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THE DEVELOPMENT OF AN INTEGRATED INFORMATION SYSTEM FOR A RESEARCH AND TECHNOLOGY INSTITUTE: THE CASE OF IPEN

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ABSTRACT

This paper reports the history of the development of an integrated information system dedicated to managing the technical activities of the Nuclear and Energy Research Institute, a governmental research and technology institute in Brazil. The start up of this development was the engagement of the Institute in a management improvement project based on the Excellence Criteria Model of the National Quality Foundation – a Brazilian version of the American Quality Award, Malcolm Baldridge. After the writings of the first managerial report following this model, it was identified that a Director Plan needed to be organized and implemented. In order to support the new planning process the design and implementation of a new management information system named SIGEPI was immediately initiated. The implementation of this system followed a strategy of integrating databases already available and developing new ones in order to facilitate the data collecting process and to improve the quality and the reliability of these data. This paper describes the evolution of SIGEPI, its main features and also reports the difficulties faced during almost ten years of developments. The success factors of this development – detailed later in this paper - can be classified in three groups: strategic, technical and behavioral ones.

1. INTRODUCTION

Management systems can be classified in managerial support systems (MSS), management information systems (MIS) and decision support systems (DSS). The first one is dedicated to long term planning; the second and third one are dedicated to a shorter period and they function as monitor and control of the organization; the third one is specifically dedicated to non structured problems (Laudon & Laudon, 1999, p.348).

A special category of management information systems is that one dedicated to integrate organization's business processes. Different names of the software packages for these management systems can be found in the literature: enterprise information system (EIS), enterprise resource planning (ERP), enterprise-wide information systems (EWIS) and enterprise systems (ES) (Loonam & McDonagh, 2005, p.165).

Literature about the experience of developing a MIS in the context of R&D organizations is very scarce. In Brazil the only case identified so far was the EMBRAPA case – a top

Brazilian R&D organization in the agriculture field. This case reported that the design of a MIS is affected by impulsive factors (e.g.: innovative conceptual design, managerial sponsoring, performance and lack of integration of the preexistent information systems, strong external information demand for the R&D activities and communication among coordination and users) and restrictive factors (e.g.: innovation perception as a threat or reworking efforts; concurrence with other information systems being implemented, lack of managerial sponsorship; size of the developing team; negative attitude due to past information systems experiences and complexities introduced by the system (Castro et al., 2000, p. 15).

This paper describes the experience of a Brazilian nuclear R&D Institute in the design and implementation of what is here being called Integrated Management Information System (IMIS) dedicated to manage the activities of more than 1000 workers and 700 students. This paper is addressed to describing the evolution of the information system developed to manage the Director Plan of the Nuclear and Energy Research Institute (IPEN) which is named Planning and Managerial Information System of IPEN (SIGEPI). The IPEN´s experience will be described in terms of how this system was developed, which features were implemented, some of the planned functionalities as well as the main difficulties faced during the development stages. As a final remark, the success factors of the experience will be pointed out.

2. SOME WORDS ABOUT IPEN

The Nuclear and Energy Research Institute is an organization with two subordinations: one is with the Development Secretary of São Paulo State and other is with National Nuclear Energy Committee (CNEN), an organization of the Brazilian Science and Technology Ministry. The second one is directly responsible for the financial support of IPEN. IPEN is also associated, for teaching purposes, with the University of São Paulo.

IPEN was established in 1956 and, as a mission, is committed to the improvement of the Brazilian population quality of life, to the scientific knowledge production, to the technology development, to products and services generation and to the formation of human resources in the nuclear and correlate areas. In 2008, the permanent working force was composed by 1029 individuals, where 219 of them were doctors and 118 masters. The income in 2008 reached about US$ 30 millions, mostly due to production and commercialization of products supplied to the nuclear medicine industry.

3. A BRIEF HISTORY OF ORGANIZATIONAL MANAGEMENT LEARNING PROCESS

IPEN has started its management improvement process in 1996 when it decided to obtain the ISO 9002 certification process for the radiopharmaceutical and radioisotopes production system. In 1998 adhered to the Excellence in Technological Research Project coordinated by the Brazilian Research and Technology Association (ABIPTI), a project in which the organization management improvement is based on National Quality Award (which is similar to the Malcolm Baldridge Award, from the United States). By adhering to this project, IPEN elaborated its first management report based on the Excellence Criteria and identified, as well, its main deficiencies in the management activities, namely, lack of appropriate customer satisfaction surveys, interrupted planning activities, absence of an organizational process to

evaluate the work force satisfaction and absence of an organizational information system dedicated to monitoring and evaluating its main technical activities.

As a result of the engagement to this project, many improvement and new management practices were implemented. One of them was especially important due to its organizational impact: The Director Plan. The present article aims at describing this practice and report in details the development of the managerial information system to support this practice.

4. THE MIS DEVELOPMENT FOR THE DIRECTOR PLAN

4.1 Antecedents

The experience of writing the first managerial report following the Excellence Criteria in 1998 pointed out clearly the need to improve the quality of the information about what the organization was accomplishing yearly. In order to solve this problem one of the first decisions was a software development dedicated to the data collecting and gathering of all technical graduated individuals of IPEN, which, so far, was being collected and gathered through paper forms.

IPEN has a technical staff for the development of information systems, thus the design and implementation of an application to operate in our internal web was initiated using this internal team. After more than 500 work hours, this project suffered a backlash: after a presentation to the IPEN´s top management team, they concluded that the project wouldn't solve properly the problem that IPEN was suffering. According to the perception of the Administrative Director, the institutional results cannot be obtained by just adding up individual results. Besides, this director argued, reinforcing the proposed method of collecting data would reinforce the individualization of the research and development activities, when what is needed was just the opposite, e.g. institutional practices that would induce team working. Despite conceptually correct, the consequences of such decision, in the first moment were devastating to the technical team involved in the project: frustration and interruption of the development of this MIS which so far has lasted almost two years.

The restart of designing the activities of a conceptually new MIS only happened two years later, with the elaboration of the first Director Plan.

4.2 The Director Plan

In 1998 CNEN started and developed a two step planning process named "Rethinking CNEN". The objective of the first phase has been achieved, which was the outline of the mission, vision and other strategies, but, two years later, the second step - addressed to identify its main stakeholders and to unfold the planning process to CNEN´s research and technology institutes – was discontinued.

In 1999, after the internal analysis of an independent evaluation of the first Managerial Report written in reference to the Excellence Criteria of National Quality Foundation, the deficiencies of the planning process became clear: "we cannot go ahead with a half strategic planning. Without it (a strategic plan), we will continue to spend energy without the synergy of our internal actions" (IPEN, 1999, p.1).

At the end of 1999, a wide managerial participative program was developed, which resulted in 2000 in the first Director Plan of IPEN. With the accomplishment of this process, the

elaboration of the first Director Plan resulted in many changes or new activities:

- Reorganization of the technical activities in alignment with the recently defined IPEN´s mission;
- Definition of the Global Strategic Objectives and organization of a hierarchical and nested structure of Programs, Subprograms and Activities according to the Federal Government Pluriannual Plan (PPA)
- Definition of a new organizational structure based on Research Centers;
- Definition of three macro processes: 1. Research, Development and Engineering; 2. Teaching and 3. Products and Services;
- Different emphasis in one or more of these macro processes from one Research Center to another according to their internal strategies;
- Definition of quantitative results indicators for each of these macro processes as well as goals for some of them;
- Organization of an annual follow up process named Plan Director Seminar.

In December of 2000 the first Plan Director Seminar was performed and since then it has been repeated annually. At that time the event was organized in 109 technical presentations that demanded 5 whole days to succeed. All the presentations had to be performed in 15 minutes by an Activity coordinator following a predefined Power Point template and the qualitative and quantitative results accomplished in 2000 should be presented. Since then, many modifications were introduced in the process, and some of them will be described later.

Almost at the same time, in 2000, the section responsible for structuring and implementing the Director Plan of IPEN also initiated the study of the Balanced Score Card methodology. Initially the idea was to understand this methodology and its implication for IPEN´s strategy formulation process. The BSC is quite easy to be understood and in the next year a Strategic Map for IPEN was already developed, proposed and approved by the IPEN´s Top Management Team (Sousa et al., 2002, p.6). The development of this Strategic Map and its respective "Board Panel" helped to identify which processes should be monitored and stressed the need to integrate the data coming from the support processes.

4.3 The demand for an effective MIS

Credibility is a fundamental aspect for an effective planning process and one basic aspect involves the management of trustful data. After the first planning – evaluation cycle, the weaknesses of this process became apparent. The Power Point presentations were operating as information systems – the data were collected and presented using the Power Point template – and many of the problems could be easily detected: lack of a common understanding of many indicators, same information presented in different presentations, repetition of results presented in previously year as well as difficulties of collecting the data and preparing the presentation.

In order to solve these problems, the design of an information system was initiated and named as Planning and Managerial Information System of IPEN (SIGEPI). Despite the previous experience, the perception of the section responsible for the Director Plan and the Plan Director Seminar was that such a system should be preferably designed and implemented – at least at the beginning of the project - with internal resources of IPEN, due to the specificities and uncertainties involved.

The beginning of SIGEPI´s design was inspired by another Managerial Information System developed by one of IPEN´s Research Center the Nuclear Engineering Research Center (CEN). Although the scope, focus and deepness of both MIS were distinct, some functional similarities were clear: (1) Same Plan-Do-Check-Action principle; (2) Easy learning capabilities offered by the MS-ACCESS software and (3) Low human resources demand: only one graduated professional from the Nuclear Engineering Research Center staff was enough to develop the whole information system.

Considering the previously failed experience and CEN´s experience, an engineer involved in both Director Plan organization and Director Plan Seminar process was allocated to design and implement the first SIGEPI-ACCESS version instead of involving someone from the System Development Section. In December 2001, six months later, the first version of the new MIS was finished.

The initial expectations about this system were high: it was expected that the software would operate through our Intranet. The link to the main database was installed at least in one computer in each IPEN´s Research Centers. The functionalities and procedures of the new system were formally presented to the managers and researchers of all Research Centers and the secretaries of each Research Center were trained to operate the system. An operating manual was also written to help the system users. But the promise did not come true: the screens of this version were not user friendly and worse, the system didn´t operate properly using the Intranet. As a consequence of these problems we backlashed and we had to collect all the data using paper form. All the data gathered were then inserted by the Planning Section in this SIGEPI-ACCESS version instead of being inserted by the Research Centers staff.

The development of the Balanced Score Card mentioned earlier and this initial experience brought some important insights. From one perspective, the poor data quality problem wasn't solved, but from another we identified that many information that should be collected and presented by the Research Center during the Director Plan Seminar were already available among the supporting sections of IPEN. In 2001 some of IPEN support processes were still being carried out manually – (e.g.: patent processes), others were already digitalized (e.g. budget) and others were being designed and modernized in terms of computerized databases (e.g.: library services, post-graduation support services). It became clear though, that all these databases could be integrated in order to have a "full" MIS system and maybe most important, we learned that such a system should be used to work for the people and for the organization and not the other way around.

The SIGEPI-ACCESS version operated until 2004, when it became clear to the top management team that there was a need to upgrade the present institutional MIS version. At that time, with all the previous experiences, we knew exactly what was necessary in terms of relational databases and information content; thus, with the support of the top management team the systems development team reengaged in the unfolding of a new and upgraded integrated management information system (IMIS) version.

At that point an important decision needed to be made concerning the IMIS design and implementation: outsource it or not?

This question was clearly expressed to the internal software development team. Both alternatives would receive support from the management director and the planning director. The management director had a preference for outsourcing due to the success of an earlier

experience in budget system. The system analysts involved in this process were inclined to develop the new IMIS by themselves – despite the programming language they were familiar was not the most appropriate but the challenge of developing such a system was too attractive, thus the design and implementation shouldn't be outsourced.

With the support of the manager of the System Development Section, three system analysts were fully allocated to write a new version web IMIS. After six months and under a lot of pressure to finish the system still in 2004, by the end of this year, a total new IMIS named SIGEPI-WEB with many new functional and databases integration facilities (income, budget, patents, pos-graduation results – ongoing, concluded and interrupted master essays and doctorate thesis -, publications and personal educational level data) - was finished and implemented. The immediate benefits were crystal clear: less data were demanded from the technical areas and the data quality reached an unprecedented level.

Figure 1, presented below, represents the data flow dynamics as well the databases integration that drives SIGEPI-WEB IMIS operation. As it can be observed, some sections (gray circles) are responsible for the data of the processes under their responsibilities. Researcher and Activities Coordinators are the data source of the information under their responsibility and that only they can supply. The researchers need: (1) to supply what they have published to the library section using the PTC-digital (a special database designed to be integrated with SIGEPI-WEB); (2) to interact with the NITEC in order to initiate and follow a patent deposit process; (3) to inform their scholarship level changes to the Human Resources Section and (4) sign up their students through the teaching section. The Activities Coordinators need to enter all the projects the group is responsible for, as well as the results of these projects. In a few words, the data gathering from the support processes, the data supplied by the researchers and by the Activities coordinators allow the management of the Director Plan.

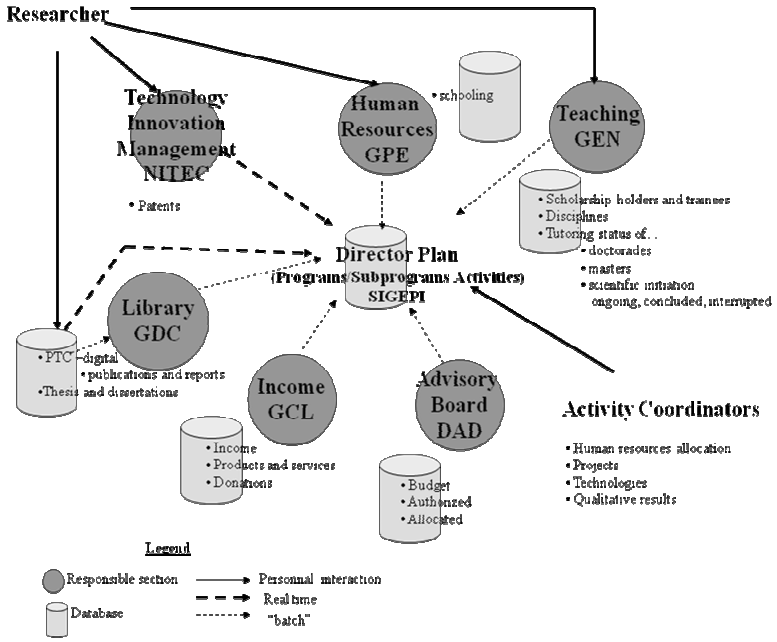

Figure 1: database integration logic and data flow of SIGEPI-WEB[1]

[1]GEN: Teaching Section; GDC: Scientific Documentation Section; GCL: Commercial Section; NITEC: Technological Innovation Section; GPE: Human Resources Section e DAD:

Three months after the new version of the system was launched, two additional features were introduced in SIGEPI-WEB which also helped to improve the perception of the benefits of such a system:

1. Automated generation of Power Point presentations for the Plan Director Seminar: the system generates the "hard" data part of the presentation by automatically retrieving and generating the slides based on the qualitative and quantitative data inserted in SIGEPI-WEB database. The Activity Coordinator responsible for a presentation is free to dedicate his time to the "intelligent" part of the presentation;
2. Quantitative indicators integration and aggregation: The main quantitative results of IPEN now can be monitored by the whole working force under diverse integration and aggregation criteria – and some of them in real-time: Institutional, Research Center, Program, Subprogram and Activities. Some results (e.g.: publications) are executed through internal partnership - these partners may be connected to different Activities, Subprograms, Programs or Research Center. The same result is properly credited to each of these aggregation levels, but institutionally they are not counted repeatedly.

4.4. Main SIGEPI functionalities

SIGEPI-WEB, or just SIGEPI, is an IMIS which operates in two sequential states: "planned" and "accomplished".

The "planned" operation mode has the objective of collecting the planning data defined by the coordinator of one Director Plan Activity for a one year time span.

The figure 2 displays the entrance screen with all the links that one coordinator has available to plan the Activity under his or her responsibility. This entrance screen is unfolded into six data groups: (1) Activity: basic information describing what the Activity is about; (2) Human resources: the allocation time can be planned according to the different team scholar profile that can be connected to the Activity; (3) Qualitative results: brief description of the main projects marks and final results expected to be accomplished; (4) Teaching Function: the expected results in terms of disciplines and orientation effort; (5) Research, Development and Technologies expected results: publications, technologies and patents and (6) Product and Service Function: expected results for commercial activities as well as for internal support activities. On the top of these six blocks, some special links are available: help, concepts, Activity planning (or "accomplished", depending on the operation mode) preview extract, planning pending data and quantitative indicators panel.

In order to facilitate this planning process, the last year results of the quantitative data are displayed, so the past information can be used as a reference point for the incoming year goal projections. For some of the regular products and services quantitative projections can be easily calculated just by entering one increase rate field and all the expected results will be automatically updated. In the case of teaching results - master and doctorate students - the system automatically calculates the conclusion date based on the legal date deadline these students are going to obtain their degree – the coordinator of the Activity may accept this suggestion or modify it. In the case of the qualitative data, the system automatically retrieves the data from the last year "on going" status, so, no need to insert them again.

Management Directorship.

Once the planning process is finished, the system mode is connected to the “accomplished mode”. The screens available are basically the same, except that some of the displayed data are based on the databases managed by the supporting areas as described in the figure 1.

Figure 2: SIGEPI entrance screen example for one Activity coordinator after logging in the “accomplished mode”

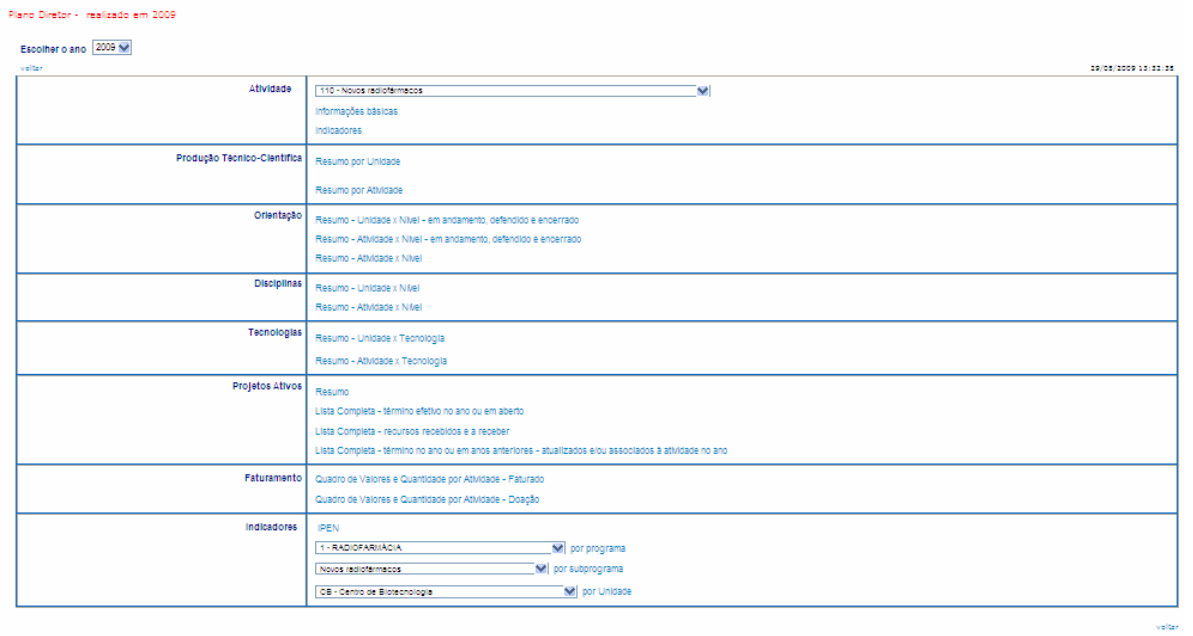

Figure 3: screen displaying the different result report categories

The SIGEPI provides several categories of reports. Most of these reports are concentrated in one screen, as presented in the Figure 3. Eight categories of reports are available: (1) Activities; (2) Scientific-and-Technical production; (3) Students orientation; (4) Teaching disciplines; (5) Technologies; (6) Active projects; (7) Income and (8) Indicators. In almost all of these report groups, additional criteria are available when the link is accessed, allowing thus refined information access.

4.5 Implementation difficulties

The implementation of an IMIS does not run softly; in the case of the SIGEPI it was not different. Firstly, as mentioned earlier, when the IMIS design was restarted in 2004, the system analysts involved in the project had the knowledge that was "enough" but not state of art.

Thus it was known that the system could face some performance limitations. Secondly, immediately after the new IMIS was released on the Intranet, the server where the program was installed presented unexpected problems – to solve the problem a server computer was fully dedicated to operate SIGEPI; thirdly, as soon as the users began to access the data derived from supporting databases, they immediately started complaining about the quality of data: many of them were incomplete or wrong. When the databases are integrated, it´s expected that they are correctly updated. In some cases they weren´t and exposed their managers to critics. Instead of observing the benefits – in the short and long term – the immediate reaction of these managers was not giving a proper support to the IMIS implementation process. Despite these initial negative reaction, the problems were gradually solved and, interestingly, reversing the responsibility of the outdated cases: in many cases the cause of the updating delay was the technical area due to presenting something pendent in regard the requisites of some supporting process (e.g.: a change in the tutor of a student hasn´t been formally communicated to support section by the former tutor).

In 2005 two new IMIS proposals were planned to operate interconnected to SIGEPI (Sousa, Giardino and Zouain, 2006). They were also conceptually developed in ACCESS (Business Plan System – SisDeN and Project Management System – SAPro) but later the integration with SIGEPI did not go ahead due to lack of availability of the internal development team as well as lack of support from the Top Management Team. The consequences of these difficulties were: (1) Research Centers that need to elaborate their Business Plan still need to write them manually (2) Some of the main Projects carried out by IPEN will continue having control deficiencies.

In 2006, the updating of the network servers operational system left SIGEPI incompatible to operate under this environment. The continuity of SIGEPI was at risk. Fortunately, a solution was found by the team of analysts but at the price of rewriting many database programs with the system operating only partially for many months.

Another problem concerns the paper work data collecting. Researchers of IPEN that are interested in financial support from the funding agencies need to fill in another database named Lattes Curriculum. This curriculum is a governmental database where the researcher academic and technological production has to be updated. Besides that, those researchers who are also involved in the IPEN´s Post-Graduation program need to supply more detailed information concerning their academic production to the "CAPES Report". The Lattes Curriculum is an important public personal database, thus, besides the financial aspect, the researchers are also interested in keeping this database updated because the access to the data is public and is also a source of who is doing what. The CAPES Report is used for the IPEN´s Post-Graduation external evaluation; thus it's important to keep the data updated in order to obtain the highest possible evaluation. A good evaluation means a good mark as well the high numbers of scholarship to be granted. The final result of all these bureaucratic demands is that these researchers that are the most productive at IPEN need to fill in their production activities into three different databases. Needless to say, that there are lots of complains about the need to supply SIGEPI´s databases with their production.

From 2007 up to 2009 new efforts to improve at least partially these presented above did not work out.
The first one was an attempt to integrate into the SIGEPI most of the information needed for the CAPES Report. The main idea was to outsource the development of the template and the integration with SIGEPI databases. A meeting was carried out with the participation of one system analyst and the manager of the Systems Development Section, the Research, Development and Teaching director, the teaching management and the Planning and Program Section manager (responsible for SIGEPI) and in that meeting it was decided not to upgrade SIGEPI. The argument that prevailed was that a personal and manual data collecting solution would be preferable to one based on an upgrade of SIGEPI. The main obstacle to change was the difficulty in obtaining the data at the deadlines: a personal and manual data collecting approach tends to be more effective than an automated one.

Two additional efforts focused on the integration and use of SIGEPI data integration with the Lattes Curriculum database.

The first effort refers to a technical visit into a Research and Technology Institute, similar to IPEN in order to know how they were dealing with Lattes Curriculum database data extracting problem. After knowing that another Research and Technology Institute was developing a solution to extract the data from the Lattes Curriculum database, members of the same team that participated at the decision meeting mentioned earlier visited this Institute for a presentation about their approach. Although their solution proved to functional for their purposes, the application of their solution to IPEN would still demand a lot of reworking effort in terms of software language programming, manual review of the extracted data as well as some complementary data request for at least one author (the Activity number of the Director Plan where each publication should be connected). Especially due to the need to review a large volume of data this solution was discarded.

The second effort refers to the possibility of exploring a feature available at Lattes Curriculum database named Institutional Lattes Curriculum. The Lattes Curriculum database has a feature where Brazilian research and teaching organizations may retrieve the production of their professionals and students registered in the Lattes Platform. Observing the results of a public reference organization in the health sector, the results pointed out the data updating problem. Clearly the last two year results could not be used to point out the institutional results of this organization.

Thus, the final remark is clear: the consolidation of the organizational results can´t depend on the data retrieved and integrated from a database managed by another organization when the data are entered by the researchers on individual basis and the publications and other documents which these data refers to are managed by IPEN´s supporting sections. This situation leads to the following situation: IPEN´s researchers will continue to supply much common information into three databases: SIGEPI, Lattes Curriculum and CAPES Report.

4.6. Recent improvements and future developments

Despite these difficulties, new features were added up to the SIGEPI recently. In 2009, for instance, quantitative indicators, lists of technologies, list of orientation status (on going, concluded and closed) and list of disciplines – all with detailed information – are now available on the Intranet and Internet. It is expected that the external availability of these indicators will stimulate the researchers to keep SIGEPI database updated since this information will help to show what they have been doing and hence helping to build a positive image of their accomplishments as well as of the Research Center.

The next planned steps to improve SIGEPI features are listed below:

(1) Researcher Portal: the objective here is to centralize in one page all the information a researcher needs to enter into the system; today part of the information demand needs to be surveyed and entered by the Activity coordinators;
(2) Graphical functionalities: currently data need to be retrieved in terms of tables and then the graphics need to be manually generated. The graphics can be automatically generated and organized as an institutional "board panel".
(3) Technological information searching function: all documents inserted in SIGEPI database could be indexed using key words. Currently only publication are already indexed, but there is no searching function available based on key words.
(4) SIGEPI Integration with CNEN SIPLAT IMIS: Presently there is no integration between both IMIS´s. The data need to be manually transferred from one system to another. The implementation of an import/export function could easily solve this problem.
(5) New modules developments: formal partnerships agreement module; training and development module and visits and events module.

5. CONCLUSION

This paper summarizes the development history of an IMIS designed to help the management of research, development and teaching activities of a public Research and Technology Institute.

The experience points out some of the design and implementation challenges of such an EIS a public organization may face:
(1) Strategic ones:
(a) Contrary to "market" practices where currently IMIS can be readily purchased and adapted according to the organizational needs, the IMIS implementation in a Research and Technology Institute requires a different approach: the knowledge management in such an organization may be very specific according to the local culture to generate process and diffuse the knowledge. Thus the development of an IMIS in such organization needs to start from scratch and not by adjusting an available market solution.
(b) IPEN´s experience showed that the development of some modules can be outsourced, but the critical modules – especially those related to the knowledge processes - should preferably be programmed by internal analyst's staff. They understand better the local culture and know who to contact and clarify tacit process aspects that would be difficult to specify in a contract if the IMIS development was outsourced;
(c) Research and Technologies Institutes may have people with excellent technical skills, including the IT area; and also may have good managers; but this experience showed the importance of having individuals strategically located with some software knowledge capable

to demonstrate, in operational terms – even in a very crude form – the concept of an integrated IMIS and, by doing this, helping the communication between the technical world and the managerial world.
(2) Technical ones:
(a) In a public Research and Technology Institute, the internal staff analysts may not always be equipped with state-of-the-art programming tools. Thus when starting an IMIS development which will last years, decision makers will face a trade off between starting the development immediately and launching it quicker but written with an older software technology or delay the IMIS development waiting for the training and learning process of a new programming tool but launched with a technology closer to state-of-the-art;
(b) Software implementation imbalances may happen: when network software is updated and the IMIS isn´t, low performance problems may happen;
(3) Behavioral ones:
(a) The demand for new habits by end users and support managers raises resistances and even in the case of a located/small system fault happens it may put the whole system into question;
(b) The RTI public organizations are financed by different interested parts, thus they need to supply their results to these interested parts. The interconnections and integration with other databases depends more on political aspects then technical aspects; meanwhile this integration is not solved, the operational levels to the institutional levels need to duplicate or triplicate the data supplying effort. The consequences are also clear: strong internal critics, lack of stimulus to update the IMIS and risk of poor data quality and/or reduced data availability.

The main implications from this experience we reported can be synthesized: (1) the cultural changes are slow, thus all the managers levels interested in the design and implementation of an IMIS need to be patient as well as perseverant with their objectives – the implementation success comes in small victories; (2) the perception of the benefits, even happening at a low pace by all work force – from the operational level to the top management team – is crucial for such undertaking and (3) the motivation by challenge and project importance of the design team – even a small one – is also crucial for the project success.

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