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Model Engineering Research Supported by Knowledge Management

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Abstract: This study presents a model of research in engineering based on strategies for knowledge management which aims to improve the relationship between the academy, the research and the enterprise in order to reduce the gap in the field of information and knowledge to strengthen the research in engineering. For this purpose, it was employed the complexity theory, applied to the academic research groups where it is expected to relate the features that are implicitly stated and they look for to provide common solutions to the problems presented in the current society, especially, in the implementation of the possible innovations (new or improved knowledge) found with the support of the public or private companies.

Key words: Model, research, academy, enterprise, engineering, knowledge management

INTRODUCTION

In college, the research seeks profound social changes that demand a response that leads to the realization of institutional changes that improve the relationship between academic research and business. To achieve this purpose it is necessary to design an organizational model of knowledge management at the university, supported by information technologies and communications, to facilitate and accretive development: scientific, technical, educational and intellectual production.

Additionally, the globalization of knowledge with new processes and development schemes seeks to create a new organizational and educational paradigm, applied to higher education where education and high quality services offered. Intellectual capital and especially, the human capital is the base that supports an organizational model based on knowledge management. The university has accumulated knowledge in different forms such as research, techniques, models or processes, learning models, among others to be managed to be competitive.

Based on the approach of an organizational model, the university provides the academy management processes that facilitate monitoring activities such as teaching, research projects, extension, new academic programs where the company and the university converge.

With knowledge management in relation academy research and business, it is expected to optimize the national and international collaboration of researchers or experts of different subjects, thus, increasing interdisciplinarity, improving the resolution of complex problems which seeks to apply advanced knowledge in different areas of research.

Similarly, one must understand the dynamics of research groups science as is argued Monroy in other words you need to see the process engineering research from the perspective of complexity theory which you can apply the theories of Morin (2004) who speaks of complex adaptive system which are in constant interaction with their environment is an open system where information and communication in the context flows, allowing transform, adapt and evolve with the purpose of stay in time.

Fundamentals of knowledge management and research: Knowledge management is an innovative term within the university, although, it is well known that the academic community does not know its scope and often its meaning and what it entails such management. This community uses the information passing through processes such as: learning, problem solving, strategic planning and decision making in critical situations, not knowing or add value to it. Knowledge management is used from the teaching of the fathers to the children or teachers to their students.

As Contreras (2012) argues, organizations have realized that there are intangible assets (information and knowledge) to be administered well in order to generate competitive advantages and thus compete in a globalized economy. In the mid-90 knowledge management emerges, defined as the set of processes that drive the analysis, dissemination, use and transfer of experiences, information and knowledge among all members of an organization to generate added value.

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This research stems, therefore, the need to generate a model of knowledge management for development and interaction of academia, research and business in which the engineering sciences articulates, based on a review of the issue of integration of knowledge and the internal-external experience-developed in different activities outside of their functioning, social and corporate responsibility.

To achieve this, the issue was addressed from the complexity theory considering adaptive systems and intelligent systems that help optimize solutions, addressing from the concepts of networks or hierarchies generating joints between different engineering sciences.

Moreover, entrepreneurs have no information about the research capacity of universities or support for specific alternatives of appropriate solutions (offers or demands) of productive and social sector.

The systematic reaction of academia, research and business focused on competitiveness, knowledge management and strategic activities is appreciated (Fuentes and Albors, 2006). From the systemic model you can see the relationships are between the academic sector (environment of scientific dynamic, teacher-R&D academic), business sector (environment of productive dynamic, economic-private R&D and operational technology) which constitutes the innovation subsystem academic-enterprise. These conform the structures of production-technological-scientific interface with teaching functions of R&D and economic.

Modern economies will no longer depend on factors such as land or financial capital for development with respect to the factor work is focusing mainly on the type of knowledge worker this intellectual capital improvement dynamics systems are charged with obtaining more dynamic, generation, implementation, appropriation and exploitation of knowledge. The functionality of these elements involves a relationship where an element influences another, generated dynamic behavior.

In a knowledge-based economic approach, a theory explains how the company builds knowledge through experiences in learning processes and organizational routines of your staff as well as its competitiveness which is becoming increasingly dependent on the "Evolution of the development of these processes into the company" (Nonaka and Takeuchi, 1995).

This is one look of the dynamic knowledge management corresponding to the activities of knowledge creation and organizational learning in which are involved different internal and external to the company stakeholders, its dynamics to create new knowledge ability as from existing can be purchased through the accumulated knowledge or action learning (Cantu and Veciana, 2005).

For creating the dynamic capabilities must meet a set of resources with complex patterns of coordination between these people and also for coordination are needed each particular learning skills that mature through repetition (Grant, 1998).

There are organizational societies conformed by human resources dedicated to handle common knowledge management processes such as universities, companies, research centers and innovation (Barney, 1991) these organizations have knowledge sources, internal and external, produced and reproduced in a social framework of information and know-how.

For our case study, sensory and intellectual activities basic process of knowledge management in an organization are: obtaining, combining the generation, accumulation and application of knowledge (Fuentes and Albors, 2006).

As mentioned before through generating a model of knowledge management for the development of academy, research and business, obeying a need to unify the information and knowledge of engineering and technology, environment issues joint research and development projects which requires permanently both teachers, students and alumni to check the progress of science, the search for solutions to problems that constantly raises the nature and particular areas of knowledge that are developed be allowed in different curricular projects.

Likewise, the organizational scheme is changing radically, mass communications, globalization does not accept an organization if you are not willing to progress. The activities taking place in the environment academy are attractive, agile, relevant and always tend to be linked to the social reality. Socialized knowledge that, the media offer makes it possible to think of new forms of education coverage, quality and decreased investment resources. In addition to improving the mechanisms with which we can improve the academic processes of the university and is one of the pillars of national development.

It is intended, so that, the implementation of a knowledge management model where the university implemented a new organizational scheme, supported by the three pillars offered academia, research and business and which converge in the generation of a system knowledge management.

MATERIALS AND METHODS

Model engineering research support by knowledge management: The model is based and initially represented on a level of context or general level (Fig. 1) where the need to interrelate academia, research and business is

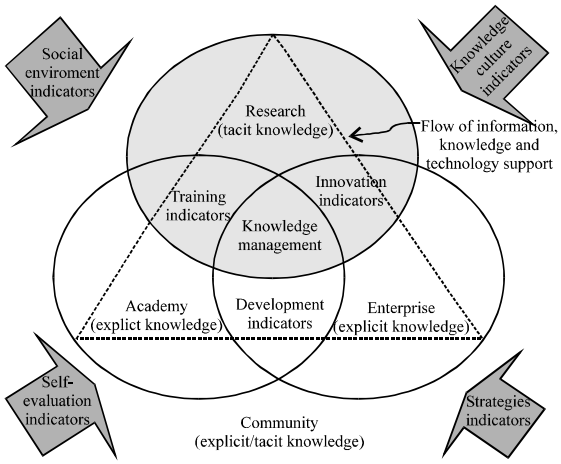

Fig. 1: Model engineering research support by knowledge management

expressed through a management process based on knowledge. This means that to achieve a balance between them the university and the enterprise must demonstrate ability to adapt to social, technological and economic environment changes in a timely manner or moreover, induce and/or anticipate them by supporting a series of enablers associated with the knowledge they generate and that has to manage properly and optimally.

These 3 components or units are represented as nodes, containing resources based on knowledge where it is generated or transferred knowledge and can perform various processing functions or required internally treatment or through links or relationships in a network.

The three interconnected nodes: academia, research and enterprise coexistence resembled the university and the enterprise ever more complex, interconnected and changing and with a horizon supported by research that can generate. In addition, a central intersection between them that is the core of the whole model is conceived: knowledge management which aims to be the engine of strengthening inter-institutional. The nodes are vertices that could be called the "Inter-institutional triangle" in permanent contact and interaction where information and knowledge supported by technology that facilitates the process flows. This scheme is framed within the ambit of a dynamic and increasingly demanding society.

But in order to facilitate the representation and understanding of other areas susceptible generation and dissemination of knowledge, other levels of abstraction are defined this means that nodes can form sub-nodes institutional triangle completely related or interconnected, forming another level of appreciation and in turn these sub-nodes would form another and so on until a level of representation understandable. In theory, it is understood that the hierarchy does not prevail by no means in order to manage knowledge, so, the functional level scheme is interconnected networks.

Conceptually in the model, organizations get some results that you get through the behavior of their facilitators agents, i.e., the actions of its personnel and the operation of its processes (Velasco and Quintana, 2003).

In the academy and enterprise, facilitators agents are the elements that will allow us to promote the actions of the policy of the university or business organization and management or fulfillment of such actions is evaluated according to the behavior of a number of indicators that will facilitate the identification, development and retention of knowledge and that definitively allow us to maintain or fulfill the mission of the organization.

As it is appraised in the model, the facilitators agents are associated with a particular node in order to provide a defined area of knowledge and they can agglutinate the different indicators that provide us with the decision on the proposals for achieving the strategy. We can also understand the indicators, like measurement units that help track the dynamics of processes and performance and therefore verify compliance with the objectives of an institution in fulfilling its mission (Medina *et al*., 2013).

In practice, the model presents an abstraction of relationships that can be generated between the academy, research and enterprise where: the academy as an institution generates the organizational and logistical support for research in undergraduate education, masters and doctorate but in turn also generates development in engineering and technology, to meet the needs and receive the resources businesses. Moreover, research from undergraduate education, master's and doctoral generates innovation for companies that have needs and provides sustainable resources and support this relationship. And at the intersection or confluence of the three nodes knowledge as a source of power and central axis susceptible to bring value to the organization and support actions in compliance with adequate knowledge management is conceived.

Finally, integration into academic, organizational and logistical physically consolidated in support of a Center for Research and Scientific and Technological Development in Engineering where knowledge management model applies to its functionality.

RESULTS AND DISCUSSION

Simulation of the relationship between the academy, research and enterprise: For our case and in general, it

Table 1: Basic relations in Ithink

Parameters	Variables
	Level: represent accumulations of stocks, levels that is what accumulates. eg. population, inventory, employees, precio-producto. Units: No. of individuals, number of items, etc
	Flow: rate of change of a level, fill or vacate levels. They can be input (inflow) or exit (outflow). Example: No. of individuals born each year, monthly hiring rate. Units: No. of items/unit time
	Connector: spend information: converters levels, levels flow regulators, flow regulators flow regulators, flow regulators converters, inverters flow regulators and converters to other converters
	Converter or auxiliary variable: modifies inputs into outputs are useful to disaggregate and break into detail the logic model, calculated algebraic relations can be constants used to calculate the value of a stream. Contrary levels, converters do not accumulate anything. Eg number of individuals born per individual that exists, every year. Units: No. of individuals/No. of individuals/unit time

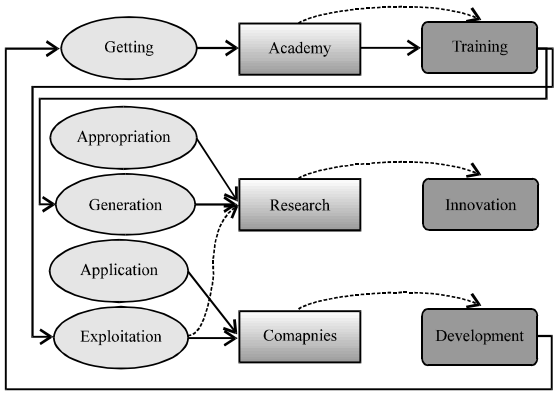

Fig. 2: Dependency relationships of the variables of a practical model of knowledge management in academic institutions

can create a direct and indirect relationship between the application variables, generation, acquisition, ownership and exploitation of knowledge with respect to academy, research and enterprise in a way that generates results as training, development and innovation. Besides the initial variables are fed back and generate cycles of improvement in knowledge management (Fig. 2).

The obtaining of knowledge has a direct relationship with the academy because it is training and other activities receiving teachers to subsequently take charge of training and formation or knowledge transfer to other academic or administrative people.

The appropriation and knowledge generation is directly related to research because patents and research generates knowledge innovation processes. The application and exploitation of knowledge has a direct relationship with the enterprise because through extension development is generated both for her and for society.

Being a dynamic knowledge system, all parts are interrelated but in our case analysis indirect relationships between the exploitation of knowledge and research as supports of technical and economic resources are generated also have indirect relationships as regulation of each stock according to his product. Finally, we can conceptualize that a dynamic knowledge system is fed back products to the variables to continue the cycle of spiral growth.

Development of simulation and mathematics models: For our example, Ithink 8 Software was implemented where to understand the functioning of program, the building blocks shown in Ithink where some basic relationships that are explained in Table 1 were modeled.

In the program, the relationship model between the different levels of stock in academia, research and enterprise, feeding on some flows (exchange rate) as: the obtaining use application, generation and appropriation of knowledge (variables). But it also shows that, a form of feedback relationship in the academy with the formation is generated, the company with research and development innovation has a feedback to development and finally, research has a degree feedback to innovation this relationship is seen in the equations below shown.

The academy through training collaborates with the company (exploration) and research (generation) in turn the enterprise (development) collaborates with the academy (obtaining) and altogether improve knowledge management in academic institutions as shown in this example for the analysis proposed, although they may propose more cases (Fig. 3).

Finally, the equations used in the example of the case where rules and relationships of different levels, flows and modeled connectors are shown as follows:

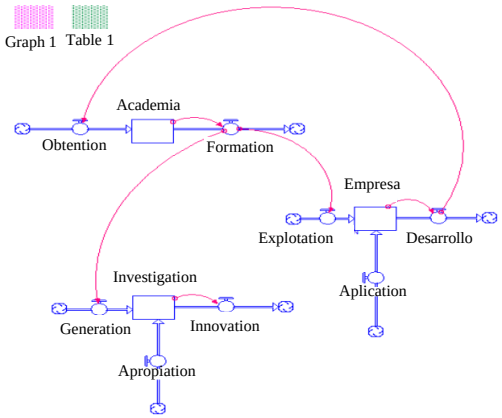

Fig. 3: Model dependent relationships of the variables of practical model of knowledge management in academic institutions in the Ithink 8 program

Academia (t) = Academia (t-dt)+(Obtebtion)*dt
INIT Academia = Obtention+0.5
Inflows:
Obtencion = Desarrollo*0.2
Outflows:
Formation = Academia*0.5
Empresa (t) = Empresa (t-dt)+(Explotation+
Aplication-Desarrpllo)*dt
INIT Empresa = Aplication*0.2
Inflows:
Explotation = Formation*0.7
Aplition = 20
Outflows:
Desarrollo = Empresa*0.2
Investigation (t) = Investigation (t-dt)+
(Generation+Apropiation-Innovation)*dt
INIT Investigation = (Generation+Apropiation)*0.3
Inflows:
Generation = Formation*0.3
Apropiation = 10
Outflows:
Innovation = Investigation-0.60

In Table 2, the variation of stocks accumulations academy, research and enterprise over time with which the model was constructed is shown. Where was shown as levels of accumulation of knowledge is generated.

This table represents the accumulation of stocks of academy, research and enterprise generated in the levels of accumulation of knowledge. It is clear that, this is a cursory simulation of reality but which is still investigating and simulating.

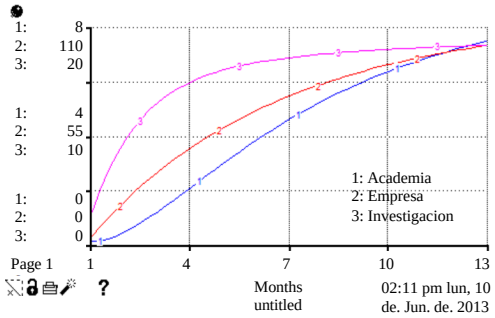

Fig. 4: Stock levels of knowledge in academy, research and enterprise

Table 2: Variation in stocks accumulation academia, research and enterprise

Months	Academia	Empresa	Investigate
1.00	0.08	4.00	3.00
1.25	0.11	8.81	5.06
1.50	0.18	13.38	6.80
1.75	0.30	17.72	8.29
2.00	0.44	21.86	9.56
2.25	0.60	25.81	10.64
2.50	0.78	29.57	11.57
2.75	0.98	33.16	12.36
3.00	1.19	36.59	13.04
3.25	1.41	39.86	13.63
3.50	1.63	42.99	14.14
3.75	1.86	45.99	14.58

It is concluded that using software such as Ithink, we apply a system dynamics for modeling levels, flows and connectors of the relationships of a system such as that proposed which involved academy, research and enterprise and to simulate, validate and test with more specific and actual data. For example you can see that there will be an equilibrium point where generate stable development in knowledge management in academic institutions (Fig. 4).

CONCLUSION

This study has raised a model engineering research supported by knowledge management at the university which aims to demonstrate the need to change or improve traditional or classical structures for model more functional, flexible and efficient operation that allows to resize the spaces for the production, dissemination and transfer of knowledge with the support of new information technologies and communications.

The academy based on the university must undertake structural reforms to solve problems of technology, globalization, access and participation, consider new forms of learning and training of new academic and undertake organizational and financing reforms. In other words, the model essentially raises the need to generate an appropriate relationship between academy, research

and enterprise, all this in order to strengthen knowledge management towards profit impact for the community.

With the development of this model administrative, logistical and educational components will be integrated seeking to consolidate a center of scientific and technological research in engineering a higher institution with reference to other existing research institutes.

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