INMATE- Innovation Management Technique: an Innovation Management tool with emphasis on IT- Information Technology

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Abstract: The main objective of this paper is to present an innovative tool for innovation management with emphasis to the information technology-IT management called **INMATE**- *Innovation Management Technique*. In order to arrive at this tool an analysis on the current market tools was conducted. This analysis observed that none of the existent tools gives the due importance to the role of information technology-IT for the innovation process. In this way, the paper presents a brief discussion of two of these market tools: an international, called TEMAGUIDE, and a Brazilian, called NUGIN. Then the paper introduces the INMATE tool with its main dimensions. Next, the paper gives detailed account on how the IT management is dealt inside INMATE, which is done via the concept of *Enterprise Architecture*, a concept from the Computing Science and Engineering. From this concept the paper presents a methodology, in an analogy to the *Structure-Conduct-Performance* Paradigm (that is traditionally used on the empirical market analysis), which identifies the firm according to three linear connected approaches: its *architecture*, its *governance*, and its *growth strategy*.

Keywords: JEL Classification**:** L23- Organization of production; L25- Firm performance: size, diversification and scope; L86- Information and Internet services; Computer software; M15- IT management; O32- Management of technological innovation and R&D.

1. Introduction

Nowadays is practically impossible not to deal with technology and innovation. Despite the vast amount of technology tools at our disposal, every day one sees the emergence of innovations turning obsoletes the tools we have been used to.

In this way, the management of *innovation* ([1]) is becoming a business imperative. This condition was the main reason for the development of a research that could analyse an innovation management tool which could be simultaneously simple, fast e effective. Hence, some available tools have been assessed in order to benchmark one tool which could generate simplicity, speed and effectiveness, and more than that, it could fit to the current technology and innovation new environments, mainly to the Web 2.0 and Web 3.0 business environments.

Amongst the analysed innovation management tools one aspect called the attention: despite the current importance of the information and communications technologies, none of those tools pays the due attention to the role of these technologies to innovation. Therefore, it seemed reasonable the development of a new innovation management tool with a competitive differential in its

[1] Innovation of a *product* (good or service) or a *process* (technological, organizational, or marketing), as proposed by the OECD Oslo Manual, 2005.

emphasis on the information technology- IT management. In other words, a tool which paid attention to the impact of: the information content management, the information systems management, and the information and communications technology management, on the technological and organizational internal choices of the innovative firm, organization or institution.

This paper is divided into five sections. Section 2 briefly presents an international innovation management tool called TEMAGUIDE. Section 3 presents some aspects of a Brazilian innovation management tool called NUGIN. Section 4 introduces the INMATE - Innovation Management Technique, a tool conceptualized and developed by this author whose main competitive differential is its emphasis on the information technology - IT management. Section 5 presents how the information technology management is dealt inside the INMATE tool. This section is subdivided into two sub-sections: the first shows the concept of Architecture, and the second introduces the methodology of *Architecture-Governance-Enterprise Growth*, also developed by the author. Finally, section 6 presents the final conclusions.

2. TEMAGUIDE: an international innovation management tool

Within the arena of the international innovation tools it is worthwhile mentioning the **TEMAGUIDE** tool. TEMAGUIDE, a contraction of the words TEchnology MAnagement and GUIDE, is the result of a research conducted by a group of European organizations, such as Fundación COTEC (Spain), coordinator of the project, SOCINTEC, CENTRIM (from the University of Brighton, United Kingdom), IRIM (from the University of Kiel, Germany), and the Research and Development Unit of the Manchester Business School (United Kingdom). The project was financially backed by the Innovation Programme (Directorate General XIII), of the European Commission.

The basic structure of the TEMAGUIDE project contains three components: a) a description of the Technological and Innovation Management aspects from the business perspective. Its proponents look at it as being more than a description; they see it as a model that can be used either at a practical level for managing the innovation process or at an strategic level for ensuring that the Technological Management is completely integrated to business and gets the praise it deserves; b) a set of tools for assisting in specific activities of the Technological Management and the promotion of Technological Management as an important aspect of the practice of good businesses; c) a set of study cases that illustrates problems, needs and solutions from typical enterprises. These components are shown in Figure 1.

By considering that Technology Innovation is not something only related to innovating with success once or twice, but rather about frequent innovations and improvements, in other words, about enterprise *innovativeness*, TEMAGUIDE recommends a simple conceptual framework (or model) which facilitates this *innovativeness* approach. The model is based on five elements that remind the enterprise what frequently needs to be done in different points in time, and in different kinds of situations: SCAN (indicating a scan of the environment in search of signs of needs for innovation and potential opportunities), FOCUS (expressing attention and efforts in a particular strategy for business improvements and innovation, or a particular solution for a problem), RESOURCE (showing that it must allocate resources in that strategy and prepares for what it is necessary to do to make that solution works), IMPLEMENT (pointing to the implementation of the innovation), and LEARN (indicating learning from the success experience or failure), as it is shown in Figure 2.

These five elements of the model can be supported by tools and techniques of a diversified nature, such as: a) External Information (Market Analysis, Technological Forecast, Patent Analysis, Benchmarking), b) Internal Information (Ability Auditing and Innovation, Intellectual Property Management, Environmental Assessment), c) Joint Work (Interface Management, Networks,

Team Formation), d) Ideas and Problem Solution (Creativity, Value Analysis), e) Efficiency Improvements (Flexible Learning, Continuous Improvements, Change Management), e Other Techniques.

TEMAGUIDE has been publically available since 1998 e it is well recognized in the world of technological innovation management. Further details about TEMAGUIDE can be found at http://www.cotec.es. Despite being comprehensive, TEMAGUIDE does not pay the due importance to the role of information technology in its conceptual design, even in the reported cases of its implementation.

Figure 1

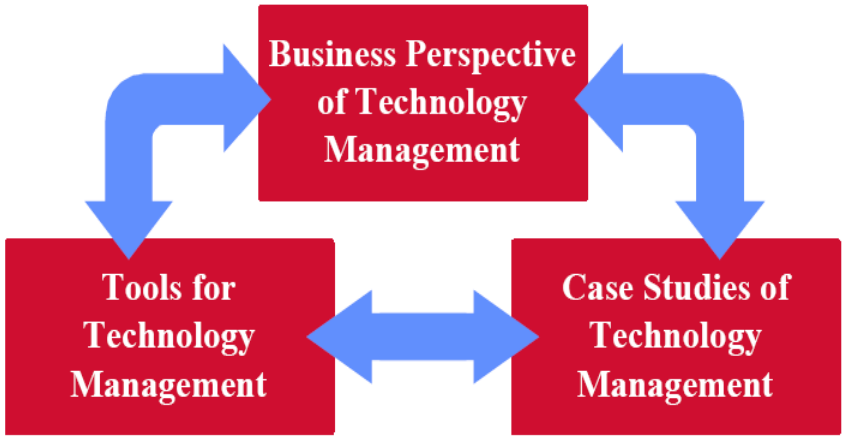
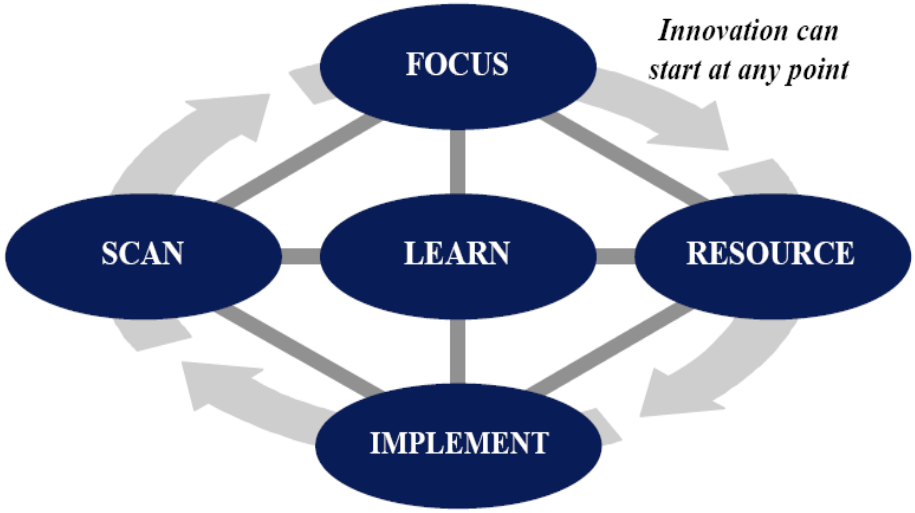


Figure 2



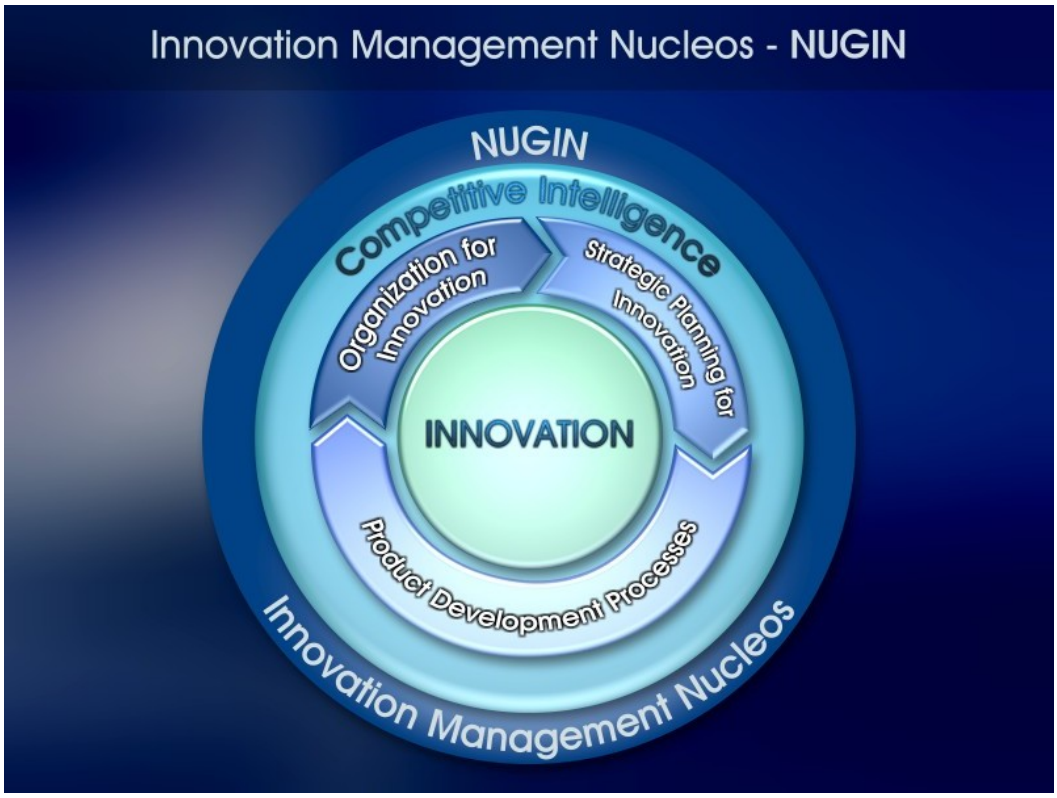
3. NUGIN: a Brazilian innovation management tool

This section briefly presents a Brazilian tool that has been recently developed called **NUGIN**. The word NUGIN is a contraction of "*NÚcleo de apoio ao planejamento de Gestão da Inovação em empresas de pequeno e médio porte*" (Nucleos for supporting the planning of innovation management for small and medium size enterprises), a project that had been proposed by the IEL/SC (Instituto Euvaldo Lodi/Santa Catarina), which is part of FIESC/SC System (Federação das Indústrias do Estado de Santa Catarina), in partnership with the UFSC (Universidade Federal de Santa Catarina), by means of the NEDIP (Núcleo de Desenvolvimento Integrado de Produtos), from the EMC/UFSC (Departamento de Engenharia Mecânica da UFSC), the IGTI (Núcleo de Estudos em Inovação, Gestão e Tecnologia da Informação) and the EPS/UFSC (Departamento de Engenharia de Produção e Sistemas da UFSC).
The NUGIN methodology, as described by Coral *et alli*. (2008) is based on the following assumptions:

a) Innovation must be a systematic and continuous process;
b) Adaptable to small and medium sizes enterprise;
c) Valuation of learning;
d) Valuation of intellectual capital;
e) Systemic vision;
f) Valuation of communications and relationships;
g) Innovation is a fundamental element for competitiveness.

This methodology, presented in a descriptive format in Figure 3, has the objective to promote innovation within the enterprise by doing systematic identification of opportunities, ranking projects, developing technologies, products and processes, and the return of this effort to the enterprise.
Its implementation starts with the *organization* for innovation, seeking to identify the enterprise capacity for innovating in products and processes. From there, one must establish an innovation management cell (*nucleous*) within the organization. The *strategic planning* of the innovation is the result of the corporate planning of the enterprise, which analyses technology and market aspects. The *product development* process comprehends several aspects since market research until the disposal or inactivation of the product, passing by the product and process design. The *competitive intelligence* involves all the other phases of the model, having its functions conducted in all the innovation process.
These aspects of NUGIN´s methodology, however, are also the elements that define its limitations. The methodology is not based in a proper justification for innovation; i.e., it takes for granted the need for innovation and seeks to structure the necessary knowledge for its implementation. It does not also departure from criteria that could point to the context in which the need to innovate (and where to innovate) expresses. In this way, it is difficult to perceive, *ex ante*, when the established tool ceases to contribute for the innovator´s performance. Furthermore, the methodology is essentially geared to the innovation management of goods (nothing is said for innovation issues in services products) in ongoing enterprises, and it does not provide any guidance for start ups or spin-off firms. Besides, by looking at the description on Coral *et alli* (2008), few is said in terms of intellectual property and funding concerns in dealing with innovation. Additionally, as the case of the TEMAGUIDE tool, NUGIN does not pay the due importance to the role of information technology in its conceptual design.

Figure 3



4. INMATE: a tool for innovation management with emphasis on IT- Information Technology

This section introduces **INMATE** – Innovation Management Technique. This tool has its roots on the experience, for more than ten years, of teaching, research e management of science, technology and innovation of the author of this paper, as well as his perception of a worldwide scenario increasingly favorable for the support of innovation within the economic environment, but, at the same time, a lack of simple innovation management tools and proper human capital formation for this management.

After a benchmark research on the current market tools, the INMATE methodology was conceptualized and developed in the form that is presented in Figure 4. Its main objective is to provide a tool in which enterprises, organizations and institutions could comprehend the diverse dimensions of the innovation process, and could, by themselves, take strategic decisions that best fit to their own interests. The INMATE methodology is based on the following assumptions:

a) Innovation is a process of perception and generation of opportunities. It is the result of a culture (entrepreneurial, organizational, or institutional) geared to the new, the disruptive, and different. It can be a systematic or a non-systematic process, depending on the context in which it reveals;

b) Innovation is an incentive sensitive process, mainly the economic ones. In the past it was believed that innovation could decline with competition, as long as more competition reduced monopoly rents that yielded successful innovators. Today it is perceived that the incentives of innovation depend not only to the innovation *ex-post* per se, but much more to the difference between post and pre-innovation rents. Hence, competition can foster innovation and growth due to the fact that can reduce the pre-innovation rents of the firms much more than reducing its post-innovation rents. In other words, competition can enhance incremental profits of innovation, and, therefore, encourage investment geared to "*escape from competition*";
c) Innovation does not correlate to the size of the organization. It can be processed either within the large, or the medium or the small size enterprises, being it a start up, a spin-off, or being generated from a technology transfer;
d) Innovation is a multidisciplinary process that could emerge anywhere inside the organization. In order to happen it is necessary to allow the convergence of distinct knowledge, competences and cultures, and in so doing, gathering them, in a continuous and interactive way, to the innovation development process;
c) Innovation must align *technical rationality* (which is geared towards success) to *communicative rationality* (which is related to the understanding of the parties involved) of the same process.

The implementation of the INMATE methodology starts from what is called the *design problem*, i.e., the problem of selecting (or designing) the *innovation strategy*, followed by the definition of the *organization* that could achieve the highest performance in the context where the innovation takes place. Assuming as its starting point the perception of a business opportunity, the strategy is selected to explore such an opportunity. Hence, an *organization* should be established (and *managed*) by properly specifying the Know-What (what to do), the Know-How (how to do it), and the Know-Who (with whom to do it).
Besides the innovation strategy and the organization management, INMATE incorporates four other dimensions. Due to the information overload characteristic of the Information Era, in the current economy it is vital to any innovation process to devise a competent management of several information and communication technologies - ICT at disposal. The ICT management reflects a previous understanding, by the INMATE tool, about what an *Information Strategy* means. *Information Strategy* is understood as a composite of the *Information Content Strategy*, plus the *Information Systems Strategy*, plus the *Information and Communication Technology Strategy*. In this sense, within the INMATE methodology, the information and communication management is the information strategy management that is needed for the innovation process.
As a result of the Information Era, it is also possible to observe the emergence of different forms of relationships and relationship networks, such as personal and corporate blogs, tweets, videologs, photologs, discussion groups, widgets, amongst others. In this way, as those different forms of relationship have been enhancing labor productivity, the INMATE methodology incorporates different aspects of several relationship networks that have emerged in the last ten years. In doing so, INMATE defines its *relationship networks management* dimension which is essential to any innovation process, particularly with the recent changes in the way new knowledge is produced via *collaborative networks* for research and development.
The development of new products, processes and services comprises a vast array of aspects, starting from market research, then the phase of product (process or service) design and project, up to its obsolescence, in a dynamics movement that is known as *creative destruction*, as defined by the Austrian economist Joseph Schumpeter in the beginning of the 20th Century. This whole cycle demands a competent *product development management* in order to arrive at the established goals in the innovative strategy. This is the INMATE *product (or service) development management* dimension.
Last, but not least, there is the *marketing management* dimension. To understand the importance of this dimension to the innovation management process, and to the consequent innovative

product sales, it is necessary to understand that there is a crucial difference between the current media (of the Information Era) and the media of the previous Era: it is the difference between *abundance* and *scarcity*. In the past we have had scarcity of access to information; today we see exactly the opposite, with the profusion of information, and associated means, as never seen before. This phenomenon was denominated by Prof. Barry Schwartz ([2]) as the *Paradox of Choice*, according to it the infinity of options available to humans is paralyzing and exhausting the human psyche**.** Therefore, in the context of information abundance it is necessary to admit the existence of an *Advertising Economics*, and fundamentally, of an emergent *Online Advertising Economics*, in which consumers are becoming increasingly more informed about the availability, variety, and quality of products and services at theirs disposal.

All these six dimensions of the INMATE methodology are covered by a conceptual apparatus of intellectual property rights which are inherent to the invention and innovation processes of products and services, particularly when technology transfer concerns are dealt with. Complementing this apparatus, the INMATE methodology defines also a parallel structure of funding models for different processes of innovation, depending on the characteristics of each innovator and the strategic trajectory established by him (or her).

Figure 4

[2] See http://en.wikipedia.org/wiki/Barry_Schwartz.

5. The Information Technology- IT Management within INMATE

This section presents how the information technology- IT management works inside the INMATE. The main feature of this dimension of INMATE is provided by how the current business technological environment can be understood through the *Architecture-Governance-Enterprise Growth Analysis*, when dealing with enterprises, and *Architecture-Governance-Organizational Growth analysis*, when organizations or institutions are dealt with.
In an analogy to the economic paradigm of *Structure- Conduct- Performance*, which is traditionally known in empirical market analysis, the *Architecture-Governance-Enterprise Growth analysis* was designed to describe how the enterprise, starting from its structure (or architecture), and followed by how it is governed, chooses its growth strategies. The next two sub-sections show how this analysis is viewed inside the INMATE tool.

5. 1. The Enterprise Architecture concept

As long as the enterprise (organization or institution) structures itself and grows in size and complexity, several factors start to inhibit its ability in solving the problem it faces. In other words, at one point in the evolution of the enterprise the factors that contributed to its structuring and business performance become numerous and complex. When one works with such complex systems, designers who face this complexity start to sub-divide it into sub-systems or domains which could be less complex than the original ones.
In the case of information systems the abstraction used to deal with this complexity is named *Architecture*. An *Architecture* (in analogy to the building sector) is a project system that specifies how all the components will operate to offer the general functionality of the system. The decomposition of the enterprise into manageable parts, the definition of those parts, and the orchestration of the interaction of those parts is what is called *Enterprise Architecture*.
Professionals of information technology field, such as Iver and Gottieb (2004), focus their attention to the set of components that allows the flexible re-tooling and the creation of support environments fro different business environments. Hence, these authors developed an enterprise architecture, called *Four-Domain Architecture – FDA*, that reflects an integration of the business processes, engines, data sources (data bases and knowledge bases, for example), visualization tools, dialog managers, infrastructure, and organizational resources.
To present the FDA, the authors separate the business of creating an enterprise architecture (i.e., the processes to defining and building models of the enterprise and organizational resources requirements) from the business of doing the enterprise job (the construction and sale of goods and services) *per se*. To the former they named the *Architecture-in-Design – AID*, and the latter they called *Architecture-in-Operation- AIO*.
In order to offer to an enterprise a guide for decision making related to the information technology projects, the authors specified some phases. According to them there are several elements in the world of information technology that can build an enterprise architecture: networks, computers, terminals, programs, cabling, data sources, tasks, and so on. To gather these elements into domains, specific architectures of domains can be built to represent a common composite, and that could be focused in a simple and clear fashion. The authors´ four domains are: Processes Domain, Information/Knowledge Domain, Infrastructure Domain, and Organizational Domain (a detailed account of these domains can be found in Iver and Gottieb, 2004).
The *Architecture Advisory Group* (US Department of Commerce, 2004) suggests a process into seven steps to define an information technology architecture: 1- Define a Vision, Objectives and Principles (Who and what their architecture efforts will cover? What general principles the IT will guide its efforts?); 2- Characterize the state of the arts (How your office does its business, what IT

is used, and how it is used?); 3- Establish a target architecture (What you wish that your IT architecture should be in the future?); 4- Determine the lags between the current and the target architecture; 5- Develop a migration plan (How would you overcome the gap between the current architecture and the target one?); 6- Implement a plan of migration and of the architecture (start to implement the plan to establish a bridge between the gaps of the IT architecture; 7- Review and update regularly (an IT architecture is a process, not a document).

5. 2. The Architecture- Governance- Enterprise Growth Analysis

The IT management methodology inside the INMATE tool is based on three approaches: a) the *Enterprise Architecture as an Strategy* approach, which was first developed by the Massachusetts Institute of Technology-MIT Sloan Center for Information Systems Research (US) and the IMD (Global Business School/Switzerland); the *Enterprise Governance* approach, based on the modern industrial (and services) organization theory; and, c) *Enterprise Growth* approach, based upon the economic theory of the contemporary firm. The three approaches can be briefly described as follows.

Amongst the approaches investigated by this paper in respect to enterprise architecture, one can be distinguished: that one from the MIT Sloan Center for Information Systems Research-CISR/MIT (Ross, Weil, e Robertson, 2008). After the development of a research of ten years about the IT impact on the performance of circa of 500 companies, researchers from the CISR/MIT arrived at some conclusions of enormous significance for the understanding of the role of IT on the enterprise performance.

According to the MIT´s researchers the reason why some enterprises – and not others- reach a superior degree of execution and manage to explore what they do better to obtain agility and profitability, is because they have a better *execution foundation*. This *foundation for execution* consists of the IT infrastructure and of the digitalized business processes that automate central capacities of an enterprise. The foundation for execution depends on the proper alignment between the business objectives and the IT systems using a direct logic.

First the administration defines an strategic direction; then, the IT unit, ideally in conjunction with the business administration, designs a set of solutions provided by the IT for sustaining the initiative; and, finally, the IT unit offers the applications, data and the technological infrastructure to implement the solutions. This process re-starts always when the administration defines other strategic initiative.

In reality the researchers realized that the traditional approach for IT development inside the enterprises was related to what they called the establishment of a set of *silos*, a set of applications inside the enterprise. Individually those applications worked well. Together they impeded the enterprise efforts to coordinating the processes to customers, input suppliers and workers; in other words, they did not constitute a *foundation for execution.*

To overcome this *silos* stage, and to build an efficient *foundation for execution*, Ross, Weil e Robertson (2008) proposed three key-disciplines: 1) *Operational Model*: it is the form to integrate the information assets and to establish patterns of the business process to offer goods and services to customers; 2) *Enterprise Architecture*: it is the organizational logic of the business processes and the IT infrastructure, reflecting the requirements of integration and patterns of the operational model of the enterprise; and, 3) *Model of involvement of the IT*: it is the governance mechanism systems that assures that the business projects and the IT reach their enterprise objectives either local or in general.

The *Enterprise Architecture* and the *Model of Involvement of IT* inside the enterprises are constituted in the evolution of *Maturity Stages of the Enterprise Architecture*. According to Ross, Weil e Robertson (2008) these stages are: a) Business Silos Architecture; b) Pattern Technology; c) Optimized Nucleous Architecture; and, d) Business Modularity Architecture.

The next step in the INMATE methodology is the *Enterprise Governance*, which must be understood as the enterprise (organization or institution) behavior that articulates the complex relation between the *IT Governance* and the *Corporate Governance* having in mind the business objectives. The *IT Governance* on the one hand, as understood by solution vendors and consultancy firms, is the implementation of best practices, mainly in IT services, i.e., services and support to the IT infrastructure, Data Centers operations, and so on (further details on Fernandes, Aguinaldo A. and Vladimir Ferraz de Abreu, 2008).

The *Corporate Governance*, on the other hand, is connected to the issues related to what in the Economic Science is called *asymmetric information*. As economic agents take decisions with asymmetric, imperfect and incomplete information, in their economic relations always emerge unbalances of power which could cause negative impacts in the performance of the involved parties, unless they are not properly treated.

Adriana Andrade and José Paschoal Rosseti (2007) list 10 (ten) issues associated to *Corporate Governance*: 1- size of enterprise; 2- property structure; 3- dominant sources of funding (internal or external); 4- typology of agency conflicts and harmonization of interests at play; 5- typology of legal regime of the enterprise; 6- typology of the enterprises according to group control; 7- ascendency of the enterprise after mergers and acquisitions; 8- geographical coverage of the enterprise; 9- cultural traces of the nations in which the enterprise operates; 10- legal institutions and regulatory frameworks in different parts of the world. They also present and discuss the 7 P´s of *Corporate Governance*: Property, Principles, Purpose; Power, Processes, Practices, and Permanence.

The last step in the IT management of the INMATE tool is the *Enterprise Growth*. The underline question of this step is: what determines the growth of an enterprise? This question has been addressed by several specialists for many years. In a series of newsletters published between 09/07/2007 to 13/08/2007 (see http://www.creativante.com.br), this author treated several aspects that have emerged on this subject, either from the empirical evidence side, or from the academic economics literature.

Summing up, it is possible to say that there are two types of growth models of the enterprise: a) *Stochastic Models* that point that the growth of enterprises is a pure random process (i.e., in the long-run some enterprises are lucky and tend to get a share above the average rates of growth, while other get bad luck and tend to remain at the same size or decline; b) *Non-Stochastic Models*. In this second kind of models there are: i) Optimization Models based in learning (passive and active); ii) Growth Models based in accumulation of human capital and those of quality ladders based on research and technology, and stochastic innovation; iii) Growth Models based in the development of the financial sector.

The approach developed inside the INMATE tool is one that filters the conditioning factors of growth (such as the macroeconomic environment) and focus on the growth strategy of the enterprise. A central concern in this approach is to model stages of growth of the enterprise. In this respect, the INMATE departures from some established models such as the *Greiner Model of Growth* (Greiner, 1972 and 1988).

Models like these from Greiner have direct correlation to the *Information Systems Maturity Models*, such as those of Nolan (1973), Gibson and Nolan (1974), which are based in the technology used and the budget of the *information systems – IS* as indicators of maturity of the information systems management, by applying an S curve consisting of four stages: i) Initiation; ii) Contagion; iii) Control; and, iv) Maturity. Nolan´s model has been expanded in Mutsaers, Ziee and Giertz (1977). These authors described three curves in S shape as three eras of the IS management maturity: Data Processing ; Information Technology; Computer Networks.

6. Final Conclusions

As it was indicated in this paper amongst market tools for innovation management none dedicates special attention to the role of information technology – IT in its innovation processes. Such an insight catalyzed the opportunity for the development of a tool that could involve the complexity of what it is means to manage modern IT technologies in the innovation processes.
In this respect this paper showed two market innovation tools: the TEMAGUIDE and the NUGIN. Then, the INMATE- Innovation Management Technique was presented with its main assumptions and dimensions.
The central concern of this paper was to demonstrate some details (and complexity) of one dimension of INMATE: the IT management dimension. By appropriating from Computing Science and Engineering the concept of Enterprise Architecture, the paper has given special highlight to a new methodology, called *Architecture-Governance-Enterprise Growth*, which embodies an analogy to the economic paradigm of *Structure-Conduct-Performance*, which is traditionally utilized in empirical market analysis. This new methodology relies on three treatment approaches: a) the Enterprise Architecture as an Strategy approach; b) the Enterprise Governance approach; c) the Enterprise Growth approach.
Despite being presented in a brief fashion, it is hoped that this INMATE tool, with its own concepts and methodology shortly presented here, can allow a new orientation for the analysis of innovation processes, since these processes can not any more ignore the advances proportioned by new content, systems, and information technologies.

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