"Evolutionary Effectiveness's Dynamics of Enterprise Innovation"

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1. Abstract

The straggled, reactive and inertial orientation of Colombian entrepreneurship has been justified, inconsistently, for the hardness resources agency (internal and leveraged), concept that intensify the deficient technological capabilities being, because this situation only not become a technological means trouble, rather strategic purposes. In fact, a classical one effect of no conscientious recognition of this limitation, explain why so many organizations connect your successful with your "intelligence", but failure with exogenous factors impact.

On this understanding and intervention level, this document illustrates 3 criterions of development: (1) integration for selection, (2) learning as absorption, and (3) innovation as evolutionary addressing, through which knowledge's constitutes as transversal action and organization principle, with 2 fundamental implications: (1) on theory help to comprehend the systemic determinants of innovation through knowledge structures; (2) on practice, an empirical analysis of this evolutionary system can help to insight focus areas for strategic stimulation of connections and synergies to better performance.

2. Antecedents

Knowledge based innovation, as determinant of productive development, was identified by Schumpeter as change's agent that dynamism externalities on productive systems, breaking off the loop flows of static equilibrium economy (Schumpeter, 1978). As concluding mode, on this economic order competitiveness come on innovation, not optimization. To mean, from this point of view (Nelson & Winter, 1977), production is combination o factors (adaptative first cycle); innovation implicates change the factors combination (evolutionary second cycle). This pronounced dichotomy is described on economic literature through of differentiated structural analysis intra (Arrowz, 1962; Grant, R., 1991, 1996; Nelson & Winter, 1982; Penrose, E., 1959; Romer, 1990) and inter (Lewis, 1955; Abemathy & Utterback, 1978) organizational, that, on first case evolve the resources and capabilities of firm, while that second case defines that deferens are not inherent at firms, rather to conditions that anyone confronts.

Additionally, this literary stream has not reached to do operative your proposals terms because, another one reasons, is insufficient the quality and quantity of available information as empirical evidence to explain the performance of organizations in specific terms of: particular conditions in environment under uncertain, the influence and difficulties of knowledge broadcast diffusion, articulated at strategy, structure and competences.

Consequently, the evolutionary research (and transformation) proposed has been conceived as dialogic on immanent relation of social fact of knowledge (structurally seen) within strategic, economic and technological dimensions contents. Therefore, goes on reference to actors for systems; from interpretative logic respect to causality; from "social construction" on "social determinism" (Silverman, 1971); from plural definition of models, to contrast the singular definition based on only ones goals and objectives.

3. Elementary Focus for Evolutionary Organizations Systemic Analysis

Adaptation and evolution are the concepts of demonstrative viability of organizations, maintaining a living identity dynamically stable on the time (Etkin y Schovastein, 1992); this functional structuralist distinction (Luhmann, 1994) recognizes the existence of different organizational forms that perceives your environment according to structural possibilities and, consequently, reaction of different modes, inclusive on similar conditions in a time given (i.e. diverge), so the strategic perspective described don't use up functional at system exclusively (Luhman, 1994), because want to guarantee the organizational viability expanding your boundaries, absorbing and harnessing exogenous complexity.

3.1 The Endogenous Framework OF Enterprises

A specific complexion of firm dispose systematically of 5 dimensions that incorporate: (1) an economic axis that orientate the *strategic* determination, (2) the *productive* dimension as logical causality on business operation (*process and systems*), (3) the organizational *structure* of relationships and resource's transference canals, (4) the *social* dimension underlying to culture and human capital relations, in form of competences and *recurrent guidelines* of organizational behaviour, and (5) the *technological* dimension (*hard and soft knowledge*) as support and facilitators of operation and management, respectively.

To consider that, the Handy's curve (Handy, 1989; Amidon, 1997) describes the emphasis that enterprises dispose in your evolutionary daily operation (Illustration 1), from the product concentrated routines, to process (kaizen), to productive structure *enabling* on business and technology relation, the *openness* that harness complexity and, finally, the evolution to *knowledge and innovation*.

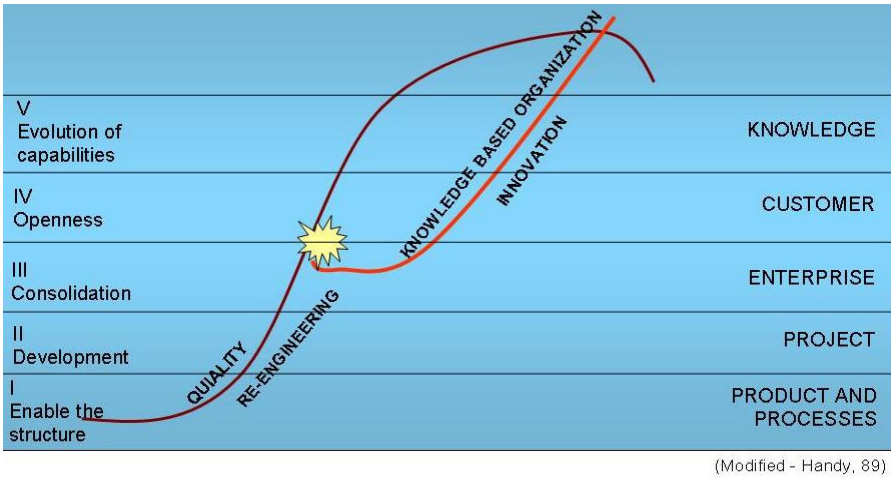

Illustration 1 – Emphasis on Evolution of the Firm – Author´s Modifications

As systemic consequence, innovation is defined as intrinsically distributed process of communities coordinated for common interesting (Coombs, Rod, et al. 2001). According to this characterization, the organization has the innovation as principal emerging property, and the challenge is comprehend the dynamical processes that generate the system activity, from evolutionary approach (Nelson, 1995; Nonaka & Takeuchi, 1995) that suggest the individual creation and administration of knowledge and the organization as knowledge auditor system that provide resources and context, and whose management must be able to:

- ✓ Identify incentives to "exploit" externalities of spill-over in strategic integration of diffusion and accumulation of productive knowledge capital.
- ✓ Foment mechanisms of dynamic spin off within interest groups, as background of innovation implicated.

These innovation scheme indicates how necessary is detect the trouble-areas in continuous dynamic adjust of capabilities, structure and strategy to stimulate the innovation as autonomous and systematic asset from each one level (i.e. modifying centred and periphery systems), because the traditional frame is begin the innovation from product-process, as Handy's curve.

3.2 Towards Evolutionary Control Paradigm Based on Strategic Knowledge

Through the evolutionary proposed focus, the organizations is understood as an productive system where the knowledge defines the levels of strategic orientation (empowered), in other words, allow to explain the specific division and stratification of the work, in attention at strategic impact of each knowledge involve at internal(ization) or external(ization) medium of the firm (Illustration 2). Therefore, the organizational control transcends the mean-aims analysis toward fundamental coordinated interaction axial on decision-action (Illustration 2).

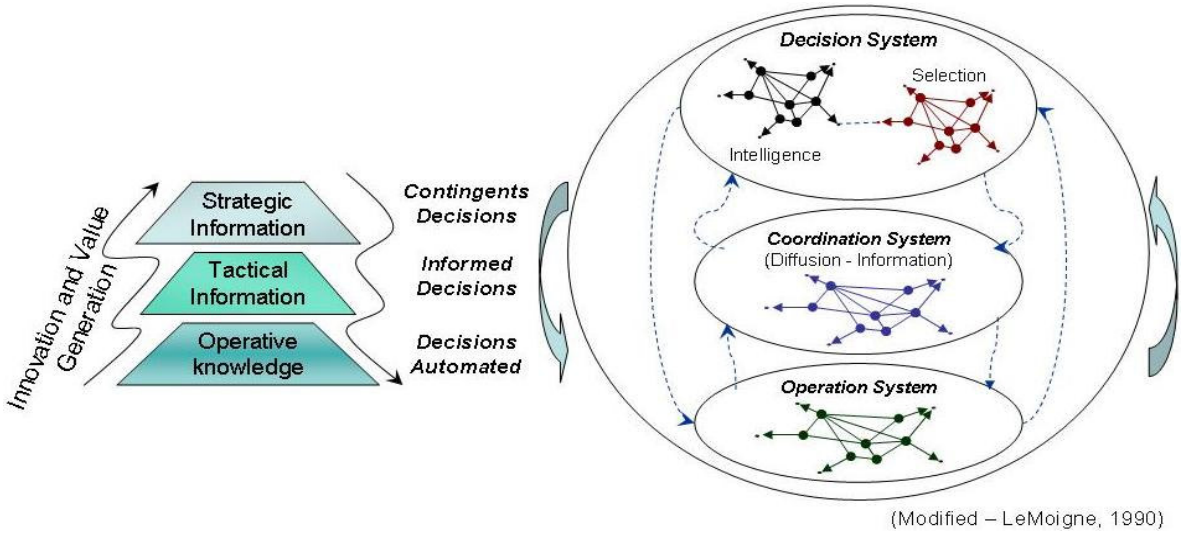

Illustration 2 – Strategic Levels of Decision-Coordination-Action – Author´s Modifications

On this purpose, is requested incorporate, collectively, adaptative and evolutionary mechanisms, distributed transversally at organizational structure, through exploration of relational schemes between the diverse knowledge (productive and informative) sources, to address (influence and control) the process (and flows) of decision-action (Illustration 3 a) as:

- ✓ Mechanisms of reaction and internal selection, as tactical instruments for adaptation, founded on capabilities and structures historically developed and learned in organization (Illustration 3 b).
- ✓ Mechanism of proaction and external selection, under assumption of deliberated efforts to construct environments (Illustration 3 b).

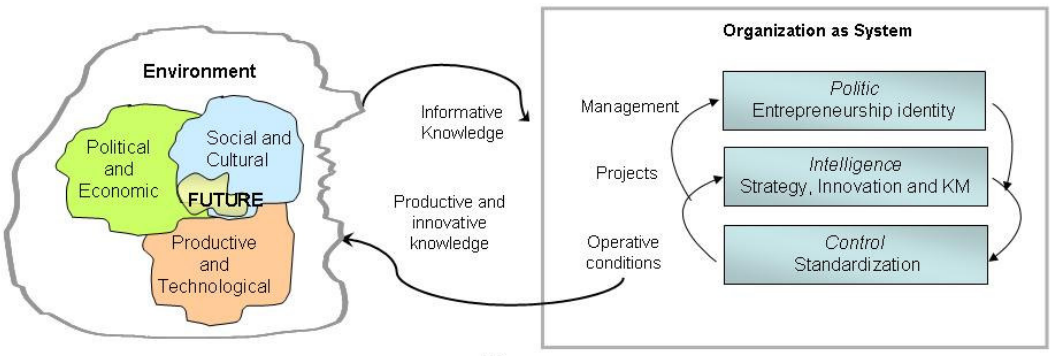

Figure a

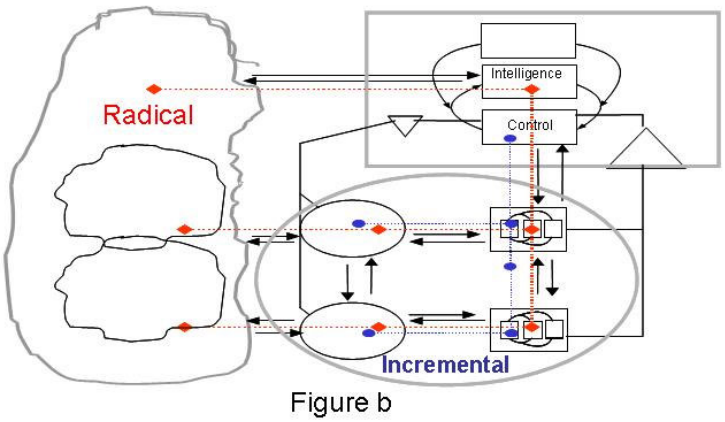

Figure b

Illustration 3 – Evolutionary Cybernetic Based on knowledge – Source: Author

As fundamental implication from this perspective, emerges an implicit request: technological and social co-evolution, therefore, when contrasts variables as incremental or radical innovation, really compares dynamic organizational forms that enable as limit the innovation, in reference to static firms (Lundvall, 2004), whose structural conditionings sources from 2 forms: (1) the agents who take decisions lost off exhaustive information, and (2) who have the information has not the mechanisms to support and feedback the decisions. For this reason, you must management the selection and distribution of informative knowledge on determined context, deconstructing the organizational history to absorb the asymmetrical generation and adaptation, and the asynchrony between offer and demand of knowledge.

3.3 Knowledge as enabler, citizenship and identifier, and synergic organizational element

Systems have the particularity of "selection" your own environment on measurement of your structural and strategic possibilities (Luhmann, 1994; i.e. autopoiésicas, Maturana y Varela, 1997); in other words, every system perceives their environment from your distinctive function (Illustration 4). In fact, the system-environment distinction is defined as structuring and evolutionary principle on social systems and, in this case, is the fundamental constituent that differentiate operational competences (i.e., know how as production), managerial competences (i.e. know why) and innovative competences (i.e. know where).

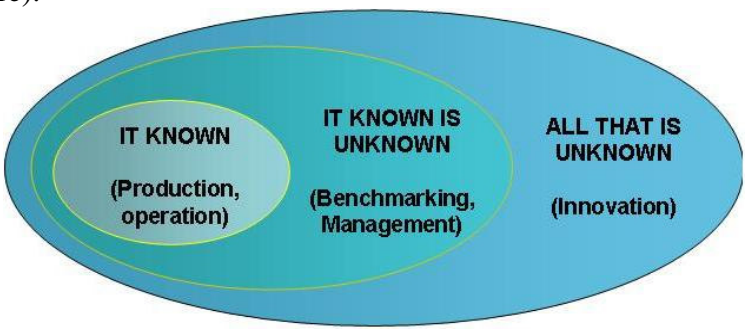

Illustration 4 – Cognitive Strategy – Source: Author

According with this, the evolutionary announcements of organizations, as determined synergies (Pisano, 1990), are represented for the Equation 1, where knowledge defines *capabilities* of enterprise; resources integration *enable* their execution; and, the strategic orientation orders *competitive* sense.

$$Capabilities + \text{Re}\, sources \leq Hability$$

$$Hability + Strategy \leq Competence$$

Equation 1 – Strategic Synergies

4. Problem Articulation

To analysis effects are understood as 2 operational modes of strategy in firms, according with their challengers on the time (Table 1): *adaptative, inertial*, for traditional or

incrementally innovative case, through spontaneous and basic changes; and, for the *evolutionary* case, modernist or radically innovative, their behaviour is permanently changing, though is probable that on reason at activities and outcomes diversity can be so many strategy trajectories that, for anyone case, converges recurrently at the 2 described modes.

Table 1 – Challenges of Evolution

SHORT SCOPE (Incremental)	LARGE SCOPE (Radical)
Uniformed (standardization)	Flexible
Homogeneous	Heterogeneous (diversity)
Specialization	Integration
Quality	Creativity

4.1 Dynamic Hypothesis

As illustrates the Figure 5, the *traditional* (adaptative inertial) and *radical* (evolutionary) reference modes are characterized as discontinuous and periodically degradable, for the firs case, and accumulative on a development curve, deliberately sustained, for second case referred (Handy, 1989; Kuznets, 1966; Abemathy & Utterback, 1978; Arrowz, 1962; Kim, 1995; Lazaric & Raybaut, 2004).

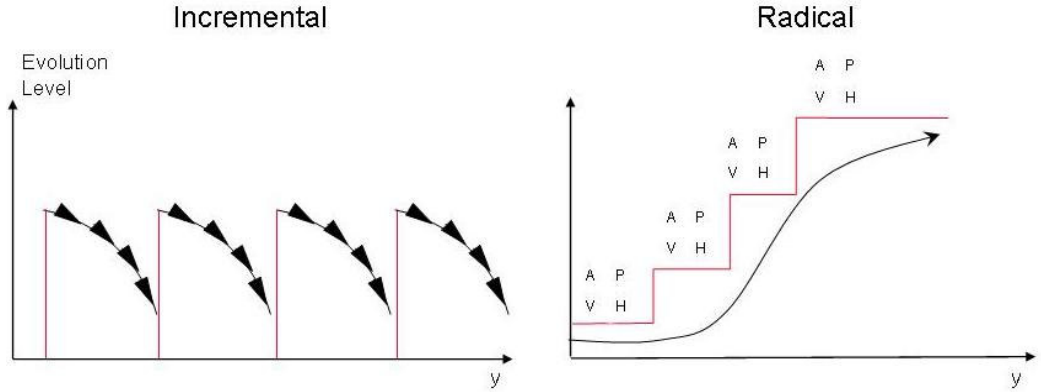

Illustration 5 – Reference Modes of Evolutionary Trajectories – Source: Author

4.2. Fundamentals Supposed of Proposed Analysis

In organizational terms, it includes:

1. Analysis unit isn't individual (agent who determinates the differences on solving problems), rather the different grouping forms about innovative strategies, as the modern practices and knowledge diffusion. The interest groups are influenced by the systematic apparition of random alterations, as discontinuous mutations. Additionally, the interest groups have an auto-replication property on organizational

medium (as viruses, López & Valdaliso, 1999), where the reproduction is based on cumulative social capital transmitted on both of other groups, homologous or not (Kogut & Zander, 1992).

2. Teleological purpose of evolutionary processes is associated at selection, adaptative or generative criterions, taking the form of controls both of first and second order, parallels and respectively.

In structural terms, it includes:

1. The dynamic nature of information acquisition is essential for understanding of development because, as first argument, the symmetries correct coordination and inequality problems and, as second reason, the adaptation of strategic conducts for planning are adjusted to temporality of actualized information that orient this process (i.e. delays effect).

   Systemic approach of described innovative organization don't discriminates hierarchical "need" (Coombs, Rod, et al., 2001; DiMaggio, 1983; Jacoby, 2005; Lazaric & Raybaut, 2004), rather on this, is conceived as dialogue and coordination/control mechanism (i.e. routines, "knowledge contracts" and power codes).

2. The knowledge and environment absorption, doing endogenous the dynamic interactions, facilitates the coordination relations between decision, information, and action, therefore the virtuousness on external control enables the re-structuration expedite, given an incentives and, with this, less intervention requested.

3. Variables aggregation complicates the maintenance and control of heterogeneity, intra and inter organizational, of factors in the samples.

5. Systemic Modelization of Evolutionary Organizations

Thinking of evolutionary organizations considers that under this adjective are concentred a process series that have configured a particular organization type (in an environment) along of time. In this road tripping, the generation and harmonization of heritage core business knowledge, to respond flexibly at onslaught medium's and vicissitudes, with a common and innovative strategy "stable" against the time is an integral dilemma, which one is comprehend through this modelling process.

5.1 Analytical Approach at Model

Consider an entrepreneurial organization structured by routines and hierarchies of knowledge. Additionally at this constitution, think about n agents each one with different academic formation, this is, specific as asymmetric knowledge, both of tacit and articulated, k_a ($a = 1,...,n$). According to this, the integration of everyone agents at

organizational strategy is focused just as knowledge levels, developing 3 practices types, both of formal and informal structure, don't excluding, referred as:

- ✓ Innovative activities, A_i
- ✓ Traditional activities standard, A_t
- ✓ Diffusion activities (learning and strategic adaptation), A_{da}.

On function of this (Equation 2), now consider the historic knowledge on the time F_y, depending of the organizational form (enabler, support, or facilitation) that determines if exist cohesion (i.e. intersection) and *synergies* effective hardness between members and responding groups.

$$F_y \geq \{Ai \cap At \cap Ada\}$$

$$donde, Ada \geq \sum_{a=1}^{n} Ka, \forall agents \quad \text{On year } y$$

Equation 2 – Cognitive History of Organization

In order that, the intersection of activities (i.e. common zones of interaction) defines the evolutionary nature such as comprehensive and expansive innovative activities, which feedback is the diffusion and learning (McGill & Slocum, 1992), selecting times of obsolescence and change.

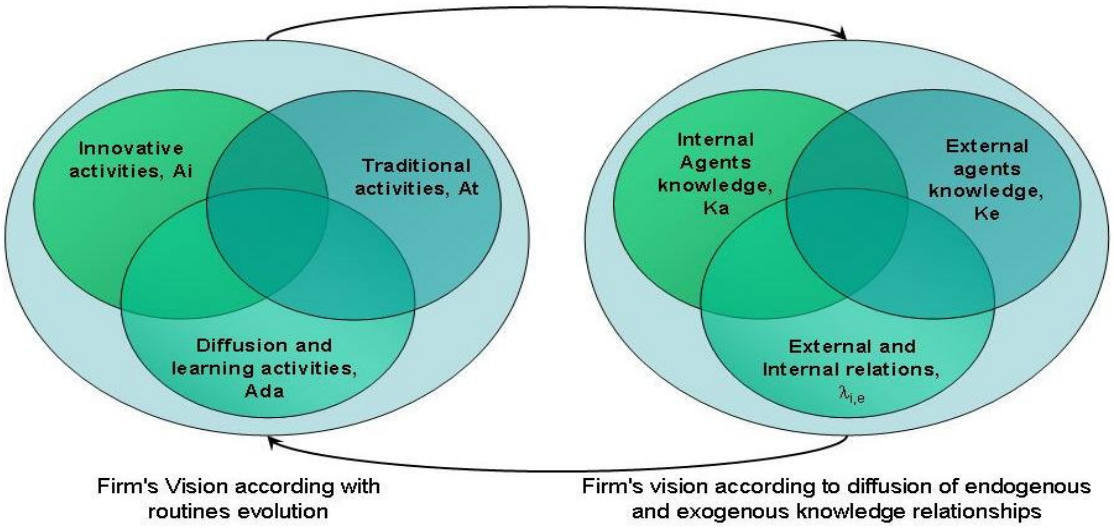

Illustration 6 – Dialogical Visions of Synergies on Evolutionary Process

In attention at this, the evolutionary condition is the expansion of the innovative activities, suggesting growing development faster and larger rates versus traditional activities that goes off inertial organization (Equation 3).

$$\left(\left[\partial Ai / \partial y \right] \Big/ Ai \right) > \left(\left[\partial At / \partial y \right] \Big/ At \right)$$

Equation 3 – Development Rates of Evolution

Whichever, the characterization of this evolutionary condition is subject of knowledge as effectiveness on systemic development of the firm too, for say, their internal and external integration of innovative relations (λ_i ; λ_e) as criterion that defines the

possibilities of absorption and diffusion of learning (Equation 4), because originates agreements and commitments as well as diversity on innovative managerial.

$$E_T = \{\lambda_e(A_i)^{Ke} + \lambda i(A_t)^{Ka} + \lambda(A_{da})^{(Ke+Ka)/2}\} / 3$$
$$where \quad Ke, Ka \in (0,1] \quad \wedge \quad \lambda i, \lambda e, \lambda \in [0,1]$$

Equation 4 – Strategic Integration for Diffusion and Evolution

5.2 Causal Determinants of Evolutionary Dynamic

The structure of descriptive information that relation the model articulates so many mental models of businessmen identified of aggregated mode through 5 experiences: (1) 2 national technological development surveys (Duran, Ibañez, et al. EDT, 1996; 2005), (2) author's participation as knowledge management coordinator in Quality Corporation in Colombia, managing the annual prizes at "technological innovation" and "quality and excellence of management" and the strategic planning process of National Program of Technological and Industrial Development, 2005-2019 (Castellanos, Gomez, et al., 2005). Unfolding this experiences have been abstracted the nuclear core rules of decision-action in the operative and strategic routine of organization.

Following to this formulation, the model considers 3 levels of participative inquiry and action: (1) the structural coherences internal to system, originated for components and relations; (2) structural coherences between medium and system; and the (3) dynamics between (1) and (2), contained through of interaction of the following variables, on the last aggregation level (Illustration 7):

- ✓ *Diversity of strategic sources of innovation*, as the requested variety on evolutionary process contained in the integration of internal sources (i.e. executives and researches in specialized teams and special teams) and external sources (i.e. customers and value chain, and benchmarking) where is generates or diffused the innovation.

  As concretion of this "variety requesting" the firm not only consolidates their viability developing an stable strategy pointed on innovative vision, else this integration on diversity derivates on creativity and organic capability.

- ✓ *Absorption (diffusion) of environment for organization*. Knowledge incorporated, as synergy of different as complementary accumulated levels for diffusion that enables the expansion of organizational boundaries through knowledge identity reinforced.

- ✓ *Innovative dynamic on market*. Represent the dimensions and velocities of effective response from organization at environment, derived of innovative initiatives implemented.

- ✓ *Organizational innovation dynamics*. As pertinence of social evolution through dynamism of forms that promote and facilitate the efforts articulation around innovation. Implies a permanent structural, functional and organizational deconstruction, as criterion of entrepreneurship effectiveness.

- ✓ *Effectiveness' outcomes of innovative activities*. Criterion that determines the sustainability of the strategy; based on commitments stimulation to knowledge and (re)inversion.

- ✓ *Evolution Innovative degree*. Determined for qualified work intensity and the integration of diverse agents around organized innovation (i.e. creative chaos where these processes are neither ordered nor disordered). Characterized as traditional, incremental and radical.

- ✓ *Strategic integration (integral)*. Comprehend the asymmetries that generates the organization if don't exist both of vertical and horizontal integration (reticular) than transcend of excluding hierarchical focus.

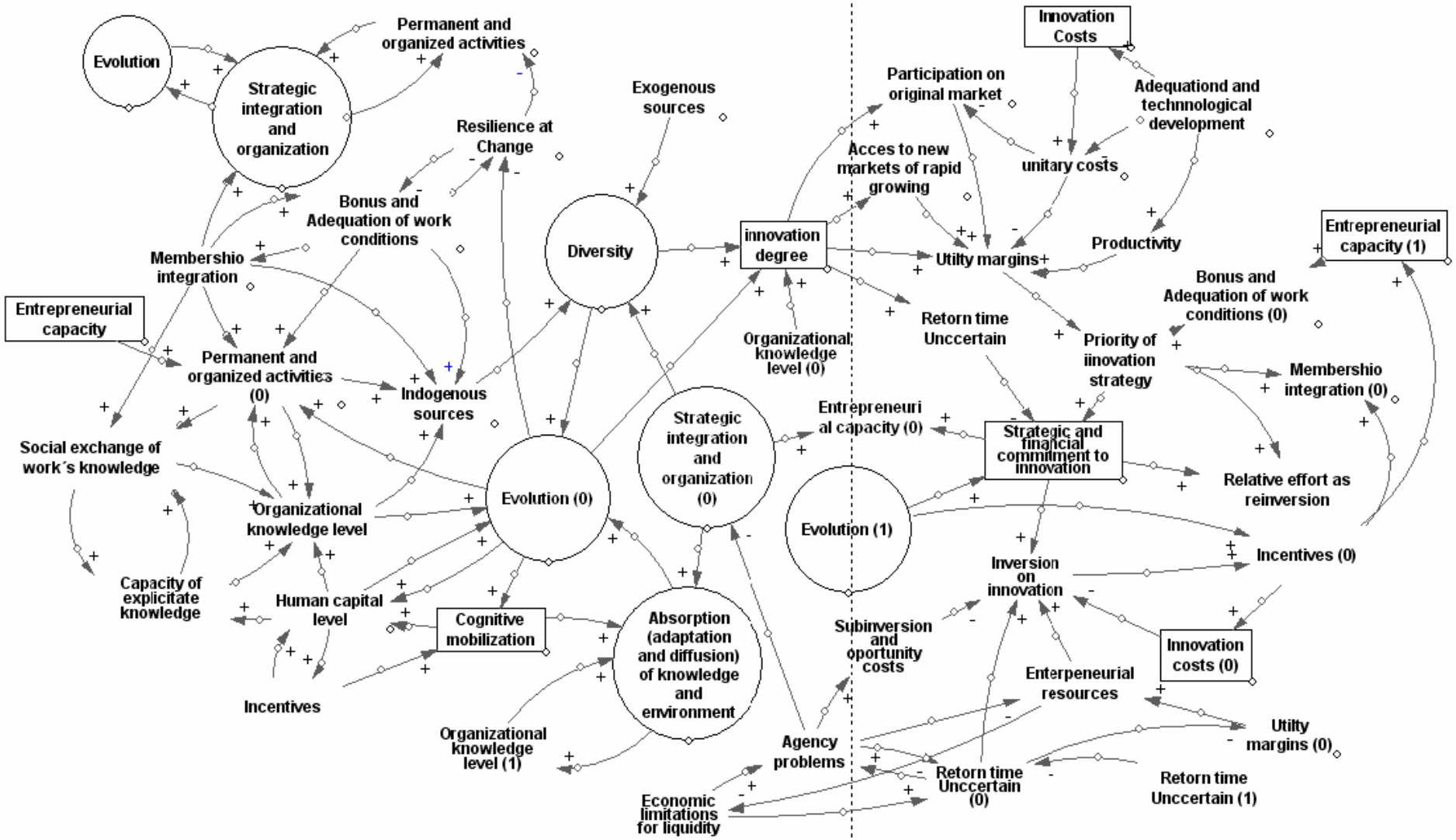

Illustration 7 – Causal Loop Diagram for Innovative and Knowledge Strategies of Enterprises in Colombia

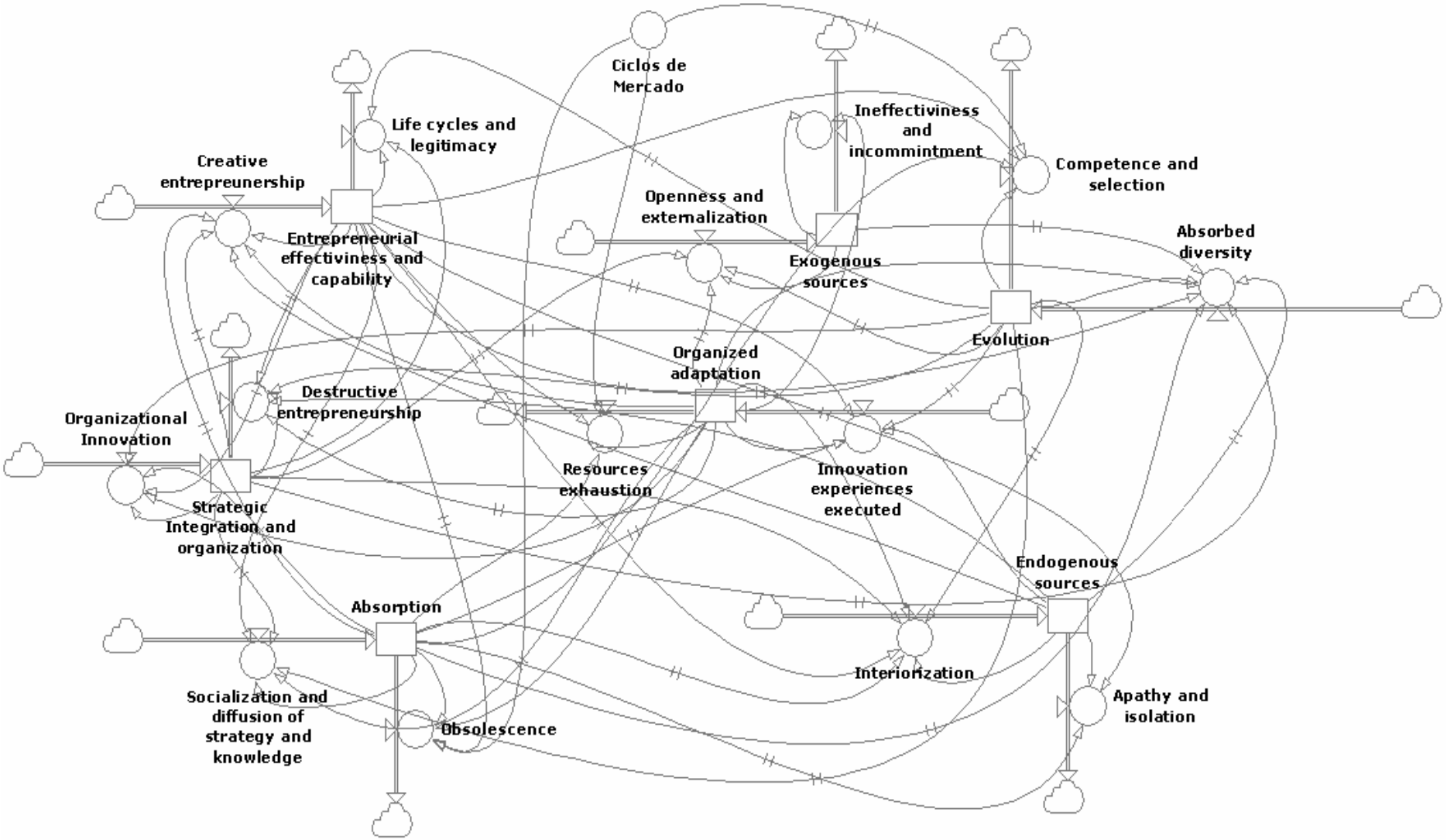

Illustration 8 – Dynamic Model of Evolutionary Process

Additionally, at state and control variables described, the strategic policies to stimulate have these following criterions:

- ✓ *Cognitive mobilization*. Founded on low density of persons on production have to other activities profiles and capabilities toward soft instances.
- ✓ *Strategic Integration*. Where the organizational structures harnessing complexity are more flexible and diversified from the participative process planning.
- ✓ *Stimulus introduction*. The induction of stimulus at creative enterprising by means of learning and knowledge contracts, formation and participation special bonuses.

5.3 Exploration of dynamic sceneries obtained

The initial conditions was the normal state of the firms in Colombia, inertial on a low development level, that illustrates a standard action different at defined before in dynamic hypothesis, bring it back from literature. Concretely, isn't a decreasing curve else, rather, is an ascendant curve; nevertheless, the stationary cycle obtains their mirror image (Illustration 9, green line), this is an interesting result because the trajectory linked at model's behaviour expose the progressive performance recuperation (ascendant), along the time, at first moment, when introduces occasionally the incremental innovations, case that in literature usually demonstrate effect immediate.

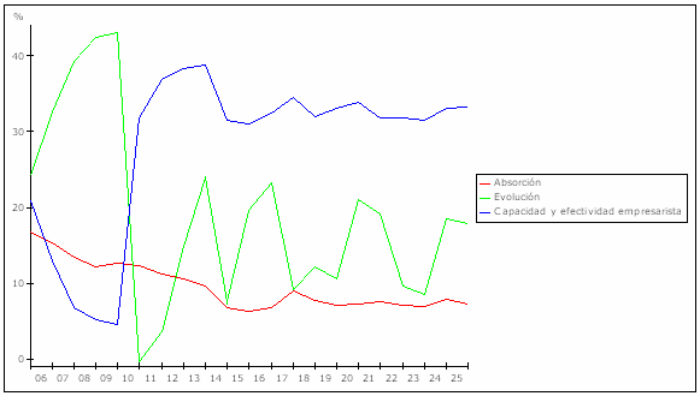

Illustration 9 – Incremental / Inertial Evolution Obtained

Additionally, the model presents a slow growing as well as logistic; in case of literature, this would be understood as exponential type. The evidence of the model, therefore, is that incremental innovation does not generate a big growing and their occasional character is an inertial manifest that declines exponentially, of new, in contrast of conventional theory that associate a logistic drop. Of this manner, between descendent times, is evident an radical declination of results that, on firm conditions, causes both of disable as limit your growth through inactive periods, on regressive dynamic series on competitive environment.

A posterior analysis, introduces the stimulus of the described policies such as a direct pulse not continuous, as evidence that the system request only a basic leverage to take the performance logistic s – stair formed (Illustration 10), where, in general, capabilities are an inventory concept usually measured for experience, stability and agents qualification, such as the diversity and complexity of the relations from the

organization. Starting of this is possible think that firms with more relation on quantity and quality of agents and activities are more diversified and sustained.

The strategic roadmaps identified on this alternative scenario, supports the dynamic hypothesis defined for this complementary development mode, demonstrating dynamic patrons of variation, continuous as response from strategy at both of random and systematic variations at that is exposed.

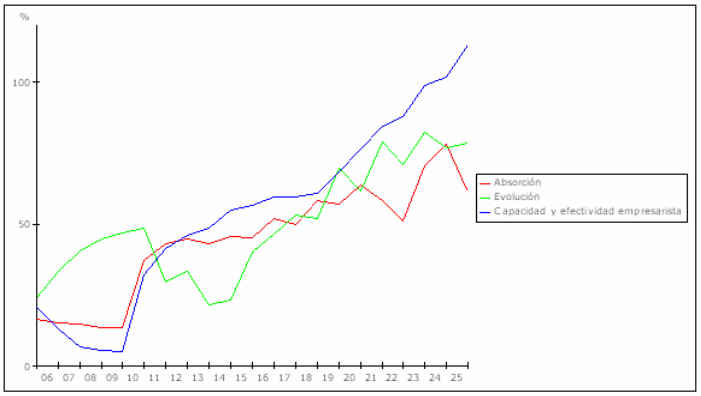

Illustration 10 – Radical S Shaped Trajectory Obtained

These trajectories comparison will allow establish and evolve the engaged mechanisms of transference and diffusion of knowledge on specific determined context, where the crossed and asymmetric effects can reflect the concentred differences underlying at different learning levels on organization. The implementation of stimulus to evolution request then of major learning and strategic managerial capabilities, as the following formula: leveraging initially the construction of capabilities to dynamism the endogenous growing (first cycle, logistic), parallel at permanent generation of social capabilities as support that integrates the sustainability of this strategy (second cycle, autopoiésica).

6. Fundamentals Learning and Proposal Researching Challengers

Generate propitiate conditions to emergence of processes managed for knowledge to evolution of firms is an situation that must be planned as both of medium and aim teleological: medium, because enable the generation and articulation of elements to response at the innovation dilemma; and aim, because the innovation and knowledge leverage an emerging diversified specialization, with positive externalities on heterogeneity between firms; therefore, resources and capabilities are not on same conditions, explaining simultaneously the both of profitability differences in specific times, and feedback the modern function of the enterprise, as substitute of the market.

Concretely, the relevance's insights originate from the researching process include, among others, these followings:

The most important consequence of adopt strategies specialized on incorporation of incremental advances, exclusively, is that declines the probability of find **diversity of trajectories** socio-technological in the firms. A possible cause is the very basic knowledge of the "system" organizational.

For this reason, **the incorporation of structural enablers through technologies must be understood as reinforcement of the changes processes**, than want to guarantee the representation and priority stable of the global vision on organizational strategy, constituted, validated and legitimated as an organizational dialogue and commitment that systematically maintain their coherence through programmatic unfolding on every instances that link the prevision to short time (contingents inclusive), with these of major scope.

As consequence of this, progressively with the evolution rising, is very important to **make better use of the (and take advantage of the) division of the work**, including, of course, the managerial.

In general, the differences between organizations, suppose an important determinant to define specific evolutionary trajectories, though us evident the emergence of the 2 identified patrons, where the convergence of structuring actions must be reinforced at **developing of capabilities for active and distributed system managerial**, even on subjects of structural restrictions that traditionally are concentrated.

In fact, the **natural imposition of this structural restrictions on the evolutionary requests from the change, demand the maintenance of an opened organizational system** as guarantee possibilities to experiment with forms orientated to collective needs.

Indefectible at the real existence of an order that enable incorporate the system distinction in the entrepreneurial case, is an **development imperative recompose a second order vision on continuous re-evolutionary coupling**, such as enable the exploration of new organizational forms around knowledge, adapting it to overcome the systematic accentuation of these structural restrictions that degrade the system through informative knowledge don't accessed and (re)known.

Stimulate resources and agents mobilizing and connectivity of the relations through promotion, developing, and collective appropriation of innovative initiatives request special attention, because this application could be malign if are not conceived around soft areas. For example, on hard productive case, are beneficiated with bonus, the exercise of extra hours, not the savings.

Through of this, **the organizational structure facilitates the synchrony between person, group and information, creating a democratic based knowledge medium**, where instruments of "power" are managed from introjected control as informatics mode.

Finally, **the innovation and knowledge management requires of knowledge's contracts**, which enable redistributing the benefits and commitments associated at innovation for evolution.

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