Design of a learning community for System Dynamics

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Abstract

This paper shows the objectives, model, functional structure and elements in the design of system dynamics learning community. This proposal of the design is motivated by the need to work and facilitate the learning in a collaborative way for members of the community of systems dynamics in Latin America in the fields of investigation, teaching and consulting. The article concludes with the discussion about possible benefits to apply knowledge administration in that design.

Keywords: Learning community, design, modeling.

1. Introduction

The motivation of this work is to put in practice the use of the System Dynamics (SD) in the design of one learning community. In fact, a learning community for its own study and application. The article focuses on modeling.

A learning community could intensify the collective capacity to facilitate the individual reconstruction of the participants. It is promoted then to share individual competitions with the purpose of producing value in the organization

On design, (Forrester, 1998) it explains, in the analogy of the pilot and designer of airplanes, the purpose of Dynamics of Systems towards the design of organizations. In this one writing the difference between the two activities specifies to handle or to control an organization and the one to design it. This one last one, emphasized in the video "Designing for Corporations Success in the 21st Century" (Forrester, 1995) in where refers to the design in the sense in that a chemical engineer would design a chemical plant.

Really, Could we be able to design our organizations in which we participated in an engineering way? With elements more rigorous than the intuition, beliefs, non-explicit knowledge of our mental models, particular experiences and good will. The following definitions have been useful from a point of view practical and operative to work in a context of knowledge and learning.

Knowledge: capacity of effective answer (Emergence, 1999), (Bourguet and Grove, 2000).

Learning: process of significance construction (ITESM, 2001). Recreation of ourselves (Senge, 1990.14).

Intelligence: ability of effective use of knowledge (Systems Thinker, 2001)

Knowledge Management (AK): administration of the capacities of organization effective answer; it mainly refers intangible elements of value.

Learning Community (CL): group of people who share their competitions in the reconstruction of themselves with the objective of producing value.

Creative tension: existing force in the people to reach its goals. It is originated by the difference between a vision puts and a present situation (Senge, 1990, 142).

The organization of the article is the following one. The modeling of the situation appears in section 2. The functional architecture and the work are described briefly in section 3. Finally, the conclusions appear in section 4. Used references are included in section 5.

2, Modeling of the Learning Community

The modeling of the learning community that appears follows the steps proposed by (Albin, 1995), that is to say: (1) Conceptualization, (2) Formulation, (3) Tests and (4) Implementation.

2.1. Conceptualization

The problematic situation that is identified is the lack of integration of investigator-consultants in Systems Dynamics that allows capitalizing its talents and visions in projects of personal growth and production of value in its community.

The clients of the model are professors, researchers, consultants and every people interested in the design of the learning community in System Dynamics.

The option to improve that it considers is the one to construct a learning community that allows to way of alliance and society between the participants to help itself to reconstruct itself thus same to generate value.

The objective of the model is to develop an understanding of how the interactions of individual knowledge entities in a learning community produce the change processes of stagnation and growth through time.

The intentions of the model are: (1) to clarify the knowledge and understanding of a community of learning in the short and long term; (2) to create a shared vision within this community, (3) to discover policies that allow to leverage the learning community and (4) to construct a commitment between the participants to construct and to maintain the community.

The time horizon is of 10 years. The first 3 years are considered as short long term and after 5 years term. The dynamic hypotheses consider periods of stagnation in short term, followed of a growth maintained in subsequent years.

The basic mechanisms are described next using the stock and flows diagram in Figure 1. This diagram represents the interaction of two organizations of knowledge A and B interacting in a learning community. A knowledge organization can be a person or a group. Nine processes of change due to the perceived interactions are generated: three processes of balance and six of reinforcement.
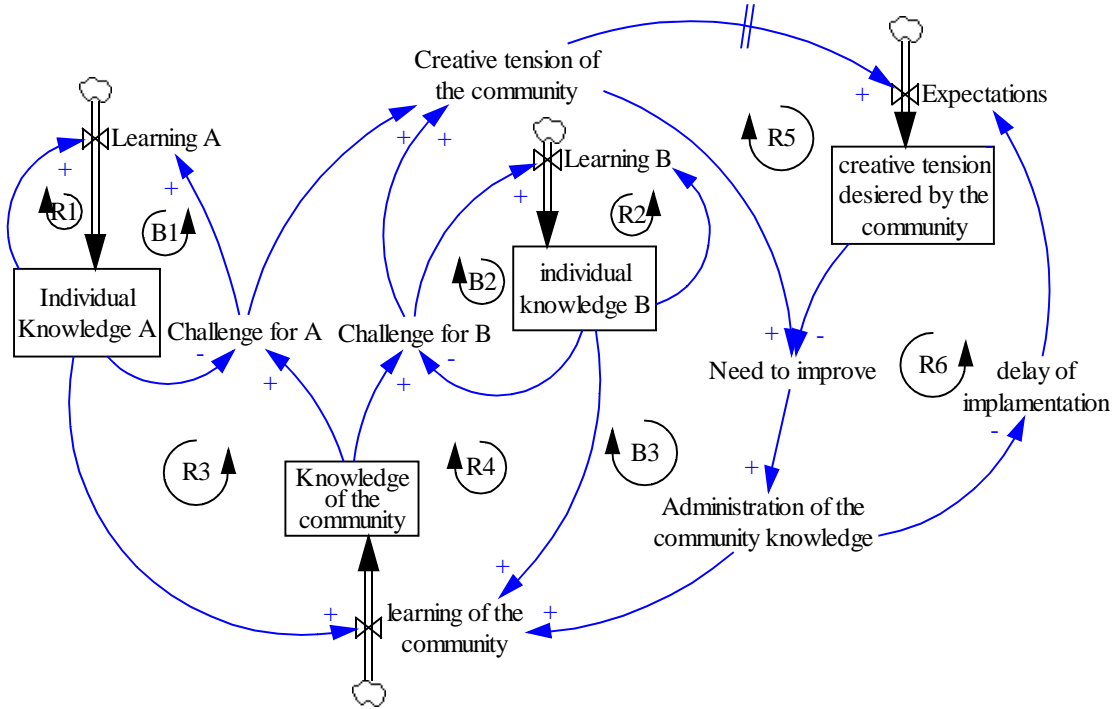

Fig 1 Interactions and processes of change in the learning community

The processes R1 and R3 refer the cycle of reinforcement where greater learning generates knowledge, which its time will allow to learn more. This process finds its limit with the knowledge available in its community. The processes of balance B1 and B2 show that with the growth of knowledge the challenges are reduced which attenuates the learning process and the rate of growth of the knowledge is reduced. Each organization of knowledge contributes value to the community that is reflected in a learning of this one. The processes of reinforcement R3 and R4 include this interaction and show as this increase generates more knowledge of the community. The challenges are increased to face, which will generate more learning for the organizations, with its increase in knowledge and its contribution of return to the community. These processes of reinforcement interact with a process of denominated balance B3, which will impose a limit. B3 indicates that to greater learning, greater knowledge in the community and consequently greater challenges to the organizations set out. Between greater challenges, greater creative tension of the community. It is reduced then the present difference between wished and the referring thing to creative tension, reason why the improvement necessities relax and the

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effort of administration of the knowledge therefore also diminishes. Consequently, the learning of the community promotes less and diminishes the reason of change of the knowledge. A process of reinforcement related to B3 is the one that appears like R5. This it indicates that to greater creative tension of the community, greater expectations are created, and therefore the creative tension wished by the community is increased. With this increase the perceived necessities of improvement increase and a greater effort is requested to the knowledge administration. Finally, the bow of R6 reinforcement refers to that to greater effort in knowledge administration, the implementation retardation is reduced to make the expectations like part of the wished creative tension. When being reduced east time they increase the expectations, those that increase the reason of change of the wished tension and generate a greater necessity of change.

2.2. Formulation
Next, a comment about the mathematical relations proposed for the interaction between variables.

The change of the stock variables is the origin of the formulation of the model.

- Learning Community - reason of change of Knowledge of the Community.
- Learning A - reason of change of Individual Knowledge A.
- Learning B - reason of change of Individual Knowledge B.
- Expectations - reason of change of Creative Tension Wished by the Community.

For the qualitative variables of Knowledge the operation interval has settled out 0-100. In where 100 mean the maximum supposedly attainable knowledge in a period of 10 years. Their units denominate Units of Knowledge (uk). Therefore, the variable Learning has like units (uk/year).

The structure of limits to growth has proposed out for the stocks Individual Knowledge A and Individual Knowledge B. Thus Learning A and Learning B are proportional to the Knowledge and the Challenges. The equations in Vensim are:

Learning A = 2/100*Individual Knowledge A*Challenges for A

Where the value of 2 implies that the maximum "doubling Time" is 0.7/2.0 = 0,35 years. The value of 100 comes from the Maximum scale 0-100. To see (Sterman, 2000, CAP 9) for more detail in the parameters of the equation.

Learning B = 1/100*IndividualKnolwedge B*Challenges for B

Where the value of 1 implies that the maximum "doubling Time" is 0.7/1.0 = 0.70 years. The value of 100 comes from the Maximum scale 0-100. To see (Sterman, 2000, CAP 9) for greater detail in the parameters of the logistic equation.

Learning of the Community = 0.15*(Individual knowledge A+ Individual Knowledge B)/100 * Administration of the Knowledge of the Community

Where value 0,15 assumes a change of annual 15% considering the influences of the individual knowledge. The value (1/100) standardizes the values of knowledge whose intervals of operation are of 0-100. The part of Administration of the Knowledge of the Community comes given investment a necessity from improvement to reach a wished creative tension. Therefore, the individual knowledge of standardized A and B are the modifiers of the 0,15 like rate of the change reason.

Expectations = Creative DELAY1I(0.1* Tension of the Community, Delay of Implementation, 1)

Where the delay of first order has like constant of time to the value of Delay of Implementation. This one indicates the time average that takes an expectation in becoming part of the creative tension of the community. Initially, the reason of change of the wished creative tension is assumed equal to 1. The delay of Implementation has a value of 2 years in case of not having efforts in the knowledge administration. The value of 0,1 represents proportionality in the impact of the creative tension in the expectations.

2.3. Tests

The basic mechanisms of shown reinforcement and balance in fig 1 if they allowed implementing the dynamic hypotheses propose on the stagnation and growth of knowledge in a community. The stagnation is associated to an administration of knowledge (AK) poor and the growth to an excellent AC, fig 2 and fig 3 shows these behaviors respectively.
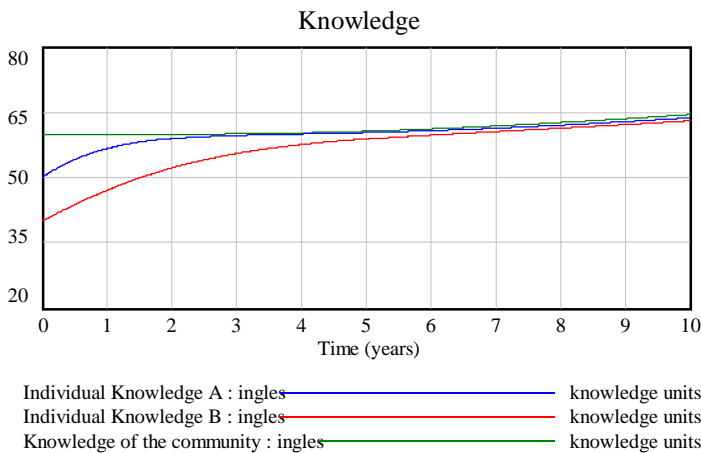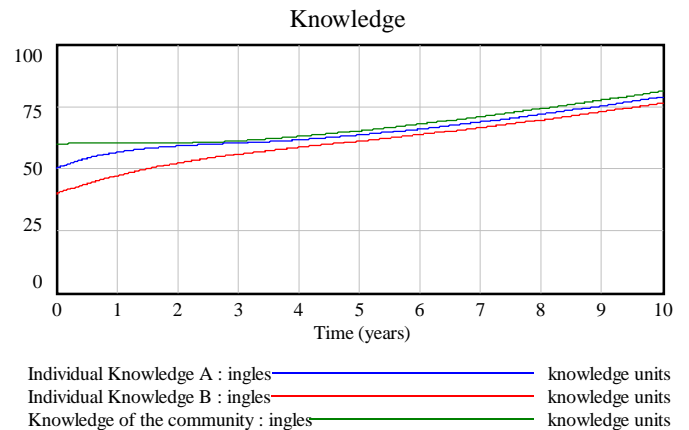

Fig.2 Knowledge with a poor AK

Fig. 3. Knowledge with a relevant AK

individual A to and individual B. The heavy line distinguishes to the knowledge of the community. It is observed as the individual curves of learning practically reach to the knowledge of the community in three years. The situation appears where the individual to have a greater initial knowledge and a higher rate of learning with respect to the individual B. The scale goes 0-

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100, where 0 is not to have idea of Systems Dynamics and 100 represent to reach Maximum the supposedly attainable capacity of knowledge in a period of 10 years.

During this phase of tests, proposed parameters adjusted initially. The excellent adjustments took place in: Administration of Knowledge of the Community and Retardation of Implementation.

Administration of the Knowledge of the Community = DELAY3(1*Needs to improve, 4)*0.3

Where a proportional relation with Necessity of Improvement sets out directly. A delay effect is introduced to emphasize that the change is not instantaneous. When AC is poor, case of fig 2, considers a time average of retardation of 4 years and an impact of 30% (value of 0,3 outside the parenthesis). When AC is excellent, it considers a time average of retardation of 2 years and an impact of 100% (value of 1 outside the parenthesis).

Delay of Implementation = 2-(Administration of the Knowledge of the Comunidad/50)

A delay of two years is considered when there is no AC (AC=0%) and a delay of a year when AC is 50% of their Maximum capacity.

2.4. Implementation

The first step in the implementation was to decide what political would be the attention center to create the learning community. In this case it was the incorporation of a knowledge administration.

The test made in the policy consisted of numerical changes of the variable Administration of the Knowledge of the Community. The description of the used values is in Subsection 2,3, previous. Its results of what it would happen if there is an excellent use of AC? With respect to knowledge they are in Figs. 3 and 4.

Next the behaviors observed in the rest of the variables are explained. In the Figs. 4 and 5,
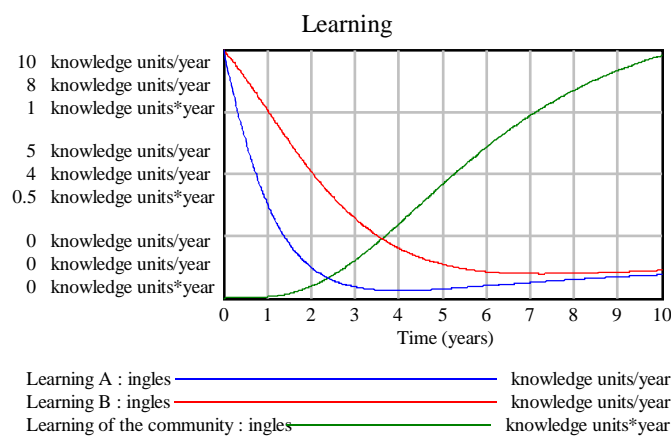

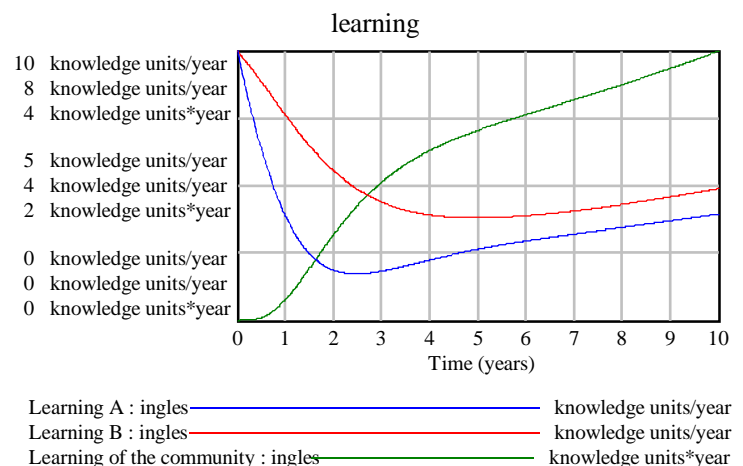Fig 4. Learning with a poor AK   Fig 5. Learning with a relevant AK

It is observed as throughout the time the learning diminishes. This is due to that the limit of knowledge of the community is reached. Every time it is less necessary to learn. The community decay in 10 years with poor AC. In fact, the learning can get to be almost null. In the other case, with excellent AC, the capitalization of the individual knowledge allows to grow to the community and to maintain a growth in the participants and itself
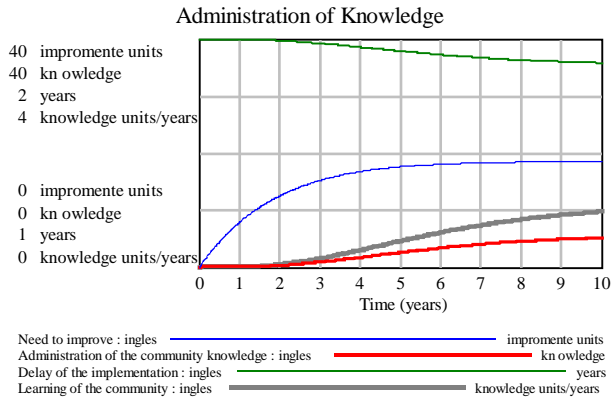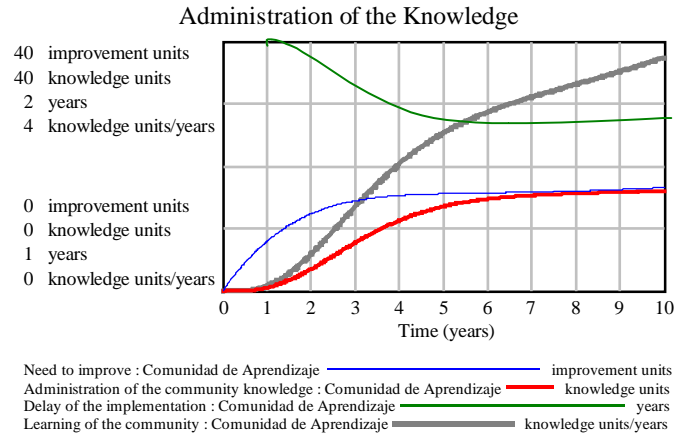

Fig 6. Learning with a poor AK

Fig 7. Learning with a relevant AK

Through comparing the Figs. 6 and 7, in the same way, are observed the benefits to apply excellent AC. The time of implementation is reduced; the improvement necessities are taken care of almost in 100%. The important variable Learning of the Community is observed with a maintained growth.
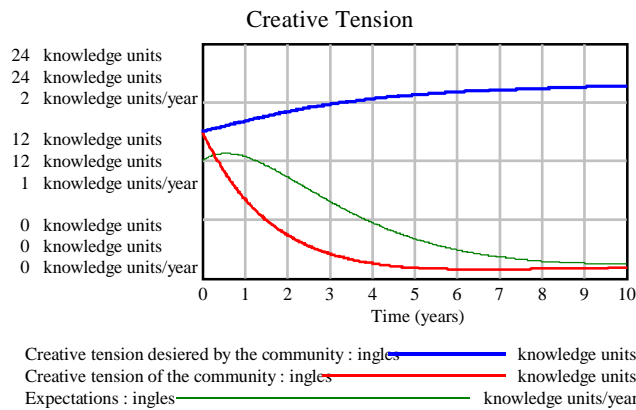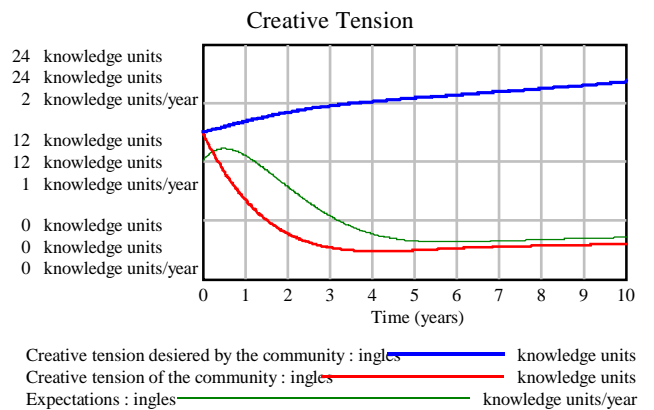

Fig. 8. Creative tension with a poor AK

Fig. 9. Creative Tension with a relevant AK

Finally, the variables related to creative tension are observed in the Figs. 8 and 9. Notice that the difference between a case and the other so is not marked as in the other variables of the model. An explanation could be that the individuals To and B, looking for to reach the knowledge of the community, in average get to reduce the number of challenges to such degree

that the distance between the vision puts of the individuals and the present one is reduced significantly, which would pronounce themselves like an attenuation in the creative tension of the community. This in the long term raises a challenge How to maintain the creative tension of the community in a degree or wished value? An option would be to increase the tension in certain periods of time and later to let to the system look for its own goal. This would allow to challenge strongly to the community in planned periods of time and later to give times him of recovery.

3. - Functional architecture

The objective of the learning community is to intensify the collective capacity to facilitate the individual reconstruction of the participants. It is promoted then to share individual competitions with the purpose of producing value in the organization.

The functional architecture propose in the design considers the functions and elements shown in fig 10. According to (Shaker and Gembicki, 1999), the intelligent organization must count on three basic functions: (1) to acquire, (2) to process and (3) to scatter information, knowledge and experiences. The acquisition will count on the harvesting of information and its functions of basic preprocess, such as, classification, codification and priority, mainly. The use of Information systems will be required then. The processing consists of the added value, which they generate specialized groups of interest, which analyze, they synthesize and they filter given internal information in reports. The dissemination is the function that makes sure to make get the information and the knowledge to that requires it. For it, it requires to support itself greatly of the information technologies. Also, the article publication contributions will have to be an activity to reinforce in the area of Dynamics of Systems.
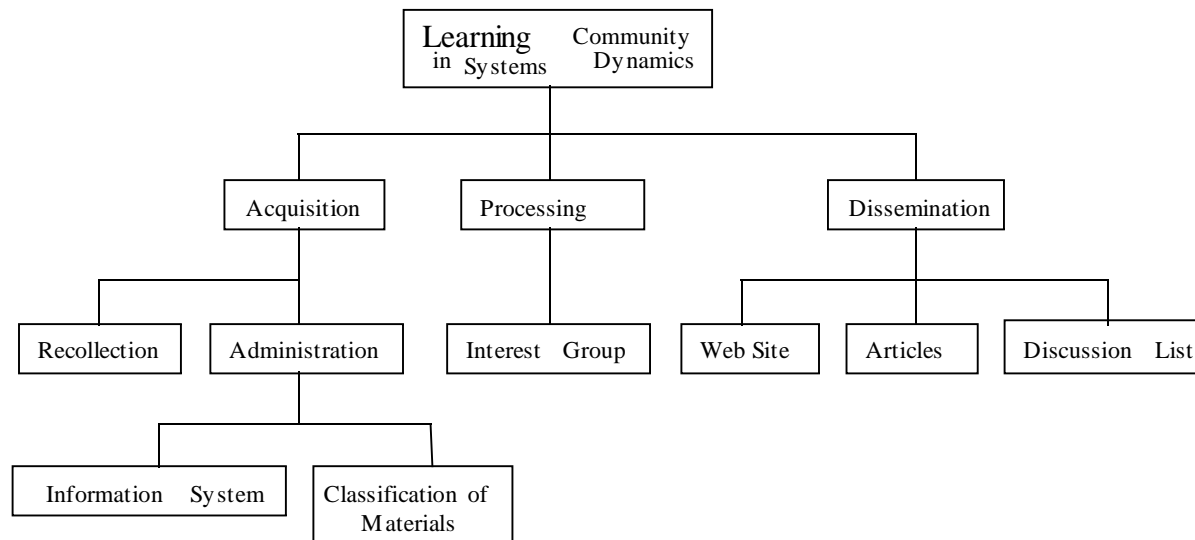

Fig. 10 Functional Architecture of the propose learning community

4. Results

The process of modeling of the improvement effect appeared that would produce the incorporation of a knowledge management during the design of Dynamics of Systems learning community. The model will be used in meetings of work with professors, investigators, interested and consultants.

During the design of the learning community, the model presented will allow: (1) to clarify the knowledge and understanding of a learning community in the short and long term; (2) to create a shared vision with the members of this community, (3) to discover policies that allow to obtain the behavior wished in the time of the learning community and (4) to construct a commitment between the participants in order to develop the community.

At the moment one is working in the technological platform that will allow to the community to interchange information relative to dynamics of systems, as well as in the organization of the 2d. Latin-American conference of System Dynamics in November 2004 in Santiago, Chile (http://dinamica-sistemas.mty.itesm.mx). These activities go directed to support each one of the elements of the functional architecture propose in fig 10.

With respect to the application of knowledge administration, one concludes, based in the modeling and presented simulation, that the incorporation of knowledge management will allow to reach the objective of design of the learning community: to intensify the collective capacity to facilitate the individual reconstruction through sharing its competitions with the purpose of producing value in the organization.

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