

The analysis of critical domains whose grades were maximum simultaneously in two of the three vulnerability criteria could be very well corroborated by the preliminary analysis of the knowledge issues. The low grades in the "*know-why*" category explains, in many cases, the strong critical tagging coming from the vulnerability criteria.

"Criticity" analysis is a somewhat length process, but it reveals a lot about the knowledge domains and makes easier to understand and evaluate the best KM actions to leverage those critical domains.

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