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Organizational Behavior: Attention, Knowledge, and Control Systems. The Learning Organization

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Author Contributions.

The paper fully reports the ideas that Carlotta Meo Colombo expressed in Chapter 4 of her Doctoral Thesis (2012). Piero Mella revised the graphic structure and the layout content of this paper, without adding anything to the original but simply eliminating some reference parts to previous chapters.

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† *To the memory of Carlotta, who died in a car accident on January 11, 2015.*

ABSTRACT (Piero Mella)

This paper aims to present organizations as Control Systems, introducing an innovative approach to explain how organizations behave in coping with and adapting to sudden environmental changes. Embracing a cybernetic point of view, it will provide a general model of control system which describes the process that allows the organization to deal efficiently with external stimuli and focus on strategy and goals. Control Systems are considered as a fundamental part of the view of organizations as black boxes with a feedback control, which processes information. I shall demonstrate how organizations carry out their processes and build their organizational activities, while linking Control Systems to attention and knowledge as starting and improving points to define viable conditions of survival and learning. In fact, organizations are concerned not only with processing external triggers but also with attention processes which foster knowledge creation, understood as a process according to which external and internal information is absorbed, processed, and structured in models, contributing to the creation of an organizational memory. The faster the organization learns to develop attention and thinking, the readier the entire organization will be to develop organizational learning.

Questo paper mira a presentare le organizzazioni come Sistemi di Controllo, introducendo un approccio innovativo per spiegare come le organizzazioni si comportano per far fronte e adattarsi ai rapidi cambiamenti ambientali. Abbracciando un punto di vista cibernetico, fornirà un modello generale di sistema di controllo che descrive il processo in base al quale l'organizzazione può affrontare efficacemente gli stimoli esterni e concentrarsi su strategia e obiettivi. I sistemi di controllo sono considerati una parte fondamentale della visione delle organizzazioni come scatole nere con controllo del feedback, che elaborano le informazioni. Dimostrerò come le organizzazioni svolgono i loro processi e costruiscono le loro attività organizzative, collegando i Sistemi di Controllo all'attenzione e alla conoscenza come punti di partenza e di miglioramento per definire condizioni praticabili di sopravvivenza e apprendimento. Le organizzazioni, infatti, non si occupano solo di elaborare impulsi e stimoli esterni, ma sviluppano processi di attenzione che favoriscono la creazione di conoscenza, intesa come processo secondo il quale le informazioni esterne ed interne vengono costruite, elaborate e strutturate in modelli, e contribuiscono a creare una memoria organizzativa. Più velocemente l'organizzazione impara a sviluppare l'attenzione e il pensiero, più l'intera organizzazione è pronta a sviluppare l'apprendimento organizzativo.

Keywords: feedback control systems–CSs; organizations as CSs; management and governance of CSs; organizational attention; Model of Enterprise as a System of Transformation; Attention and knowledge coupling; cognition; learning organizations; the 5 disciplines.

1 – Introduction

> "*All stable processes we shall predict. All unstable processes we shall control*" (von Neumann, 1950, from Dyson, 1988, p. 182).

> "*In general terms, therefore, a control problem is to choose the input to some system in such a way as to cause its output to behave in some desired way, whether to stay near a set reference value (the regulator problem), or to follow close upon some desired trajectory (the tracking problem)*" (Arbib, 1987, p. 49).

As noted in Meo Colombo, 2021 (*editorial addition*), many authors involved in organizational studies have considered organizations as "cybernetic systems", while others have argued the difficulty in considering organizations as such (Kast and Rosenzweig, 1972; Beer, 1979, 1981; Jackson, 1993). We believe organizations are entities that can adapt and survive in a changing environment thanks to their vital structure.

Cybernetic theories have been applied to strategy (Warren, 2004) and decision-making (Robb, 1984), and we recognize that "organizations", due to their intrinsic nature as self-regulating systems, can be investigated as cybernetic systems (Ericson, 1972) that are self-controlled (Wiener, 1948), remain vital, and carry out the processes for which they were created (Mella and Demartini, 2011). The cybernetic approach undergoes a systemic one, which is embedded not only in a single discipline (Jackson, 2001) but promotes interdisciplinary approaches, such as the one proposed in this work, which presents Mella's view of organizations as control systems (Mella, 2010, 2012), introducing an innovative approach to explain how organizations behave in order to cope with and adapt to sudden environmental changes. Following Charles Darwin, the "fight for survival" originates a learning process which pushes organizations to adapt and renew products, processes, and their overall structure (Volberda and Lewin, 2003; Mella and Demartini, 2011).

We embrace the cybernetic point of view since, following Mella (2012), control systems models are a means to regulate and allow organizations to be viable over time. To demonstrate how organizations carry out their processes and build their actions, we link Mella's approach to attention and knowledge as starting and mediating points of organizational behavior.

2 – Introducing Control Systems

Starting from the above citation, we can, in general, define a variable Y_t as "controllable" if, on a temporal, continuous, or discrete scale, $t = 1, 2, \ldots,$ it is possible to assign it a given value Y^* (set-point) which can represent an "objective", "goal", "constraint", or "limit" of Y_t. If $Y_t \neq Y^*$, we can measure a distance (or variance or error), which we denote by $E(Y)_t = Y^* - Y_t$.

Mella (2010, 2012) notably defined X_t as a "control variable" which determines the values of Y_t according to a causal relation defined by processes realized by apparatuses (for a deeper analysis about causal relationships and Causal Loop Diagrams, see Senge (2006) and Mella (2010, 2012)). Acting on the "control variable" X_t, the control system triggers dynamics in Y_t that push it towards Y^*.

After these technical assumptions, following Mella (2012), the concept behind the control system approach is that it is possible to produce a gradual approximation of the movement of a variable

toward desired values of Y* (objectives, constraints, or limits). However, this presupposes that it is possible to identify one or more control variables, or "control levers", that can modify the trajectory of Y_t according to a "control strategy" – that is, the choice of the control variables to be activated and the intensity of their activation – whose values are recalculated, at each moment, as a function of the" error ", $E(Y)_t = Y^*-Y_t$, to progressively counteract any deviation from the objective (Mella, 2012). The new variable, $E(Y)_t$, which represents the shift away from the constraint or the objective, tells us "*how far we are from* Y^*", or "*by how much we have exceeded* Y^*" (Mella, 2012, p. 123- 124). This variable can be described using various synonyms, such as margin, deviation, or "error", and also represented along a continuous time scale.

> A Control System is any set of apparatuses, logical or technical (algorithm or machine, rule or structure, etc.) that, for a set of instants, perceive $E(Y)_t$, calculate and assign the values X_t, and produce the appropriate Y_t to gradually annul, when possible, the error $E(Y)_t = Y^*-Y_{t^*}$ at instant t^* (Mella 2012, p. 123).

The concept of "error" could be understood thanks to Norbert Wiener's idea of "distance". In fact, Wiener states:

> […] in order to perform an effective action on the external world not only is it essential to have good motor organs but the actions of such organs must be adequately reported to the central nervous system for control purposes, and the readings of the control organs must appropriately combine with other information from the sense organs in order to determine a regulated motor output (Wiener, 1948, p. 30),

and

> […] since, in fact, the system 'perceives and evaluates' its variance from the objective, a typical feedback control is carried out" (Mella, 2012, p. 123).

Control systems are made of actions (X acts on Y) and reactions (E(Y) acts on X through Y) with a certain number of iterations on the control lever. The system tries to achieve the objective (goal-seeking systems) or to respect the constraints or limits (constraint-keeping systems). According to Mella (2012), all control systems can be represented by "balancing loops" in which there is a direct causal relation in the direction of variation "s" (Mella, 2010, 2012) between X and the corresponding Y, and a relation in the direction of variation "o" between Y and E, so that if Y needed to be increased or decreased, it would be necessary to increase or reduce X by an action rate that could be a constant or a function of some variable linked to X and/or Y. The variable X is defined as an "action variable" (or control lever or active variable); if X is a set [X] composed of N action variables (the "vector" [X]), the system is called a "multi-lever control system". The variable Y is defined as "variable under control" (or objective variable, passive variable); if the system must control a set of many variables (vector [Y]), the system is a "multi-objectives control system" (Mella, 2012).

As Mella (2012) notably argued, Control Systems are dynamic systems that achieve and maintain their objective over a succession of iterations. It would be possible to include among Control Systems those cases where the objective must be achieved in a single cycle, as occurs, for example, in hunting, an activity where the hunter usually is allowed to fire a single shot to get its prey (objective), or in industrial or artisan processes, where a given operator must carry out an activity that leads to irreversible effects. Falling into this category are all systems where a decision must be made that produces a single effect which cannot then be modified. Mella (2010, 2012) proposes calling these Control Systems *one-shot systems*, or simply *decision-making*

systems, which, however, are typical of the "feedforward control". The decision-making processes, in the traditional meaning of choosing the best alternative for achieving an objective, can thus be considered special cases of control processes.

We find justifications for our behavioral analysis of organizations, since

> … no part of our world could exist without a control system, and where these are missing, and the variables take on unacceptable values, a catastrophe occurs; the system that includes those variables is disturbed and even destroyed (Mella, 2012, p. 120).

Furthermore,

> Cybernetics is a 'theory of machines', but it treats, not things but ways of behaving (Ashby, 1957, p. 1),

and

> We have decided to call the entire field of control and communication theory, whether in the machine or the animal, by the name Cybernetics (Wiener, 1961, p. 11).

To complete the description of the structure of control systems, we must always identify:

– a "manager", the organizational entity whose task is to regulate the X_t variable in order to produce the necessary dynamics of the Y_t variable, despite disturbances from the environment;

– a "governance", the organizational entity that establishes the objectives to achieve.

Control systems ought to be understood as "logical models" useful in understanding organizations and in developing quick learning behaviors, setting objectives, translating them into coherent and shared values, verifying achievements, and undertaking the necessary actions to measure and erase errors thanks to regulation processes and apparatuses.

Note. Control and regulation are two different concepts in Mella's point of view (2008). The term "control" indicates the entire logical process that allows Y to reach the objective Y^*, even under the assumption of intentional and systematic variations in the latter. "Regulation" stands for the choice of values of X and the correlated values of Y. The terms *control* and *regulation* also have other meanings. In control theory, the term regulation is used to indicate the form of control typical of systems that have to achieve an objective – which is set *una tantum* and only occasionally changed by the intervention of the governance of the system – and to maintain a stable value for the variable Y around the values of that objective. A further meaning, according to Mella (2011), is involved in the distinction between "control process" and "technical system": the *control* concerns the process involving the "movement" of the controlled variable toward the objective; the *regulation*, on the other hand, concerns the "machine" that carries out the control to determine – or regulate – its functioning parameters to enable the control to be possible and efficient. Therefore, Mella (2011) argued that the control depends on the regulation. However, the opposite relation is also valid: the "machine" depends on the type of process to be carried out. Therefore, the regulation depends on the control. A third meaning of control would imply the achievement of a man-made objective; regulation, on the other hand, would represent a "natural" control, without human intervention.

3 – Organizations as Control Systems

In summary, control systems develop a gradual approximation of the movement of a variable (Y) toward desired values (Y^*- objectives), an action made possible by the action of one or more other variables – the control levers – whose values are recalculated, at every instant, to gradually counter any shifting away from the objective (Mella, 2010, 2012).

Following the above considerations, Figure 1 shows Mella's model (2012) of a standard control system:

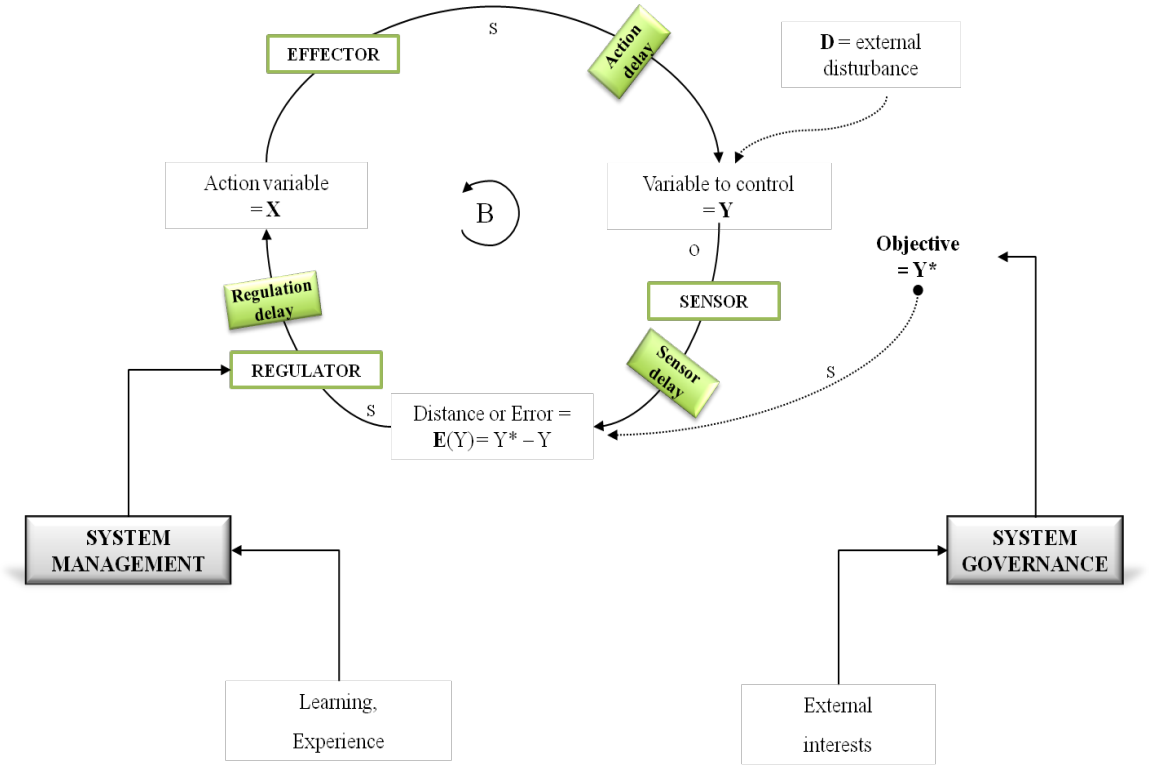

Figure 1 – Standard model of Control System (source: Mella, 2012).

Figure 1 shows that a Control System is a balancing loop where the values of X_t – which determine Y_t in the direction of variation "s" ("same") – does not depend on Y itself but on the error, $E(Y)_t$, in the direction of variation "s": the higher the error, the greater the corrective intervention of the X. It is clear that the higher Y_t is, the lower the variance; for this reason, there is a relation in direction of variation "o" ("opposite") between Y and E(Y).

We can put forward the following propositions.

Proposition 1*:* The Management of the Control System is the "subject" (individual, group, organ, or organization) that, through a series of decisions – based on its particular culture, initial cognitive frames, experience, and preferences – pays attention to certain issues and decides to regulate the X_t in order to change the Y_t. The management, in this control system approach, is an integral part of the chain of control. Management's "attention" is influenced by control system error since the latter will lead to further degrees of attention (see below).

Proposition 2*:* The "Governance" of the system is the process by which the objective Y^*, or the vector $[Y^*]$, is determined. The Governor of the Control System is the subject (or the collectivity) that define(s) the objectives, Y^*, of the control system. The Governance is not part of the control system but an outside process that considers the control system as an instrument for achieving objectives necessary for attaining outside individual interests.

Figure 1 also shows that a control system requires three technical apparatuses – "effector", "sensor", and "regulator" – which represent the chain of control, to produce variations in the X, Y, and E(Y).

Proposition 3: Any control system includes the three fundamental "machines", or apparatuses, that produce the variation in the variables and represent the "physical control system".

Figure 1 shows that three possible "delays" can occur in the chain of control – action, sensor, and regulation – and make control particularly difficult (for a deeper analysis of delays, see Mella, 2012).

We recognize that in every organization that operates through its own structure of men and machinery the "global control system", which directs the entity towards its objectives, is composed of "hierarchically-interconnected" subsystems of control. Systemic and *holonic approach* influences are evident in Mella's thinking. For more insights about systems theory, see von Bertalanffy (1968), Forrester (1994), Sterman (2001), Senge (2006), and Mella (2008). On holonic approach, see Koestler (1967) and Mella (2012).

Control systems, which form and regulate the organization's structure, contribute to viewing organizations as "cognitive systems" (Mella, 2012; Mella, Demartini, 2011) in which a network of control systems maintain the network of processes performed in order to preserve "viability" and foster organizational "teleonomy" (Monod, 1970) while developing cognitive processes (Maturana and Varela, 1980) and learning (de Geus, 1988, 1997; Senge, 2006). Thanks to control systems, organizations learn and self-renew products, processes, and the entire structure (Volberda and Lewin, 2003).

4 – Organizational Behavioral Elements

4.1 – *Attention is Essential*

Our aim is to discover how organizations become "intelligent", acquiring higher levels of efficiency and viability according to the control systems approach. We will explain how the organization carries out a "cognitive activity" that aims at giving a meaning to environmental stimuli, translating these into "information" and, through planning, structuring these as "knowledge", thereby developing a "pro-active behavior" for the long-term reproduction of the economic processes, while at the same time anticipating environmental changes.

From a theoretical point of view, systems theory and cybernetics analysis have enabled me to focus on Mella's model as a system of transformation of environmental stimuli into responses. Thanks to this perspective, I understand how organizations are made and how they behave thanks to control systems (Mella, 2012).

What is unstated is why organizations behave strategically in some ways and not in others (Gavetti, Greve, Levinthal, and Ocasio, 2012). Recent research in organizational behavior has studied the link between cognition and control systems (Mella, 2012; Mella and Demartini, 2011). In fact, by exploiting its knowledge, the organization, considered as a cognitive intelligent agent, can divide the "territory accessible through its own processes" (Mella and Demartini, 2011, p. 38) into significant areas, and for each of these it manages to express the value assumed by the performance indicators it desires to maximize (for example, the Economic Value of the Firm (EVF), the Return on Investment (*roi*), the Return on Equity (*roe*), the cost of input, the selling price, etc.) (Mella, 1992, 2005).

For the authors, the "accessible territory" is characterized by an "attractiveness function" that indicates, for each area (and subarea) into which it is divided, the average level for the significant performance indicators, thereby forming an "attractiveness landscape" that specifies

which areas are more attractive and which less so, based on the various performance indicators chosen. Of course, it is plausible to believe that, based on the characteristics of the different areas, the attractiveness of the landscape will have "valleys" of moderate attractiveness, "peaks" of high attractiveness (that is, the area where the best performance can be achieved (Demartini, 2009)), or 'troughs' of repulsion (no attractiveness) to avoid entirely.

For example, after choosing *roe* and *roi* as performance indicators to be maximized, an area considered rich in potential consumers and poor in competitors could become highly attractive, since it has potentially high revenues both from the point of view of quantity and price, and thus a high *roi*. On the contrary, an area rich in competitors could be scarcely attractive since, precisely due to the competition in terms of price and quality, it would be assumed to have a lower *roi*. On the other hand, an area with a low tax burden would have, all things being equal, a higher roe than the others and a greater tax burden. An area with a large amount of pedestrian traffic could favor sales for a small retailer, while one with ample parking space could increase the economic and financial performance of a large retail firm.

The optimal conduct of an organization as a "rational agent" (Demartini, 2009) is to configure, update, and continually explore for future use the attractiveness landscape for those areas accessible with their own productive, economic, and financial transformation processes, trying to avoid the "troughs" and attempting to climb the highest "peaks".

> Once again, the organization-firm, even when it is viewed as an explorative agent, is a Control System, since the objective of achieving a given performance obliges it to continue to explore until it can identify the areas where the objective can be achieved (Mella and Demartini, 2011, pp. 38-39).

Theoretically, we move towards an *attentional perspective* following *attention-based* theories on organizational architecture and action (March and Simon, 1958; Weick, 1979a,b; Dutton, 1997; Ocasio, 1997, 2011; Ocasio and Joseph, 2005; Joseph and Ocasio, 2012), which represent a "co-penetrating approach" to the transformation and cybernetic one followed earlier in this work.

Managers and organizations are supposed *not* to have complete cognitive capabilities to deal with all environmental stimuli (Simon, 1945; March and Simon, 1958; March and Olsen, 1975). Therefore, the emphasis on "attention" provides some useful insights about issues focused on by organizational decision-makers, among all the possible triggers given (to the organization) by the external world.

> Everyone knows what attention is. It is the taking possession by the mind, in clear and vivid form, of one out of what seem several simultaneously possible objects or trains of thought. Focalisation, concentration of consciousness are of its essence. It implies withdrawal from some things in order to deal effectively with others (James, 1980, pp. 403-404).
>
> Attention facilitates perception and action towards those issues and activities being attended to, and inhibits perception and action towards those that are not (Kahneman, 1973)" (Ocasio, 1997, p. 190).

The concept of attention has been widely analyzed in organization theory, but it has not yet been linked to a unified perspective of organization as a simple model that undergoes different transformations and actions. Therefore, my aim is not only to link organizational structure and behavior to "attention", but also to understand how this shapes into cognition thanks to "categorization" and "interpretation", as a basis to develop organizational moves, as shown in Figure 2.

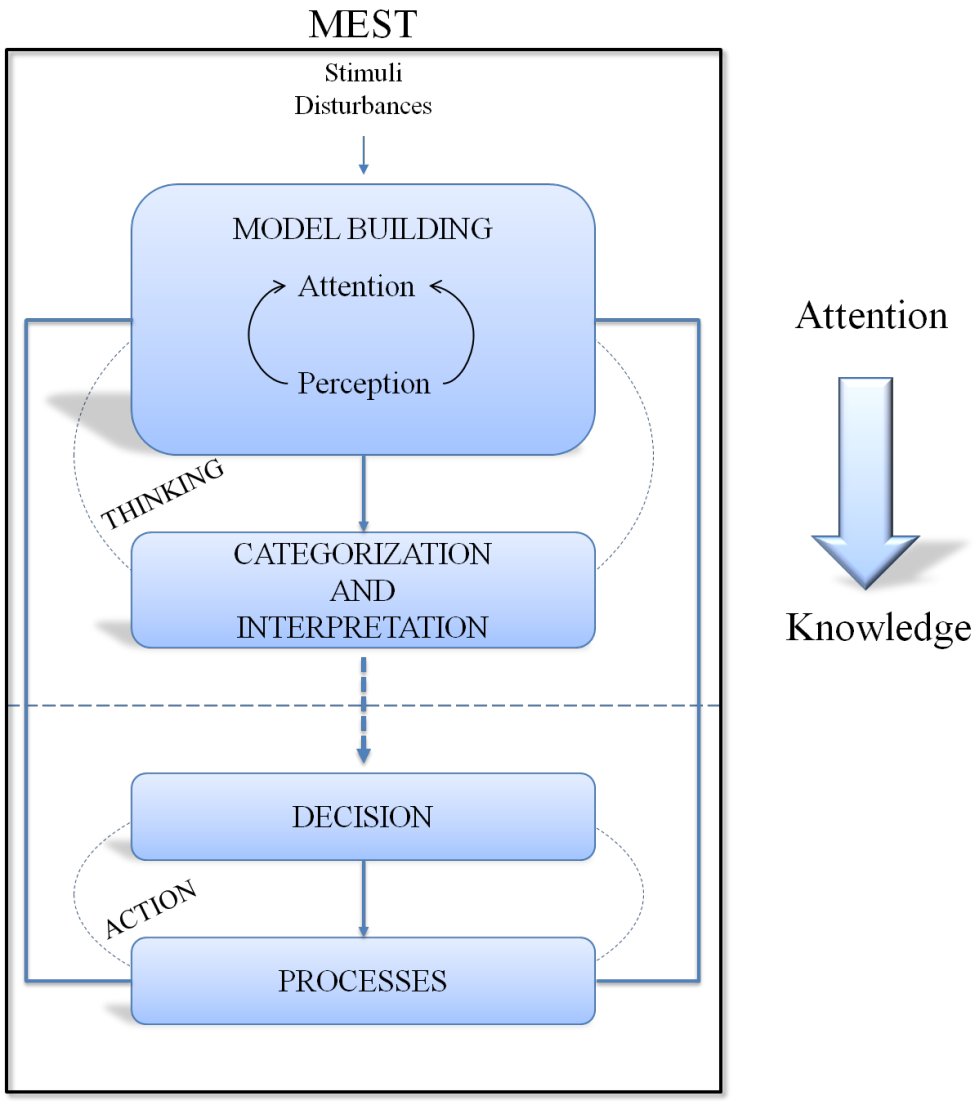

Figure 2 – Attention – Knowledge coupling. Model of Enterprise as a System of Transformation – MEST – as a generating structure for "model building" through attentional processes, knowledge development, and action taking (Source: author's elaboration).

Attention theory, as a guide to interpreting Mella's MEST transformations and behaviors (Mella, 1992, 2008, 2011, 2012), provides an alternative explanation for the firm's behavior both to theories of rational choice (such as game theory and agency theory) and to theories that deepen environmental determinism (such as population ecology). Therefore, since the model's architecture and behavior has been deeply analyzed in this work, I will discuss attention processes which are developed during entrepreneurial and managerial transformations (Mella, 2008) – at the Level of Thinking –- and how they foster knowledge.

As previously anticipated, in organizational behavior "attention" is defined as

> the noticing, encoding, interpreting, and focusing of time and effort by organizational decision makers on both (1) issues: the available repertoire of categories for making sense of the environment; and (2) answers: the available repertoire of action alternatives (Ocasio, 1997, p. 189).

> "Issues and answers together constitute the corporation's agenda and are central to adaptation and change" (Joseph and Ocasio, 2012).

Focusing on attention processes implies that

> … decision makers will be selective in the issues and answers they attend to at any one time, and what decision-makers do depends on what issues and answers they focus their attention on (Ocasio, 1997, p. 188).
>
> Managerial attention is the most precious resource inside the organization and the decision to allocate attention to particular activities is a key factor in explaining why some firms are able to both adapt to changes in their external environment and to introduce new products and processes (Tseng, Fang and Chiu, 2011, p. 52).

The Attention Based View of organizations developed as an echo of behavioral theories of the firm, focusing mainly on understanding how organizations behave. It is important to remember that this is a fundamental question that defines strategic management (Rumelt, Schendel and Teece, 1994). Organizational attention to an issue raises and develops when an organization (i.e., individuals who take decisions and manage them) perceives and prioritizes that issue (Hambrick, Cho, Chen 1996; Ocasio, 1997). The relationship between managerial attention and how this translates into organizational action is still underdeveloped (Sonpar and Golden-Biddle, 2008).

Therefore, we argue:

Proposition 4: When regulating control systems to define which levers of control to use to achieve goals (Mella, 2012), decision-makers define a set of prioritized organizational moves. Attention is seen as a particularly relevant process that integrates the organization's strategic agenda (Joseph and Ocasio, 2012).

This is an outstanding topic, since it helps us to comprehend how "strategic choices" are produced (Child, 1972) and how an organization is able to adapt and change (Dutton, 1997; Mella, 2012).

> There is an assumption on the relationship among three concepts: top managerial attention to an issue leads to organizational attention on that issue, which in turn affects organizational action on that issue (Sonpar and Golden-Biddle, 2008, p. 798).

Thanks to behavior defined by control systems, MEST develops organizational strategy and policy, defined as

> … the pattern of decisions in a company that determines and reveals its objectives, purposes, or goals, produces the principal policies and plans for achieving those goals (Andrews, 1971, p. 13).

This is not in contrast with Mella, who defines *strategy* as

> … an order of priorities regarding action on the control 'levers' (2012, p. 142)

and *policy* as

> … an order of importance for the objectives (2012, p. 157).

According to Mella's approach and to the Attention Based View, *strategy* and *policy* are studied and considered here as a "*pattern of organizational attention*" (Ocasio, 1997, p. 188, author's italics); that is, they focus on particular issues (threats or opportunities) given a particular configuration of skills, routines, plans, and procedures (Allison, 1971; Burgelman,

1983, 1994), and determine which levers of control to activate in order to achieve a defined policy of goals (Sonpar and Golden-Biddle, 2008, p. 799).

> Organizational action on an issue is the result of top managerial and organizational attention (Sonpar and Golden-Biddle, 2008, p. 799).

This process could be described as a sort of "selective attention" (Simon, 1945; Fiske and Taylor, 1991; Hoffman and Ocasio, 2001) toward a plurality of *undifferentiated stimuli* through which organizations, and individuals, detect some environmental issues useful for the decision process, while disregarding others (Hoffman and Ocasio, 2001). This perspective embraces the concept of "organizational enactment behavior" in the environment (Weick, 1979; Hoffman and Ocasio, 2001). According to Weick,

> … enactment emphasize(s) that managers construct, rearrange, single out, and demolish many of the objective features of their surroundings (Weick, 1976, p. 164).
>
> Enactment actively orders the environment through the imposition of schemas and causal maps on the objects of action (Hoffman and Ocasio, 2001, p. 415).

In this sense, therefore, attention guides perceptions, cognitions, decisions and, ultimately, actions.

> Selective attention is driven by salience (Fiske and Taylor, 1991) and salience is shaped by how individuals, organizations and industries enact events in the external environment (Joseph and Ocasio, 2012, p. 415).
>
> According to cognitive research, social saliency is a key determinant of whether a stimuli such as an external event is attended or not (Fiske and Taylor, 1991, p. 247).

These definitions make clear that "attention" is connected to the capability to distinguish, in a specific context, differences (salience) within relative uniformities. This capability may be automatic (*guided by chance*), controlled by the cognitive perception (*controlled attentional processing*), or pushed by specific external signals or information (*automatic attentional processing*) (Shiffrin and Schneider, 1977; Ocasio, 1997). Controlled processing is highly reliant on the individual's degree of attention while automatic processing does not depend directly on the individual's active control.

Thanks to this distinction, it is possible to improve Mella's MEST as a control system (2012) by arguing that:

Proposition 5: Automatic (control) systems (Mella, 2012) are embedded in automatic attentional processes, while non-automatic (control) systems are involved in attentional control processes:

> … the distinction between controlled and automatic attentional processing also helps us to understand the linkage between action and the focus on attention. In the case of automatic processing, action is highly routinized and habitual, as decisions are unreflexively triggered by environmental stimuli that is 'automatically' attended to. In the case of controlled processing, the action of decision makers is triggered by those issues and answers they are mindful of. But given their selective focus on attention, decision makers are limited in the number of issues and answers they can attend to in any particular situation, and only those issues and answers will affect what they do (Ocasio, 1997, p. 190).

4.2 – *Attention Development*

It is worth considering developments in "attention theories" that analyze *situated cognition/attention* (Suchman, 1987; Ross and Nisbett, 1991; Ocasio, 1997; Hoffman and Ocasio, 2001). From the previous definitions and distinctions, it could be possible to state the relevance of the context in which cognition is developed:

> What decision makers focus on, and what they do, depends on the particular context they are located in (Ocasio, 1997, p. 190).

The term "context" refers to characteristics of situations decision makers feel they belong to (Ross and Nisbett, 1991), and we call this kind of context *arenas*. Thus, decision makers focus their degrees of attention, and develop behavior (through control systems), according to the arena they belong to. As notably argued by Ocasio (1997):

> … the consistency (or variance) in attention and behavior is dependent more on consistency (or variance) in the characteristics of the situation rather than characteristics of the individuals (p. 190).

A useful example for understanding this issue is the study by Cialdini and his collaborators (Cialdini, Kallgreen and Reno, 1991) through different field experiments. They discovered that the decision whether or not to litter in public places was dependent on the *situation/context* people found themselves in. As Ocasio (1997) notes about these kinds of experiments and topics, the "*amount (and placement) of litter"* was *"less in litter-free environments than in littered ones*" (p. 190). Therefore, it is possible to understand that littering norms and attitudes condition the degree of attention and behavior of individuals. That is to say, arenas shape an individual's attention and therefore his actions (this is a typical example of Combinatory Systems of Accumulation, developed by Mella (2002, 2005, p. 134)).

A further insight for our study is the following proposition:

Proposition 6*:* Control systems typology and development depends on the arenas decision-makers belong to. Organizational behavior, which is engaged in developing strategy and policy, is shaped, therefore, by the organizational and environmental context, which influences decision-makers' focus on attention and action.

Attentional perspectives have studied the structural *determination/distribution* of attention, which indicates that

> … the particular context decision makers find themselves in, and how they attend to it, depends on how the organization distributes and controls the allocation of issues, activities, communications, and procedures (Ocasio, 1997, p. 191).

This topic shows that the way individuals make plans and attend to triggers is a social and cultural process influenced by the group, organization, and industry (Hoffman and Ocasio, 2001). We believe that attentional processes start with Mella's MEST and develop according to control systems, even though the "attention-based view of theories of organizations" consider attentional processes of individuals (and groups) as involving all the multiple functions present in an organization (Ocasio, 1995, 1997). From my point of view, organizations are made up of different levels and different control systems, which shape structure and behavior. Those levels contribute to defining attentional processes and organizational moves. Mella's MEST well identifies the importance of a "mind" that shapes its attention into a series of issues to define an efficient strategy and an effective policy.

Individual and global cognition are defined by single repertoires and by organizational experience. Every level of Mella's MEST, which contributes to forming the structure of an organization, is based on different control systems, and every level embeds its own knowledge.

Note. To study the plurality of types of knowledge in organizational analysis as a basis for dynamism, see Spender (1993); regarding knowledge and the evolutionary theory of change, see Nelson and Winter (1982); for deeper insights into knowledge management models, go to Kogut and Zander (1992, 1996), Brown and Duguid (1991), Hedlund (1994), and Hedlund and Nonaka (1993); regarding knowledge creation and innovation, see Nonaka (1991, 1994) and Nonaka and Takeuchi (1995, 1996); for the knowledge dimension and a critical analysis, see Polanyi (1958, 1964, 1966) and Penrose (1959) for some insights about organizational growth; regarding knowledge and memory, see Halbwachs (1992), and on learning, see Arrow (1962); for insights about uncertainty, see Dosi and Egidi (1991); for interesting insights about knowledge and the collective mind, see Weick and Roberts (1993), Nonaka, von Krogh and Voelpel (2006), and Nonaka and von Krogh (2009).

Every decision-maker will find himself in a particular channel of communication and procedures and develop his attention inside this selected "environment" of issues and answers. We can then posit that:

Proposition 7*:* Control systems are developed by decision-makers in their local arena, where a set of procedures and communications are sorted out.

Proposition 8*:* Control systems development is influenced and directed by the managerial degree of attention (in this local arena) on a selected set of issues and answers.

While the concept of "distributed attention" has been analyzed in the past by organizational strategy (Simon, 1945; Bower, 1970; March and Olsen, 1975; Ocasio, 1997), and its linkage to individual information processing by "cognitive anthropology" (Latour, 1987; Lave, 1988; Hutchins, 1995), this work emphasizes how control systems follow attention, information distribution, and processing to develop an effective and efficient strategy-policy set. Indeed, Mella's MEST, and its behavior through control systems, could be seen a system where, thanks to attentional and decision-making processes, the inputs from the external and internal environment are *converted/transformed* into a set of outputs – the organizational moves. In fact, we read that:

> … the selection of organizational moves depends on the issues and answers that decision makers attend to (Ocasio, 1997, p. 201),
>
> … organizational moves include both explicit and implicit decisions made by the organization and its decision makers, as a result of both controlled and automatic attentional processes. Organizational moves encompass both exchanges of resources and information with the firm's external environment as well as changes in the firm's own resources and attention structures (Ocasio, 1997, p. 201).

"Organizational moves" are the result of an attentional decision-making process and become part of the organization's decisional environment, influencing, in turn (feedback perspective), future organizational moves, as shown in Figure 3.

The "environment of decision" (Barnard, 1938) is defined by Ocasio as a

> … background that encompasses multiple material, social and cultural factors, both internal and external to the firm, that impinge upon any decision activity (1997, p. 193).

It is important to note that the results of past organizational decisions and actions (i.e., moves) are an integral part of the organization's environment of decisions.

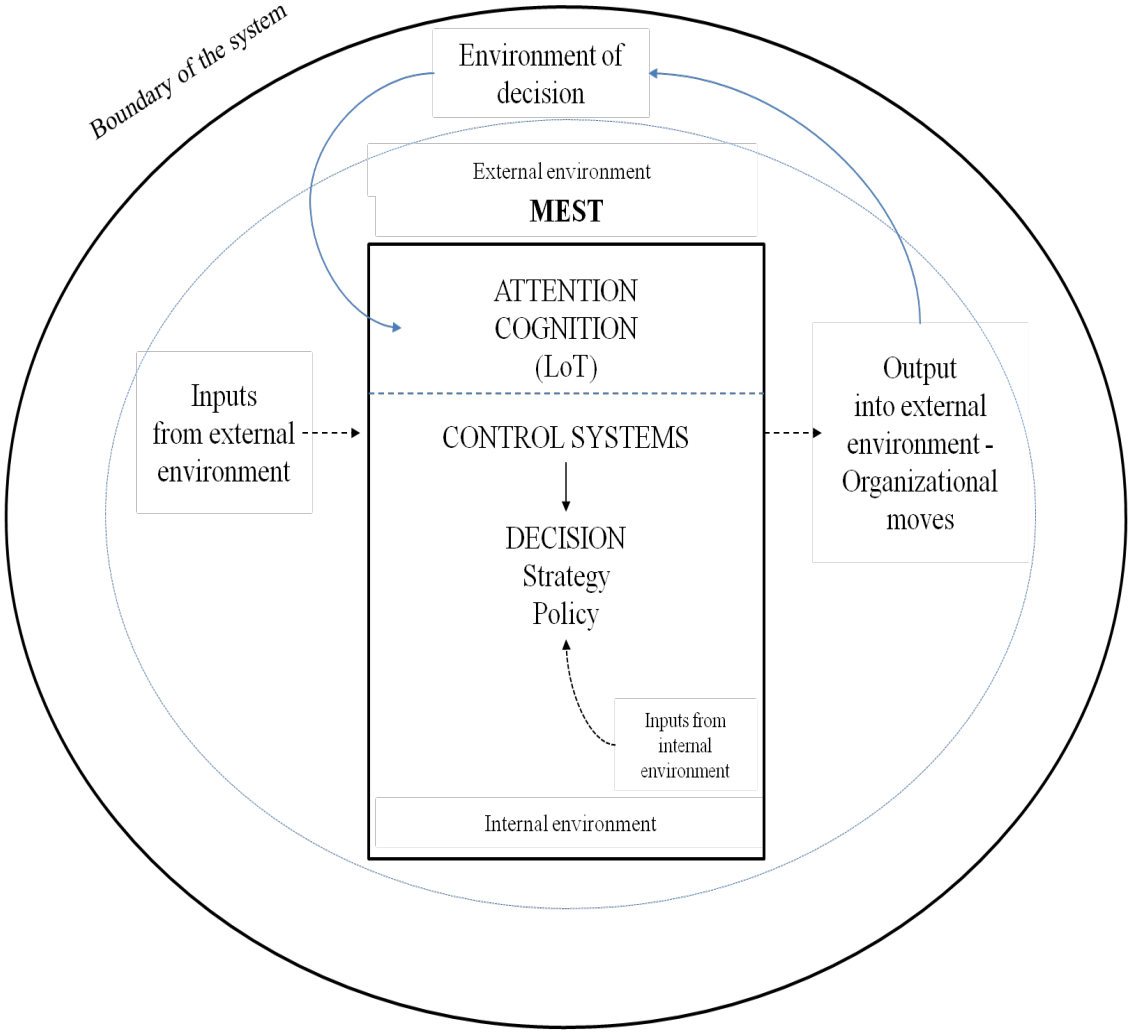

Figure 3 – Mella's MEST as a "transformer" of stimuli into organizational moves and its environment of decisions (Source: author's elaboration).

As shown in Figure 3, the "environment of decisions" is influenced by organizational moves that, in turn, affect future organizational moves, which underlines the power of Mella's control systems perspective:

Proposition 9*:* Control systems allow the organization to behave according to its paths of attention in order to reach goal effectiveness and strategic efficiency. Therefore:

> not all information is processed at once; rather different information is attended to within each channel (Joseph and Ocasio, 2012, p. 654).

Information is selected by "attentional processes" and "transformed into actions" thanks to "organizational control systems" generated according to an entrepreneurial and managerial transformation, which in turn is further developed by diverse functions of the organization. "Situated attention" within a channel or a specific area of the organization is an important issue which could help managers in reducing information complexity.

5 – Attention and Knowledge Coupling

Emerging research has addressed cognition in organizations since it could help to understand how the firm responds to its environment, which has been deeply studied in management theories since Lawrence and Lorsch's classic work (1967). The cognitive perspective views the environment not as exclusively exogenous; therefore, organizational moves into that environment are coupled with the managerial interpretation of it (Kaplan, 2011). Another stream of literature, drawing on the work of Simon and March (March and Simon, 1958; Simon, 1945), considers the cognitive limits of managers (Daft and Weick, 1984; Dutton and Jackson, 1987). For other authors who studied managerial action analysis – e. g., transaction cost economics (Williamson, 1975, 1993), population ecology (Hannan and Freeman, 1977), resource dependence (Pfeffer and Salancik, 1978) – the cognitive approach was helpful in studying outcomes not determined by structural features but by managerial choices and actions.

Researchers involved in a "resource-based view" of the firm and behavioral theories of the firm believe in the organization's difficulty to adapt to changing environments due to path dependence associated with initial endowments (Leonard-Barton, 1992). Other authors have analyzed "pre-adaptive" organizational capabilities (Klepper and Simons, 2000; Cattani, 2005; Kaplan, 2011). The literature is vast. For quite recent insights about cognition in different managerial areas, see Helfat (1997), Teece, Pisano and Shuen (1997), Tripsas and Gavetti (2000); on cognitive dynamic capabilities and technical renewal as adaptation, see Laamanen and Wallin (2009) and Eggers and Kaplan (2009).

When facing problematic issues in a changing environment, organizations have difficulties regarding technical innovation (Henderson and Clark, 1990), market crisis management (Smith and Tusham, 2005). Some organizations can adapt while others cannot (Kaplan, 2008). Knight (1921, 1965) has argued that these difficulties do not rely exclusively on environmental changes but are negatively related to the managerial capability to access, understand, and respond to change. Information from the environment is not always understood and processed as a set of precise and clear signs (Kaplan, 2008); therefore, decision-makers must pay attention to external and internal issues and organize them to define a prioritization process of issues.

> The information from the environment is not comprehended as a set of recognizable signals (Kaplan, 2008, p. 729).

This process of generating a "range" of issues is justified since resources and information are scarce and human cognitive capacity is limited. Therefore, managers selectively attend to some issues and not to others: i. e., selective issue attention due to limited cognition (Dutton and Jackson, 1987; Ocasio, 1997, 2001; Hoffman and Ocasio, 2001; Joseph and Ocasio, 2012) and the capability to react to crises thanks to managerial communication (D'Aveni and Macmillan, 1990).

A significant assumption is that decision-makers, embedded in their own cognitive repertoires thanks to an attentional process (influenced by their cognitive frames), select the variables to be controlled and choose which levers of control to move (strategy) to achieve the stated policy objectives (Mella, 2012). Managerial perspectives are translated into strategic choices (Daft and Weick, 1984), which form the organizational knowledge. Therefore, decision-makers need to organize this process with attention to understand their environment (Kaplan, 2008). Organizational moves, a result of managerial action, influence decision-makers' cognitive frames and future choices, following the feedback perspective shown in Figure 4.

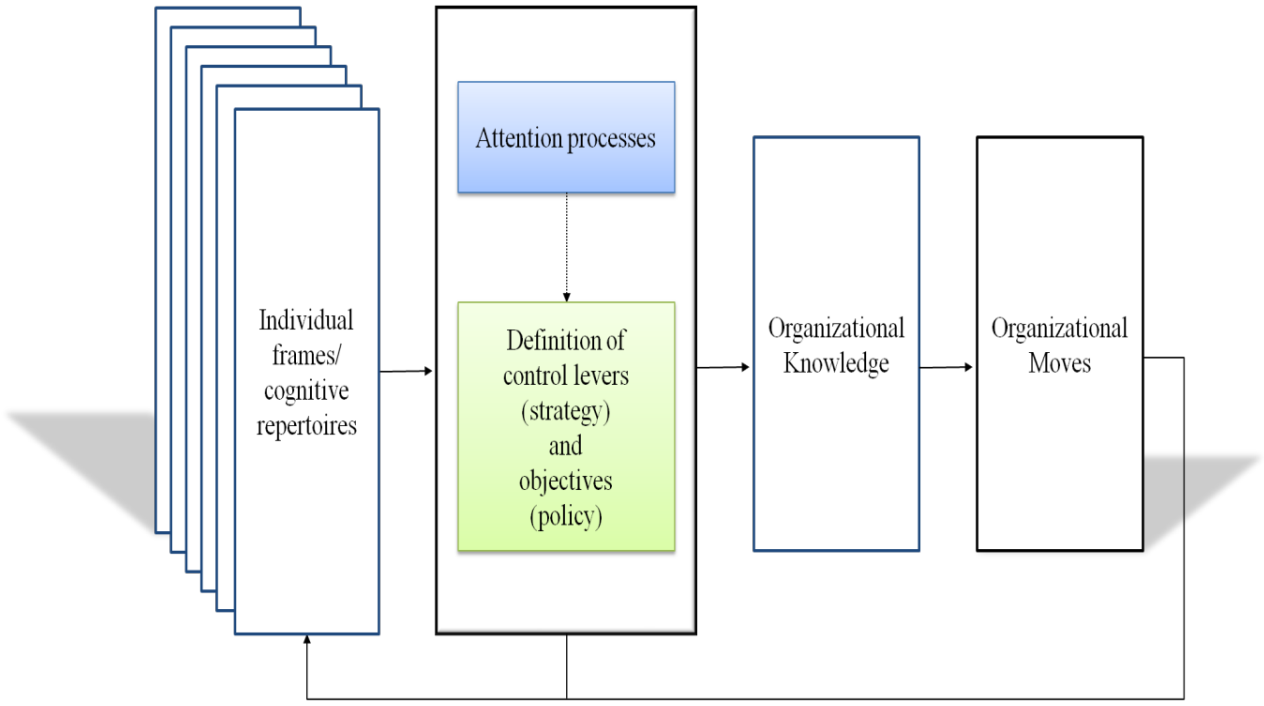

Figure 4 – Cognition - Attention coupling (Source: author's elaboration)

Several theoretical models show how interpretive and cognitive processes could influence strategic choice (Kiesler and Sproull, 1982; Ocasio, 1997, Barr, 1998; Tripsas and Gavetti, 2000; Kaplan, 2008, 2011). Individual frames are defined as individual cognitive predispositions that influence how individuals/decision-makers interpret information from the external environment; Cho and Hambrick (2006) refer to these as the "mental models of managers". They could be seen as "lenses" through which individuals see the environment (Kaplan, 2008).

Note. For a deeper analysis about managerial cognition and cognitive frames, see Gavetti and Levinthal (2000), Levinthal (1997); regarding adaptation, see Garud and Rappa (1994), Tripsas and Gavetti (2000); on cognition and managerial inertia, see Porac, Thomas and Baden-Fuller (2011); for a discussion of competition and cognition, see Sutcliffe (1994); on how managers perceive and analyze issues, see Jackson and Dutton (1988); for further studies about understanding the sources of frames, see Wiersema and Bantel (1992) and Kaplan (2008, 2011).

Organizational moves are involved in crafting organizational cognition and also influence how attention will be focused on issues in the future. It is worth remembering that attention helps managers make decisions and set goals, which fosters the building of an *organizational knowledge background*. Successful organizational results will be regarded as a practice to follow (predominant frame), and these will be attended and shaped according to environmental changes, while negative outcomes will be regarded as a basis for improving and changing strategy or policy.

> The plurality of frames and the presence of conflict appear to be a vital part of strategy making in a setting with high stakes and ambiguous outcomes (Kaplan, 2008, p. 745).

Organizational knowledge is the result of a *cognitive activity* through which a *cognitive system* (the organization) (Mella, 2012; Meo Colombo, 2012; Maturana and Varela, 1980, 1988) *pays attention* to certain issues and processes information according to certain rules.

Attention and cognition are possible thanks to the existence of a mind (defined by Level 1 of Mella's MEST) able to deal with triggers and to a "program" (Mella, 1997a,b) that translates them into mental representations/frames.

> Frames influence strategic choice, mediated by organizational framing contexts. […] frames are both constraints and resources for actors acting purposefully to shape strategic choices (Kaplan, 2008, p. 745).

We argue that:

Proposition 10*:* Knowledge is possible when the mind of the organization pays attention to environmental stimuli, translates these into useful information and, thanks to control systems (which allow strategies and policies to develop), produces further decisions for the organization itself.

A remarkable aspect to analyze in explaining the model shown in Figure 4 in depth is that every attentional process linked to control system behavior deals with memory. According to Mella (1997a,b), memory is defined as a computational activity thanks to which attended triggers and information are codified and conserved in the mind of the organization, in order to be used for future strategic and operative decision-making. Cognitive activity behaves according to a *program*. *Computational* activity helps management transform triggers into information useful in fostering decision-making. This is possible only because of the existence of a program that transforms perceptions into information, which works according to rules, instructions, and principles of association, identification, recognition, separation, and exclusion. The program must embed evaluation rules of representations to select those considered to be the best answer to organizational problems. In this sense, useful and negative information is stored and contributes to building the organizational knowledge base. We could also call it the "experience" of the organization.

Therefore, there is a relationship between cognitive repertoires and what is constructed through attention translated into decision-making, i.e., the predominant frame (Kaplan, 2008), which, in turn, affects knowledge accumulation and individual repertoires.

> Attentional capacity can be limited by decision makers general receptivity to stimuli as well as their ability to focus on competing sensory inputs" (Tseng, Fang, Chiu, 2011). Ocasio and Joseph (2005) argue that organizational attention should be backwards and future oriented: it will contribute to face organizational problems while providing links with perceived opportunities and threats in the environment (Tseng, Fang, Chiu, 2011).
>
> In knowledge creation, one cannot be free from one's own context. Social, cultural, and historical contexts are important for individuals because such contexts give the basis for one to interpret information to create meanings (Nonaka and Toyama, 2003, p. 3).

6 – Improving Attention and Knowledge. Learning Organizations

Figure 4 shows the relationships between individual frames and attention. "Proposition 7" emphasizes the need to develop attention as the driving force of knowledge. The development of knowledge and individual attention is the premise for more complete organizational learning, in the sense of Peter Senge's theory of "learning organizations".

For Senge, organizations that "learn" are:

> […] organizations where people continually expand their capacity to create the results they truly desire, where new and expansive patterns of thinking are nurtured, where collective

> aspiration is set free, and where people are continually learning to see the whole together (Senge 2006, p. 3).

The learning organization's goal is to give individuals the best conditions to learn together, for which it is first necessary to "learn to learn together". The faster the organization learns how to develop "attention" and "thinking", the readier the entire organization is to deal with external events. It is thus necessary to create the *organizational conditions* so that individuals not only learn to improve their knowledge but learn together with other individuals how to increase "collective knowledge".

Proposition 11: The "mind" of the organization must continually "learn" in order to improve its capability and "attention" skills with regard to environmental stimuli, translating these into useful *information* and further *decisions*. The organization whose mind follows a continuous path of learning is a "Learning Organization".

To transform organizations into learning organizations, Senge identifies four fundamental disciplines that organizations must try to apply, even separately, to develop **"**organizational learning".

1. The "first discipline" is "*Personal Mastery*".

To improve the organization's performance, it is necessary to develop the discipline of personal mastery, which, bringing out the desire to learn and to create in everyone in the organization, teaches them to face life in a *creative* and *non-reactive* way; this favors individual growth through *personal learning* and *improvement*, thereby contributing to clarifying the individual's view about his life and work.

> Personal mastery is the discipline of continually clarifying and deepening our personal vision, of focusing our energies, of developing patience, and of seeing reality objectively. As such, it is an essential cornerstone of the learning organization—the learning organization's spiritual foundation (Senge 2006, p. 7).

> The discipline of personal mastery […] starts with clarifying the things that really matter to us, of living our lives in the service of our highest aspirations (Senge 2006, p. 8).

2. The "second discipline" is termed "*Mental Models*".

This discipline is particularly relevant because it concerns the ability to clarify and improve the "frames" and "repertoires" that affect attention and decision-making, improving the actions of individuals in the organization. In fact, a "mental model" is a "pattern" or a "theory" that guides a person in the decisions and choices he makes when he acts. If the results of the model are positive, the model is strengthened; otherwise, it is "set aside" and another model of behavior is sought.

> 'Mental models' are deeply ingrained assumptions, generalizations, or even pictures or images that influence how we understand the world and how we take action" (Senge 2006, p. 8).

Mental models influence in a crucial way the "pattern of attention" of individuals, but they also are pervasive in their effects on organizations in the form of operational procedures (I do this because it is so written in the manual), widely-accepted organizational practices (I act like this because everyone else does), standardized decisional rules (it might be wrong, but that is what I have been told to do), and so on. The "mental models discipline" is fundamental for

organizational learning since it not only increases the group or individual's capacity to form a stock of shared knowledge, but facilitates the process of recognizing and modifying the group's mental models to collectively decide in an effective way, as if the decision came from a single individual.

> The discipline of working with mental models starts with turning the mirror inward; learning to unearth our internal pictures of the world, to bring them to the surface and hold them rigorously to scrutiny" (Senge 2006, p. 8).

3. "*Building Shared Vision*" is the "third discipline".

To build a "shared vision", the heads and leaders of the organization must continually pay attention and share their personal "visions" with the other members and have these accepted by the latter, who then, in turn, spread them through personal commitment. As Senge observes, in most *modern-day organizations*, relatively few people can be said to be "enrolled", and even a lesser amount "committed". Most are in a state of conformism, whether formal or genuine. The enrolled people assume the role of *raising attention* to other members to improve their attention and knowledge. The "*Building Shared Vision*" discipline has always been fundamental for the long-term survival of organizations, but it is even more essential today for building "learning organizations".

> If any one idea about leadership has inspired organizations for thousands of years, it's the capacity to hold a shared picture of the future we seek to create. […] The practice of shared vision involves the skills of unearthing shared 'pictures of the future' that foster genuine commitment and enrollment rather than compliance (Senge 2006, p. 9).

4. The "fourth discipline" is "*Team-learning*".

Team learning improves the process that seeks to create and develop the "team's capacity" to *focus the attention* of all participants on stimuli, categories, and objectives in order to work together in a coordinated manner to obtain results its members truly desire, perhaps to achieve a "shared vision" through "dialogue" – in order to listen to the different points of view – and "discussion" – in order to search for the best point of view to support the decisions that must be made.

> The discipline of team learning starts with "dialogue," the capacity of members of a team to suspend assumptions and enter into a genuine "thinking together." […] The discipline of dialogue also involves learning how to recognize the patterns of interaction in teams that undermine learning (Senge 2006, p. 10).

The "alignment of attentional processes" is a necessary condition to allow the power given to an individual to increase the power of the entire team.

> […] there are striking examples where the intelligence of the team exceeds the intelligence of the individuals in the team, and where teams develop extraordinary capacities for coordinated action (Senge 2006, p. 9).

As discussed above, *knowledge development* and *attention* are the basis for a complete "organizational learning", according to Senge (1990, 2006). The speed of this learning process depends on the capability of the organization to develop attention and knowledge processes in order to face external events quickly, efficiently, and effectively.

7 – Conclusions

According to the necessity found in the literature to fill the gap between a clear understanding of "cognition" and "strategy", I have previously discussed the concept of Control Systems, which consist in actions (X acts on Y) and reactions (E(Y) acts on X through Y), with a certain number of iterations on the control lever, that aim at achieving objectives (goal-seeking systems) or at respecting the constraints or limits (constraint-keeping systems).

Control Systems are "logical models" useful in understanding organizations and developing quick learning behaviors involving objectives, their translation into coherent and shared values, the verification of the achievements, and the development of the necessary actions to measure and erase errors, thanks to regulation processes and apparatuses.

I have improved Mella's MEST (Model of Enterprise as a System of Transformation), arguing that it is a control system in its overall unity, composed, in turn, of sub-systems considered as sub-control systems. As a cognitive control system, the MEST carries out a cognitive activity that gives meanings to environmental stimuli, translating these into information and, through planning, structuring these as knowledge, thereby developing a pro-active behavior for the long-term reproduction of the economic processes, while at the same time anticipating environmental changes.

Improving this approach, I have linked "attention" to "cognitive systems", arguing that "organizational attention" to an issue arises and develops when an organization prioritizes that issue. The MEST has been seen as a system which develops a "pattern of organizational attention", focusing on particular issues given a particular configuration of skills, plans, and procedures, determining which levers of control to activate in order to achieve the organizational goals. Organizational moves are the result of an "attentional decision-making process" and become part of the organization's environment of decisions, in turn influencing future organizational moves in a feedback perspective.

Organizational knowledge is the result of a cognitive activity, through which the MEST pays attention to certain issues and processes information according to certain rules. I have subsequently showed how and why attention, linked to control systems, is the driving force of organizational knowledge creation and development. The aim was to demonstrate how the development of knowledge and individual attention could be the premise for a more complete organizational learning. The faster the organizational learns how to develop attention and thinking, the more ready the entire organization is to deal with external events. In fact, there is strong evidence for seeking progress in cognition, attention, learning, and intelligence.

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