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Capitalistic Firms as Cognitive Intelligent and Explorative Agents. The Beer's VSM and Mella's Most Views

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Abstract. *In this paper we propose a general model to understand (not merely describe) the operating logic of Business Value-Creating Organizations and, in particular of the capitalistic firm - that is, the business for-profit organization. When viewed as autopoietic and teleological organizations, firms can be interpreted both as viable systems (following Beer's Viable System Model, or VSM) and as operating systems for efficient transformation (following Mella's MOEST, or Model of the Organization as an Efficient System of Transformation).Beer believes that organizations must be viewed as viable systems, which, through their structure, which is capable of learning and cognition, can achieve an enduring structural coupling with the environment, continuing in this way to exist for a long time through continually adapting to the environment. Mella asserts that organizations must be conceived of as transformation systems that carry out five parallel transformations: (1) a productive transformation of factors into production; this is a transformation of utility, governed by productivity and by quality; (2) an economic transformation of costs and revenues into operating income; this is a transformation of value, governed by prices and therefore by the market; (3) a financial transformation of risks, which transforms capital into returns and guarantees the maintenance of its financial integrity; (4) an entrepreneurial transformation of information into strategies, which leads to a continual readjustment of the firm's strategic position; (5) a managerial (organizational) transformation of strategies into actions of management control. The MOEST proposes a system of performance indices and measures and highlights the mutual relationships among these indexes. Based on VSM and MOEST, we will try to demonstrate that, just as individuals in a Social System are responsible for their own actions and behavior with respect to the other individuals in the system, Organizations, as vital entities that make up the Social System, must also necessarily be held accountable for the economic and non-economic consequences of their actions. The complex "thinking-action" interaction leads the organization to behave as a cognitive entity, as a vital unitary system, that must be held "socially responsible" for its own actions, as these are produced, in turn, by its own decisions. This results in the necessity and inevitability of CSR.Specifically, the MOEST shows that the action of*

every BVCO assumes a Corporate Governance that specifies stakeholder objectives and environmental constraints, in this way defining the various levels of CSR. The CSR thus represents a fundamental variable in the strategy of BVCOs, as corporate ethics and reputation is based on this. For this reason we have enlarged the original structure of the Kaplan & Norton's Balanced Scorecard (BSC) by including in the model of four scorecards a fifth scorecard that measures the firm's capacity to create well-being for the collectivity and demonstrate the firm's social utility by indicating its capacity to achieve social and environmental objectives.

Keywords: *value creation, capitalistic firms, performance indicators, viable system model, MOEST, balanced scorecard.*

Introduction

Just as individuals acting in Social Systems are responsible for their own actions and behavior with respect to the other individuals in the system, Organizations, as vital entities, must also necessarily be held accountable for the economic and non-economic consequences of their decisions, actions and controls, which are determined by policies and strategies.

This study is based on a coherent framework built on the following guidelines:
1. Permanent production organizations, in particular Business Value-Creating Organizations (BVCO), or "capitalistic firms" carry out the processes for the production of value;
2. From an internal point of view, BVOCs are operationally-closed systems that are at the same time structurally and behaviourally coupled to the environment; they perceive disturbances such as external stimuli, process these, and act (react or pro-act) to balance the network of vital processes;
3. In this sense, BVCOs can be conceived of as "conscious cognitive systems" that link themselves to the environment through a system of processed, up-dated, and evaluated information, which we can define as the representation of the external world;
4. From an external point of view, BVCOs are teleonomic systems that can continue to exist only as long as their performance as systems for the production of value is appreciated by the environment, according to a coherent system of performance indicators for the production of value (productivity, quality, economic efficiency, returns, Economic Value Added and Economic Value of the Firm).

In this framework "capitalistic firms" are BVCOs that are viewed as systems acting in a complex environment whose Management's maximum objective

is the creation of economic and financial value for their shareholders (Rappaport, 1998). The spread of Value Based Management is a relatively recent process. Only since the 1990s have many large firms turned to this managerial technique, whose objective is to direct management toward the primary goal of creating shareholder value. Value Based Management does not represent a new management technique, a specific method, or a new system of control; rather it is a mental attitude toward the conscious, systematic, prevalent application of a set of traditional methods specifically directed, as a whole, to maximizing shareholder value.

Arnold and Davies's definition is very clear: "Value-based management is a managerial approach in which the primary purpose is long-term shareholder wealth maximization. The objective of a firm, its systems, strategy, processes, analytical techniques, performance measurements and culture have as their guiding objective shareholder wealth maximization" (Arnold & Davies, 2000, p.9).

From an internal point of view, performance for shareholders is based on profit and the value of capital, and it is measured by a system of monetary values. Again from an internal point of view, performance must also be assessed according to non-monetary variables; for example, based on Kaplan's balanced scorecard model (see below). From an external point of view, if firms are seen as vital systems operating in the environment, then performance is perceived by external stakeholders as the capacity to produce sustainable value by means of ethical business and managerial behavior.

In order to achieve autopoiesis and maintain the organization viable indefinitely, three particularly significant models have been proposed:
1. Beer's Viable System Model, which indicates the structure organizations must have in order to remain indefinitely viable;
2. Mella's Model of the Organization as an Efficient System of Transformation (MOEST), which points out that the main condition of vitality of organizations consists in their carrying out five parallel transformations in the search for maximum efficiency:
a. a *productive transformation* of factors into production, governed by productivity and by quality;
b. an *economic transformation* of costs and revenues into operating income, governed by prices and therefore by the market;
c. a *financial transformation* of capital into returns, governed by risk;
d. an *entrepreneurial transformation* of information into objectives and policies, specifying the levers, that is, the strategies, for controlling these;

e. a *managerial* (organizational) *transformation* of strategies into decisions, actions and management controls.
3. The model of organizations as *control systems*, in the sense that a firm must set a system of objectives for itself which is centred on its shareholders and stakeholders. These objectives can be achieved by the organization only if it acts as a system of control that produces effective strategies for carrying out a policy regarding the production of value which does not exclusively benefit the shareholders but instead concerns a vast group of stakeholders. As a result we must also broaden our notion of the production of sustainable value in order to include both social value and environmental value.

Despite the differing perspectives from which firms can be viewed, it is appropriate to introduce *capitalistic firms*, viewed as autopoietic and teleonomic business and profit-oriented BVCOs (Mella, 2005), whose *fitness* resides in their capability, or efficiency, to produce adequate levels of economic and financial values through a network of efficient processes carried out by a structure of organs (processors) joined by networks of control systems (Alter & Hage, 1993; Mella, 2014).

The capitalistic firm as an autopoietic and teleonomic system

Capitalistic firms are *autopoietic* and *homeostatic systems* (Bednarz, 1988; Luhmann, 1995; Maturana & Varela, 1980; Varela, 1979) in the sense that, through their metabolic processes, they produce themselves by regenerating the network of financial and economic processes, searching for the metabolic and energy inputs in the environment which are useful for *autopoiesis* and fleeing from those which are damaging (Mingers, 1994; Zeleny & Hufford, 1992).

This incessant activity regarding the *production of outcomes* and the *search for inputs* to maintain the organization in existence shows that organizations, in addition to being autopoietic and homeostatic systems, also produce *teleonomic* behavior to achieve the "existential project" for which they were created, according to Jacques Monod's definition: "All artifacts are the product of the activity of a living being that expresses in this way, and in a particularly evident manner, one of the fundamental features that characterizes all living beings, without exception: that of being an object endowed with a project which is represented within their structures and is carried out by means of their performance (for example, the creation of artifacts). […] All the structures, all the performances, all the

activities which contribute to the success of the essential project will thus be called 'teleonomic' " (Monod, 1970, pp.22-25).[1]

Defining *teleonomy* as the ability of an autopoietic system to maintain its existence by regenerating its autopoietic processes, then capitalistic firms are undoubtedly teleonomic systems, in that they maintain their own autopoiesis by carrying out cognitive processes aimed at giving significance to the environmental stimuli, translating these into information that is structured in knowledge and producing a reactive and proactive behaviour in order to search for the conditions that allow individuals to benefit, directly or indirectly, from the achievement of a common end that defines the capitalistic firms' teleology. We can also distinguish between *endogenous* teleonomy and *exogenous* teleonomy (Monod, 1970, p.124; for an opposing view see Maturana & Varela, 1988; Paetau, 1997). While *endogenous* teleonomy characterizes the internal structural dynamics of the organization, *exogenous* teleonomy characterizes its environmental dynamics.

The organization has a high endogenous teleonomy if, by developing efficient processes of adaptation, it continues to exist despite the unfavorable structural disturbances from the environment; it is characterized by a high exogenous teleonomy if the environment itself sets the conditions that favor its autopoiesis, and thus its lasting existence, as a unit as well as an organizational type (Toffler, 1985). In this sense the organizational activity of cognition and learning (De Geus, 1988; Senge, 2006) is necessary for the organization's teleonomy.

We can easy understand the relationships between teleonomy and autopoiesis: teleonomy – understood as the attitude of the organization, to preserve itself – can be considered the phenomenology that corresponds to autopoiesis – understood as self-production with respect to the individuals forming the structure; "In effect teleonomy is teleology made respectable by Darwin, but generations of biologists have been

[1] Tout artefact est un produit de l'activité d'un être vivant qui exprime ainsi, et de façon particulièrement évidente, l'une des propriétés fondamentales qui caractérisent tous les êtres vivants sans exception: celle d'être des objets doués d'un projet qu'à la fois ils représentent dans leurs structures et accomplissent par leurs performances (telles que, par exemple, la création d'artefacts). Plutôt que de refuser cette notion (ainsi que certains biologistes ont tenté de le faire), il est au contraire indispensable de le riconnaître comme essentielle à la définition même des tre vivants. Nuos dirons que ceux-ci se distinguent de tiutes les autres structures de tous systèmes présents dans l'univers, par cette propriété que nous appellorons la téléonomie) (Monod 1970, p.22) [...] Nous choisirons arbitrairement de définir le projet tèléonomique essentiel comme consistant dans la trasmission, d'une génération à l'autre, du contenu d'invariance caractéristique de l'espèce. Toutes les structure, toutes les performances, toutes les activitès qui contribuent au seccès du projet essentiel seront donc dites "téléonomiques" (Monod, ibidem).

schooled to avoid 'teleology' as if it were an incorrect construction in Latin grammar, and many feel more comfortable with a euphemism" (Dawkins, 1982, cited by Barrows, 2001, p.705).

The capitalistic firm as a Viable System

Stafford Beer (1979, 1981, 1984) has developed a model of the firm as a viable system – universally known as the Viable System Model, or VSM – which is briefly outlined in figure 1. Directing the reader to Beer's books for a detailed description, here it is enough to mention that this model interprets organizations as "viable systems" that are open, recursive and adaptable and that, thanks to their cognitive and control structure, which is capable of communicating with the economic and non-economic environment, tend to endure for a long time through continual adaptation, even in the presence of disturbances not foreseen at the time of the system's design and implementation. In his book *Brain of the Firm* (1981), Beer provides a definition of viability: "This book has been wholly about the viable system. There must be criteria of 'independent' viability, even though any system turns out to be embedded in a larger system and is never completely isolated, completely autonomous or completely free" (Beer, 1981, p.226). "The object is to construct a model of the organization of any viable system. The firm is something organic, which intends to survive – and that is why I call it a viable system" (Beer, 1981, p.75).

The VSM characterizes any vital organization as a structure composed of five interconnected sub-systems (SS):

1. SS1: OPERATIONS. This represents the operational units, which in turn are viable systems whose purpose is to achieve the operational objectives at the various levels by connecting with the environment, to which they are structurally coupled; the operational units that make up the SS1 are unquestionably Control Systems oriented toward objectives and specific and particular constraints, both internal and external.
2. SS2: COORDINATION. The operational units of SS1 – which employ common resources and are potentially in competition regarding the objectives – are interconnected Control Systems which are usually interfering systems that can thus produce, in their local values, an oscillatory dynamics that may cause inefficiencies. For this reason SS2 is charged with coordinating the interconnected operational units according to a logic of control systems for organizational coordination.
3. SS3: CONTROL. The operational units of SS1 each pursue local objectives. They must therefore be directed toward the achievement of the higher-

order objectives, which refer to the organizational unit, based on a common programme. The SS3 are charged with this function. The same term used by Beer – the SS of control – clearly reveals that SS3 is a typical Control System based on planning. Since it is capable of activating a range of control levers, SS3 is charged with formulating the utilization strategies of the levers for the various objectives. Nevertheless, SS3 cannot detach itself from subsystems 4 and 5, as it forms together with them a higher-order subsystem that carries out cognitive activities and represents the organization's intelligence.

4. SS4: INTELLIGENCE, or research of information on the environment. The survival capacity and vitality conditions of the organization depend on the latter's capacity to continually observe the environment and forecast its "future" state in order to allow SS3 to formulate programmes of action to which it adapts the units and activities of SS1. SS4 represents the viable system element charged with proposing the vital objectives – based on foreseeable future scenarios – and translating these into programmes of action whose implementation it oversees.

5. SS5: POLICY. To complete the VSM, Beer has clearly observed that organizations are multi-objective Control Systems (Mella, 2014). Thus the control lever strategies used by the lower-order subsystems are not sufficient; instead, a careful assessment and rational ordering of SS4 objectives is indispensable. SS5 is necessary precisely to guarantee that the organization will have a unitary management, together with an entrepreneurial and managerial capacity that can define the policies needed to achieve the vital objectives.

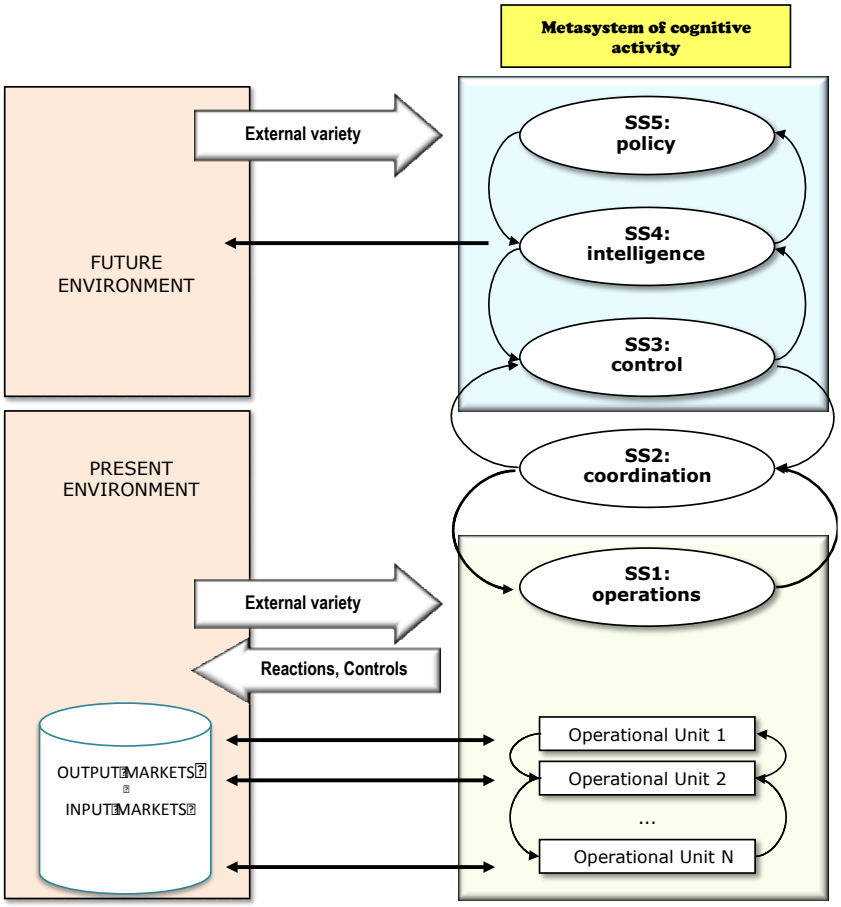

Figure 1. A synthesis of the Viable System Model (Mella, 2014)

According to Beer, the viable system represents in all respects an autonomous holonic entity (Mella, 2009), since every organization, while a complete unit, is in turn composed of smaller vital entities (organs, groups of organs, operational units, departments, functions, divisions, etc.), and at the same time part of a larger vital unit, as Beer clearly recognizes in the following theorem: *Recursive System Theorem*. In a recursive organizational structure, any viable system contains, and is contained in, a viable system. There is an alternative version of the Theorem as stated in *Brain of the Firm*, which expressed the same point from the opposite angle: 'if a viable system contains a viable system, then the organizational structure must be recursive" (Beer, 1979, p.118).

In short, with the VSM Beer recognizes that in order to be vital the organization-firm must operate as a unitary Control System, such as the one outlined in figure 2 (see Appendix), where the operational organs are arranged in a holarchy of Control Systems (Mella, 2014).

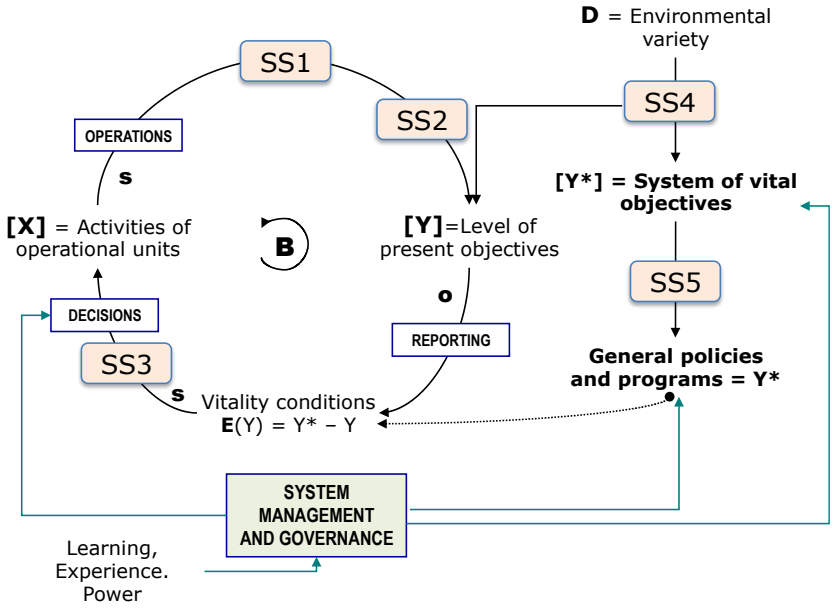

Figure 1. The VSM as a Control System (Mella, 2014)

The capitalistic firm as a System of Efficient Transformations

The VSM illustrates the structure an organization must have to remain vital, but it does not highlight the economic and financial processes that all *capitalistic firms* – when viewed as autopoietic and teleonomic organizations – must necessarily carry out through their structures to remain vital. A specific model (in many respects parallel to the VSM) the MOEST, has been proposed by Mella (2005, 2012, 2014). The MOEST considers all *capitalistic firms* as *systems of transformation* that, in order to remain in existence over time, must carry out five interconnected vital *transformations*, each of which, operating with maximum efficiency, carries out a vital function similar to what is proposed in the VSM. Unlike the VSM, which represents organizations from the point of view of their *structural* synthesis, the MOEST sees them from a *functional* viewpoint. Moreover, the MOEST highlights the role of information and communication from and to the stakeholders, and thus the need to define the reputational and ethical spheres of organizational behavior.

The MOEST, shown in figure 3, interprets capitalistic firms as operating systems of transformation that carry out five parallel efficient transformations:

1. an efficient PRODUCTIVE TRANSFORMATION [P] of productive *factors*, F, into flows of finished *goods*, P; this is a transformation of utility governed by maximum *productivity* of the processes and *quality* of the products; in figure 3 the efficiency of this transformation is indicated by the average productivity measure, □ = QP / QF – where QF represents the input factors and QP the output production – or by the average requirement coefficients for factors qF = QF / QP; "quality" is an "elusive" concept, but for capitalistic firms there are three main notions of quality to consider for evaluating the efficiency of production process (Mella, 2011): (a) *functional quality*, according to which the product must be fit for a purpose, leaving to clients the task of identifying the needs and aspirations the product must satisfy; (b) *design-based quality*, according to which the product must, in any case, conform to a design, prototype, or standard in order to satisfy client needs; (c) *environmental* (or context) *quality***,** according to which the product must not only satisfy the clients but be compatible with its introduction in the environment; it must possess a set of characteristics which, from the point of view of external impact, make the product compatible with the environment, both in terms of pollution, waste disposal, environmental risks, or suitability for introduction into the context in question;
2. an efficient ECONOMIC TRANSFORMATION [E] of costs and revenues into EBIT (operating income); it is immediately clear that economic efficiency depends on productivity, which reflects productive efficiency, and on the ratio between the *average selling price* and the *average unit cost of production*, which represents *market efficiency*; the efficiency of this transformation is represented by the following quantities: (i) e = RP / CP = pP / cP which represents the economic efficiency of the economic transformation; RP indicates revenues, pP = RP/QP indicates the average price vectors for output production and cP = CP / QP represents the average unit full cost of production; (ii) OI = EBIT = RP - CP, or *operating income*, expresses the value produced by the firm above and beyond the value of the factors consumed (CP); (iii) ROC = OI/CP is the <u>return on cost</u> or mark-up;
3. an efficient FINANCIAL TRANSFORMATION [F] of risks, which transforms capital into the maximum returns and guarantees the maintenance of the firm's financial integrity; the profit organization that finances its economic processes with external capital in the form of *Equity* and *Debt*, which constitute the *Invested Capital*, becomes a *capitalistic enterprise*. To carry out the economic transformation the firm must raise *capital* – equity, E, and debt, D – for financing capital *investments* to form, maintain and renew the productive structure. In order for the shareholders and investors to decide,

despite the investment risk, to invest their capital in the firm, there must be a transformation of capital into adequate (fair, minimum) *returns* in the form of profit (R for equity) and *interest* (I for debt). The financial transformation is thus typically a transformation of *risk* through investments. In figure 3 the efficiency of the financial transformation is represented by: (i) *roi*, *roe* and *rod* which express the return on the invested capital (CI), on the equity (E), and on the debt (D), respectively; (ii) CI = D + E is the capital invested *by* the firm, which is equal to the capital invested in the firm; (iii) der = D/E represents the leverage of the financial structure; (iv) $spread = roi - rod$ indicates the differential between the return on equity capital and that on invested capital;

4. an efficient ENTREPRENEURIAL TRANSFORMATION [I]; this is typically a transformation of internal and external information into *strategic decisions* regarding the portfolio of businesses to manage, the technology, the markets, the prices, and the financial structure in order to produce the maximum shareholder value, subordinate to a system of *corporate governance* (Damasaru, 2015) that is an expression of the stakeholders operating in an external environment. Its function is to monitor the *present* and *future* environments in order to: a) identify the survival conditions and define the *maximum objectives* that will guarantee an enduring vitality; b) decide which *entrepreneurial policies* have priority in terms of the vital objectives; c) for each objective, establish the *entrepreneurial strategies* to order the most effective control levers which lead to a continual readjustment of the firm's strategic position. To carry out this function, [I] produces a continual transformation of *information* and *forecasts* into *strategic decisions*, preparing the long-term plans and programs and designing the *management control systems* that give rise to and regulate the three other transformations for the achievement of the objectives of quality, productivity, economic efficiency and profitability. This transformation is referred to as "entrepreneurial", since it produces to the maximum extent possible the conceptual, creative and innovative activities that characterize the entrepreneurial function; as shown in figure 3, the highest level *shareholder value indicators* are the following:

$$EVF = \frac{R^{\circ}(T)}{roe^{*}} = E(t_0)\frac{roe^{\circ}}{roe^{*}}$$

which corresponds to the shareholder value that derives from the capitalization of the future expected standard earnings, R°(T), obtained at an expected *roe*° on initial equity, $E(t_0)$, and discounted at expected fair return, *roe**, for the shareholders:

$$EVA = roi\ IC - (rod\ D + roe^{*} E)$$

which can be viewed as the *economic value added* that is, the residual economic result from IC when *roi* is greater than the *weighted average capital cost*, *wacc*, calculated as follows:

$$\text{wacc} = \frac{\text{rod D} + \text{roe} * \text{ E}}{\text{IC}}$$

In fact, it is easy to derive: $\text{EVA} = \text{IC} \left(\text{roi} - \text{ wacc}\right)$

5. an efficient MANAGERIAL (organizational) TRANSFORMATION [M] of strategies into programs that represent the operational guide for actions and management control. [M] undertakes five sub-functions: () it divides the vital objectives determined by [I] into operational objectives to be assigned to the organs (functions) and operational units; (2) it divides the *overall* entrepreneurial strategies drawn up by [I] into *functional* and *operational* strategies, which it assigns to the organs and operational units that carry out the "technical" transformations, and as a consequence (3) it draws up the operational programs and budgets that serve as the *operational objectives* for the Control Systems, which are required to achieve the maximum level of productive, economic and financial efficiency; (4) it carries out the *managerial coordination* of the organs, operational units and members of the organization that together represent the engines of the "technical" transformations; (5) it decides on the *operational regulations* which oblige the controlled units (organs, units and individuals) to undertake the necessary actions to achieve the objectives.

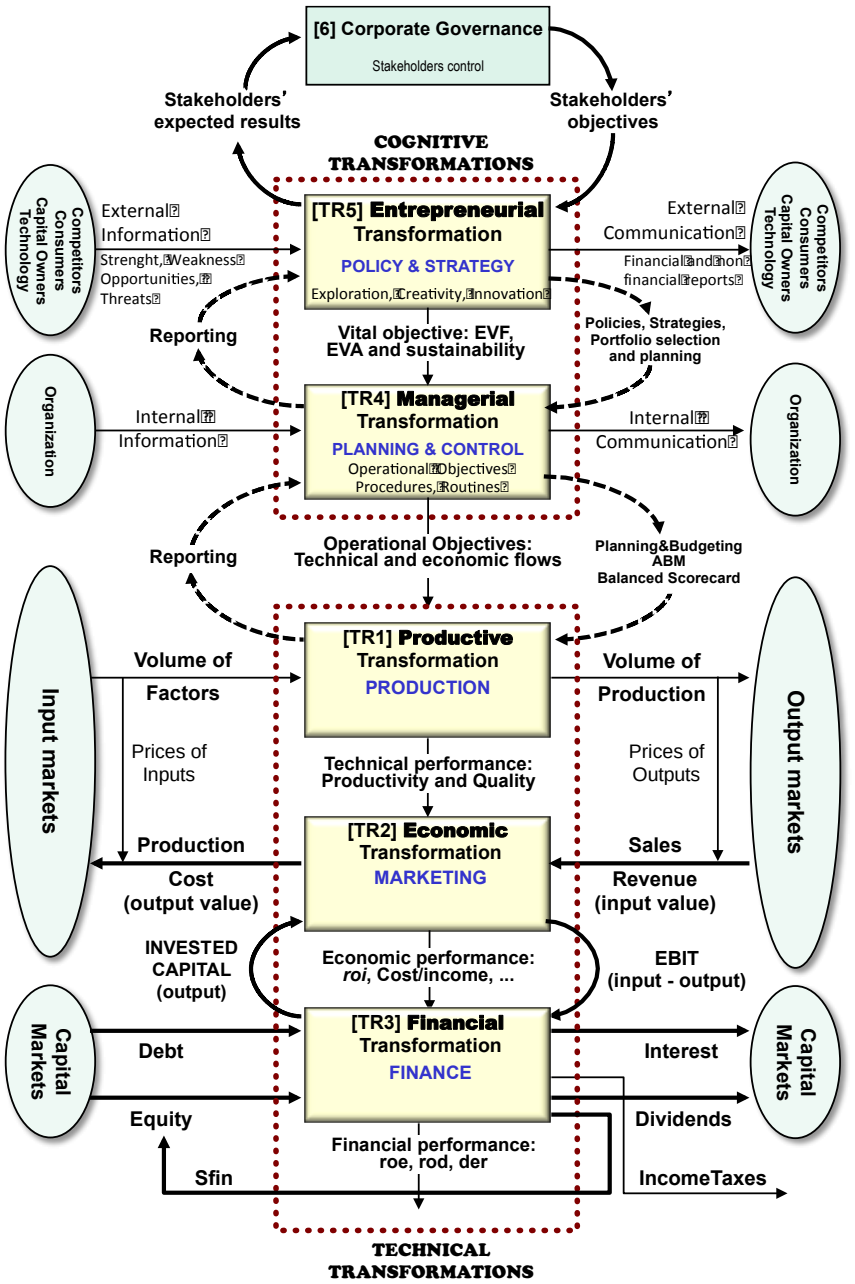

Figure 3. Model of the organization as an efficient system of transformation (Mella, 2014)

The MOEST contains all the elements of the VSM; the operational units of SS1, described by Beer, correspond to the units that produce the "technical transformations" of the MOEST; the "cognitive" transformations of the MOEST, entrepreneurial and managerial, correspond perfectly to the activities entrusted to the high level meta-systems of the VSM.

The MOEST differs from the VSM in three respects; above all, it explicitly sets out three different control levels: institutional, strategic and operational, each of which pursues objectives of different scope; secondly, it highlights the possibility of constructing a precise system of performance indicators, represented by the efficiency indicators: productivity, economic efficiency and profitability (in the model these are only mentioned), all of which can be connected from a value production perspective; finally, the MOEST presents a different perspective with respect to VSM; the VSM represents organizations from the point of view of their structural synthesis; the MOEST sees them from a functional viewpoint (Mella, 2014).

Finally, from the MOEST we derive that the capitalistic firm bases its *autopoiesis* on its capacity to regenerate its financial and economic circuits, or loops. The financial circuit is renewed if the capitalist firm succeeds in acquiring and preserving its invested capital: IC = D + E. If we let R* and I* represent the "fair remunerations" for Equity and Debt, the difference [OI – (R* + I*)] = EVA represents the Economic Value Added shown above. From {[max] (pP – cP) > 0}, it follows that EVA = [max] and EVF = [max] as well. In capitalistic firm, autopoiesis depends on the organization's capacity to develop economic transformations capable of achieving an OI > [I* + R*]. This implies that Roi > Rod*, and Roe > Roe*. Therefore, autopoiesis is achieved if the economic transformation is continually renewed respecting two conditions: the OI must be obtained under fair conditions of use of the factors of production; the OI must be viewed as the consequence of an increase in the quality of the product and not only as the consequence of price control policies (monopolies, trusts, etc.).

When capital is abundant, *economic efficiency* is necessary to maintain the integrity of the invested capital; in order to maintain the conditions for *teleonomy* it is thus necessary to have an efficient *entrepreneurial* transformation that continually modifies the business portfolios producing *roi* and the financial portfolios producing *rod*, in order to guarantee that it is always the case that *roi* > *rod* and a sufficient EVF is produced

This clearly reveals the significance of *human capital* and *intangible assets* as dominant elements in the production of capitalist firms (Griliches, 1996) and the need for:
a) *creativity*, by which products and processes are continually innovated, favouring applied scientific research and technological innovation,
b) *knowledge* in order to make more powerful models for understanding internal and external environment of the organization;
c) *intelligence* in understanding, on the basis of continually reformulated and innovative models, internal and external processes, in order to rationalize the technical processes of production and management (Business Intelligence with all its instruments: Data Warehouse systems, online analytical processing, or OLAP, query/reporting, and data mining);
d) *organizational learning* and the formation of *learning organizations* that move and guide individuals in the organization to take on greater responsibilities and to learn and act together to deal with the new competitive challenges through new work rules (Computer Supported Cooperative Work (CSCW) (Greenberg, 1991); Work Group Computing Systems and, in general, *Groupware* (Whitaker, 1995); Performance Management, in order to assign all the members of the organization objectives that are coherent with the entrepreneurial transformation);
e) *management control*, to make the control process efficient (from the Decision Support System to Just-In-Time production, from Business Intelligence to *Web-Based Information Technology*, from Performance Management to Competence Management, in order to set the competences at the levels needed for the development of adequate organizational actions)*;*
f) *strategic renewal,* to increase the efficiency and efficacy of the formulation of models and representations of the environment, which are necessary to redesign the strategic actions and direct these toward ever new *strategic positions* (balanced scorecard, *Tableau de bord* or organizational cockpit) (see below).

The capitalistic firm as a control system

The five transformations of the MOEST are interconnected. A necessary condition for the firm to activate the first three "technical" transformations [P], [E] and [F], is that two "cognitive" transformations also be carried out: the *entrepreneurial* [I] and *managerial* [M] transformations, whose function is to "control" the "technical" transformations.

Figure 3 shows that the *entrepreneurial* transformation, [I], identifies, or receives from the governance, the *vital objectives* for survival and determines the *policies* and *general programs* that become the *strategic*

objectives the *managerial* transformation, [M], must achieve through the Control Systems (normally defined as *strategic*), which act at the business and general function levels. Figure 3 also indicates that the *managerial* transformation, [M], translates the strategic objectives into *operational objectives*, to be achieved by means of a planning and budgeting program which is necessary for the *operational control* system to produce the necessary strategy to activate the available levers.

The *entrepreneurial* transformation, [I], is, in turn, subject to an *institutional control* at an even higher level, carried out by the stakeholders, who represent the CORPORATE GOVERNANCE. In fact, the amount of control [I] has in the organization depends on the limits set by the governance. To maintain the conditions for *viability*, organizations internally determine the policies and activate the levers and strategies needed to eliminate the negative effects from environmental disturbances during the course of their existence; such disturbances cannot be foreseen at the moment the system is designed and created. The model in figure 4 (see Appendix) illustrates the role of the three technical transformations in implementing the control in order to achieve the vital objectives and provides technical clarity regarding the *policies* and *strategies* of production organizations viewed as multi-objective, multi-lever Control Systems.

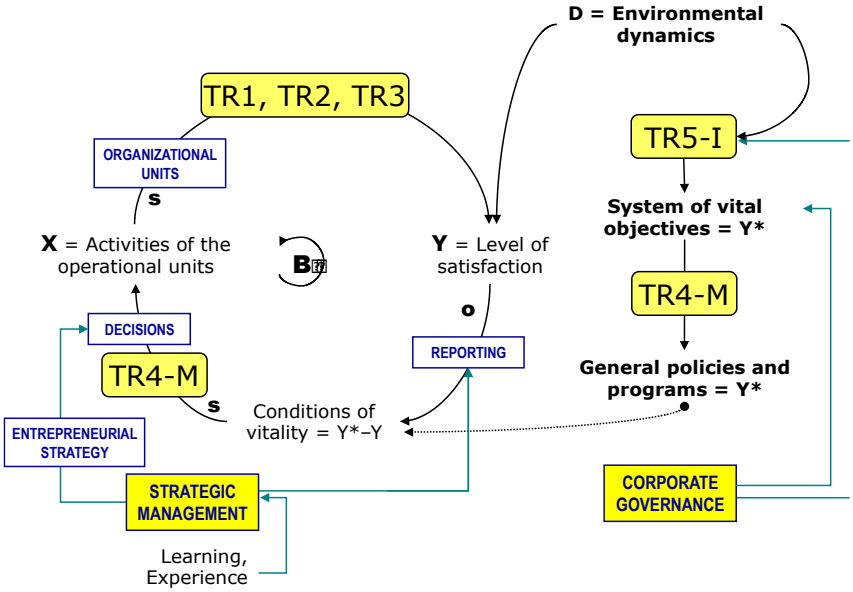

Figure 4. MOEST as a Control System based on policies and strategies

Viewed as control systems, the capitalistic firm displays a "cognitive behavior" aimed at survival, and it can be viewed as a "living system" that reproduces itself over time, along the lines of Maturana and Varela's (1980) analysis; in effect, the organization as an organizationally-closed system that appears in all respects as an autopoietic machine, that is: […] "a machine organized (defined as a unity) as a network of processes of production (transformation and destruction) of components which: (i) through their interactions and transformations continuously regenerate and realize the network of processes (relations) that produced them; and (ii) constitute it (the machine) as a concrete unity in space in which they (the components) exist by specifying the topological domain of its realization as such a network" (Maturana & Varela, 1980, p.131) which tends to endure by continually regenerating the coordinated and cooperative behaviors of its processors (organs) and the network of processes which is a necessary condition for maintaining over time the internal structural coupling among organs and individuals. From this can follow that "... an autopoietic machine is homeostatic (or rather a relations-static) system which has its own organization (defining network of relations) as the fundamental variable which it maintains constant" (Maturana & Varela, 1980, pp.78–79) and that "If living systems are machines, that they are physical autopoietic machines is trivially obvious [...] However we deem the converse is also true: a physical system, if autopoietic, is living" (Maturana & Varela, 1980, p.82).

The idea that the capitalistic firm is a living system which self-regulate its dynamics in the environment to achieve vital objectives, has been excellently described by Salvatore Vicari in a convincing book entitled *The Organization as a Living System* (Vicari, 1991) and by Arie De Geus in his work *The Living Company: Habits for Survival in a Turbulent Business* (2002; see also 1997). De Geus clearly shows the importance of cognition and learning for an organization's teleonomy, especially large corporations, whose teleonomic activity can be interpreted only by assuming that the organization (company) is a living being and the decisions for organizational activities taken by this living being result from a learning process.

It is not without significance that the *Forward* of this work was written by Peter Senge (1997), who sums up the reasons organizations must be viewed as living beings and not as simple machines. Among these reasons, I find the following quite convincing: "Seeing a company as a machine implies that its actions are actually reactions to goals and decisions made by management. Seeing a company as a living being means that it has its own goals and its own capacity of autonomous action. Seeing a company as a machine implies

that it will run down, unless it is rebuilt by management. Seeing a company as a living being means that it is capable of regenerating itself, of continuity as an identifiable entity beyond its present members. Seeing a company as a machine implies that its members are employees or, worse, "human resources", humans standing in reserve, waiting to be used. Seeing a company as a living being leads to seeing its members as human work communities. Finally, seeing a company as a machine implies that it learns only as the sum of the learning of its individual employees. Seeing a company as a living being means that it can learn as an entity, just as the theater troop, jazz ensemble, or championship sport team can actually learn as an entity. In this book Arie argues that *only* living beings can learn" (Senge, 1997, pp.IX-X).

By acting as a "living systems", organizations are capable of forming representations of the external world and of acting (reacting or pro-acting) to regenerate and re-equilibrate the network of vital processes in order to couple themselves successfully to the environment and survive, even by modifying their own structure in line with the variations permitted by the genetic and operative programme (Uribe, 1981).

In this sense the linving-organization can be conceived of as a conscious cognitive system, a system with internal organs of memory, computation, and evaluation (preferences), able to compare objects, calculate information, and construct representations in order to couple itself successfully to the environment and survive, even by modifying its own structure in line with the variations permitted by the genetic and operative programme (Toffler, 1985; Walsh, 1995); "A cognitive system is a system whose organization defines a domain of interactions in which it can act with relevance to the maintenance of itself, and the process of cognition is the actual (inductive) acting or behaving in this domain."' (Maturana & Varela, 1980, p.12; see also Weick, 1990).

Management is the extrinsic manifestation of the so-called "cognitive chain", or "thinking-action chain", implemented at every level of the organization, which is composed of the "decision-action-control" links in the chain – as shown in figure 5 – which produce the cognitive behavior from which originate the outcomes in the environment composed of the various categories of stakeholders. The complex "decision-action-control" interaction leads the organization to behave as a *cognitive* entity, as a *viable* unitary system, that must be held "socially responsible" for its own actions, as these are produced, in turn, by its own decisions.

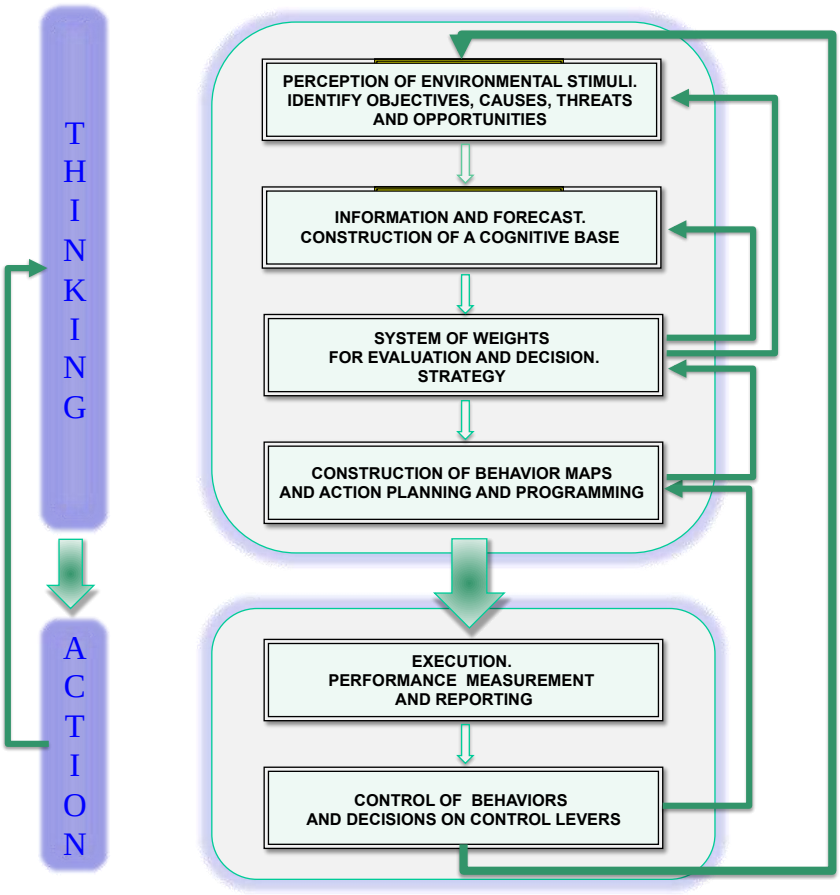

Figure 5. The thinking-action chain

The capitalistic firm as an intelligent and explorative agent

As a cognitive and viable system, the organization-firm becomes, in all respects, an "intelligent" and "rational economic "agent" that develops the capacity to control its own structure, its own processes and its own dynamics in order to achieve increasingly higher levels of efficiency, according to the MOEST logic. It is an "economic agent" since the organization-firm designs and traces its own trajectory in the productive, economic and financial space in which it operates. It is an "intelligent agent" precisely because, as we have observed above (SS4 and SS5 of the VSM, and TR5-1 of the MOEST), the organization carries out a cognitive activity that aims at giving a meaning to the environmental stimuli, translating these into information and, through planning, structuring these

as knowledge, thereby developing a pro-active behaviour for the long-term reproduction of the economic processes while at the same time anticipating environmental changes (Tomè & Figueiredo, 2015).

Garvin (1993, p.80) clearly stated: "Without accompanying changes in the way that work gets done, only the potential for improvement exists" and he suggests that Learning Organization must be capable of systematic problem-solving, experimentation with novel approaches, learning from experience and benchmarking, and transferring knowledge rapidly and efficiently to all parts of the organization. We believe that a necessary and sufficient condition for an intelligent cognitive system is that it should be able, with its own cognitive processes, to build representations of the world, i.e., descriptions, concepts, uniformity and laws, and to develop a formal communicative behavior through which it extends the range of structural couplings that favor its existence. It is a "rational agent" in that its cognitive activity must tend toward maximizing the efficiency of the vital transformations by seeking the maximum productive, economic and financial performance. In its quality as a rational cognitive agent the organization-firm is also an explorative agent which, continually searching for improvement of any kind in its performance, explores its own territorial environment – possibly segmented into areas of interest (continents, states, regions, provinces, etc.) – and "directs" itself toward areas of greater attractiveness; that is, areas where the conditions are favorable to an increase in efficiency: for example, areas that facilitate the creation of new businesses, areas with greater sales volumes or more favorable expectations regarding prices and supply costs, higher social protection, greater environmental incentives, a lower tax burden, and so on (Mella, 2006). In this way 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.

Based on the characteristics of the different areas, it is plausible that the attractiveness landscape will have "valleys" of moderate attractiveness, "peaks" of high attractiveness, or "troughs" of repulsion (no attractiveness) to avoid entirely.

Thus, assuming we have chosen roe and roi, and their components, as performance indicators, it is plausible that an area rich in potential consumers and poor in competitors is 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 other things 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.

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.

The capitalistic firm viewed as an economic social actor

The capitalistic enterprise viewed as an autopoietic and vital system of control is an *economic social actor,* in the sense that it interfaces and interacts with a set of *external,* or *institutional* interlocutors, or stakeholders – in an ethical, social and political (ethical) environment – that influence the organization's structure and processes through a system of *corporate governance* (Carroll, 1996; Freeman, 1991).

The *autopoiesis* of the firm, when viewed as an *economic social actor*, depends on its external teleonomy, which represents the capacity to earn the appreciation of the stakeholders (Gazzola & Colombo, 2013) who are not components of the organization but who gain external advantages, individual or social, from its existence (Toffler, 1985). The production of adequate levels of *economic value of the firm* (EVF), from which shareholder value derives and the maintenance of the conditions of *sustainability* represent the maximum objectives imposed by [I] on [M] (Arnold & Davies, 2000; Mella & Pellicelli, 2008). However, the entrepreneurial transformation is, in turn, controlled by the stakeholders, who activate the corporate governance and set the maximum Institutional Objectives and the environmental restrictions for the survival of the organization as a vital system.

According to the concept of sustainability – originally introduced in the 1987 Brundtland report, *Our Common Future*, which was commissioned for the United Nations – whose central principle is "development which meets the needs of the present without compromising the ability of future

generations to meet their own needs'" (WCED, 1987), the following *hypothesis* is proposed: the capitalist firm, as a social unit, must produce social shared "value" (Harrison & Caron, 1998), understood in the broader sense that its economic existence as a producer of economic and financial values must be appreciated in terms of the *sustainability* of the development path of the firm and evaluated by a wide range of social performance measures of *outcome* or *benefit*: the efficiency of materials, technical innovation, energy efficiency, community relations, eco design, product recyclability, and employee relations.

The attainment of perceived levels of *social performance* produces *reputation*, *brand* and *confidence*, so that the environment itself sets the conditions for the firm's legitimation and consent, which favors autopoiesis and thus a lasting existence for the enterprise as a social unit as well as an organizational type (Gazzola & Mella, 2015). This implies, on the one hand, the organizational ability to recognize the set of relevant stakeholders as well as to identify their expectations, and on the other the capability to communicate the global "value" produced in terms of social benefits and prevented damage to the physical environment. The following section proposes an expanded model of the Balanced Scorecard which also includes these social variables.

Expanding the Balanced Scorecard in a capitalistic firm

Capitalistic firms cannot be limited to merely controlling financial performance. A number of other interesting non-financial variables can serve as performance indicators. Created by Kaplan and Norton (1992, 1996, 2001), the *Balanced Scorecard* (BSC) is one type of *corporate dashboard*, which provides top management with information for a continual evaluation of the performance of an entire firm. In control theory, *corporate dashboards* must be considered in all respects as *continual reporting* instruments for monitoring a system of *performance objectives* and *standards* in order to allow for the control of operations and personnel at a specific operational level. The dashboard variables can also be generally defined as *key performance indicators* (KPI), since they monitor the *performance* regarding the objective of the control process (Mella, 2014, p.438). As an instrument of strategic control, the role of the BSC can be represented by a model entirely similar to the one in figure 6, considering only the rectangular boxes.

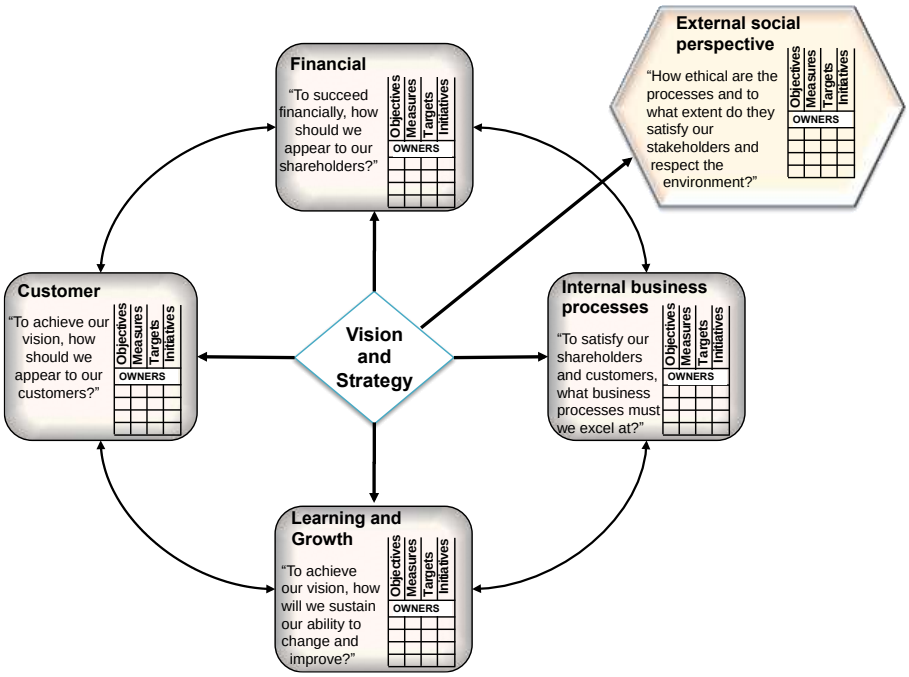

Figure 6. The BSC as a strategy-forming instrument (Mella, 2012, p.190)

The BSC considers four *strategic variables*, or *perspectives* (or focuses), held to be fundamental for providing management with a "balanced" perspective on the *strategic performance* of the firm:
1. *Financial perspective*: how the organization wishes to be viewed by its shareholders;
2. *Customer perspective*: how the organization wishes to be viewed by its customers;
3. *Internal Business Processes perspective*: through which processes must the organization develop its abilities in order to satisfy its shareholders and customers;
4. *Organizational Learning and Growth perspective*: which changes and improvements must the company make to implement its vision.

Each perspective is represented in a *scorecard* and a weight of relative importance is assigned to it. For each perspective a limited number of *performance measures* that managers deem truly significant are included in the BSC, as shown in figure 7.

Perspective	Number of Measures	Weight
Financial	5	22%
Customer	5	22%
Internal Business Processes	8 to 10	34%
Learning & Growth	5	22%

Figure 7. Weights and measures of the BSC perspectives (Kaplan & Norton, 2001, p.375).

The following measures are particularly efficient in choosing each perspective:
a. measures for the financial perspective: value of the action, growth in profits, profit rate, ROI, EVA, ROE, operating costs, operating margin, corporate objectives, survival, profitability, growth, cost reduction, increase in ROI, cash flow, earnings, increase in earnings, profit rate of shares, and so on (Mella, 2005);
b. measures for the client perspective: service level, market share, new clients, new products, new markets, customer satisfaction, customer loyalty, product reliability, perceived quality of the product and/or collateral services, customer complaints, etc.;
c. measures for the internal perspective: increase in efficiency, quality of processes, utilization rate of production capacity, stock storage period, waste, recycling rate of production waste, remanufacturing, lead time, average unit cost, employee morale, motivation, and so on;
d. measures for the learning and growth perspective: trend in value creation, product diversification, supplier diversification, increase in R&D, risk diversification, strengthening of internal control, development of new products, continual improvement, technological leadership, employee involvement, etc.

In its original formulation the BSC had a mainly internal point of view. In order to measure social performance (Clarkson, 1995) it is useful to include in the BSC a new scorecard that measures the firm's capacity to create well-being for the collectivity and demonstrate the firm's social utility by indicating its capacity to achieve social and environmental objectives (Ranganathan, 1999). In fact, capitalistic firms must, in any event, include in their strategy actions that guarantee that the environmental constraints of sustainability, ethical behaviour and, in general, Corporate Social Responsibility (CSR) are respected.

For this reason the model in figure 6 also includes a *fifth scorecard* (the hexagonal shape) for the continuous monitoring of the performance of the entire firm evaluated from an *external perspective* with regard to the interactions with the external stakeholders. In effect, according to Kaplan and Norton (1996, p.34), "The four perspectives could be viewed as a scheme of reference and not as a straighjacket. Many organizations use the BSC and establish relative weights for each of the scorecard measures. These relative weights are used to evaluate performance".

"If, as we have indicated, the scorecard could guide us in growing our business, then it is natural to believe it possible to change the number of perspectives, areas, or focusses" (Olve, Roy & Wetter, 1999, p.120). The *measures* for the new external perspective could involve, for example: actions to guarantee CSR; respect for the environment and measures for environmental sustainability; the elimination of refuse without damage to the environment; the use of the "commons"; the use of renewable and clean sources of energy; ethical behavior by the organization; ethical production that does not harm individuals; measures to enhance the reputation of the organization (Gazzola & Mella, 2015; EEA, 2001).

Conclusion and final remarks

The capitalistic firms should not be considered merely as systems for the production of value for stockholders but also as economic social actors which operate in a social environment to which they belong and with which they interact, not only through a system of monetary and financial exchanges (Clarkson, 1995) but also through physical, human and communication flows that produce knowledge, trust and reputation with regard to the optimal use and safeguarding of human, natural and social resources (Gazzola, 2014). In this way it becomes possible to judge the social responsibility of the firm (Keeley, 1988) and promote an image that gains the consensus of the collectivity and enhances the reputation of the firm, which in turn is fundamental for ensuring greater trust by the public (Zadek, 2001). *Economic prosperity*, *environmental quality* and *social justice* are the pillars on which the creation of corporate value is based, according to the "triple bottom line" (Warren, 1999).

Autopoiesis thus implies both the attainment of a high degree of *endogenous teleonomy,* through the search for internal conditions for survival by means of an optimal mix of creativity, productivity and incentive systems, and a high degree of *exogenous teleonomy*, which guarantees the external conditions for survival through an increase in customer satisfaction

(obtained from the optimal mix of quantity, quality, variety and price of production) as well as in social satisfaction, deriving from the valued social impact of the organization (spread of employment, rise in average income, payment of taxes, environmental interest, etc.).

In order to maintain the autopoiesis and viability of *capitalist firms,* the entrepreneurial and managerial transformations must formulate strategies that guarantee investors a financial return (interest or dividends) at least equal to the opportunity cost of the best alternative investment (fair cost of capital), while maintaining an acceptable degree of risk (actuarial integrity) and, in any event, preserving the purchasing power of their capital (monetary integrity) (Boulton, Libert & Samek, 2000). Nevertheless, autopoiesis also depends on the extent to which the policies and strategies of the entrepreneurial transformation respect the constraints imposed by the external stakeholders and thus guarantee ethical behavior, the sustainability of production, the safeguarding of the environment, and, in the final analysis, the social needs of the entire collectivity.

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Appendix. Control systems in short

Following Mella (2014), a variable Y_t is "controllable" if, on a temporal, discrete or continuous scale, t=1, 2, …, we can 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, variance or error, indicated by $E(Y)_t = Y^*-Y_t$.

We define X_t as a control variable which determines the values of Y_t according to a causal relation (defined by some process or apparatus), so that, by acting on X_t, we can produce a dynamics for Y_t that tends toward Y*.

We define as a Control System any set of apparatuses, logical or technical (algorithm or machine, rule or structure, etc.) that, for a set of instants, perceives $E(Y)_t$, calculates and assigns the values X_t, and produces the appropriate Y_t to gradually annul, when possible, the error $E(Y)_t = Y^*-Y_t^*$ at instant t* (figure 8).

The variable X_t (or, if there is more than one variable, the vector [X]) is also defined as the action variable, the control lever, or the active variable. If [X] is composed of N action variables, the system is called a multi-lever control system.

We define the manager of the Control System (in the broadest sense of the term) as the subject (individual, group, organ or organization) that, through a series of decisions – based on its particular culture, experience and preferences – can regulate the X_t in order to change the Y_t. We define the governance of the system as the process by which the objective Y*, or the vector [Y*], is determined.

With multi-lever systems it is fundamental to understand the concept of *strategy*, which entails programming the activation of the various levers to achieve the objectives. In multi-objective systems the choice of strategy is coupled to the definition of policy; that is, the activity through which the governance and management choose the order of priorities regarding the various objectives. Specifying the control strategies requires introducing the concept of cost–benefit analysis applied to the various levers. Specifying the control policies brings up the notion of a scale of priorities for the various objectives.

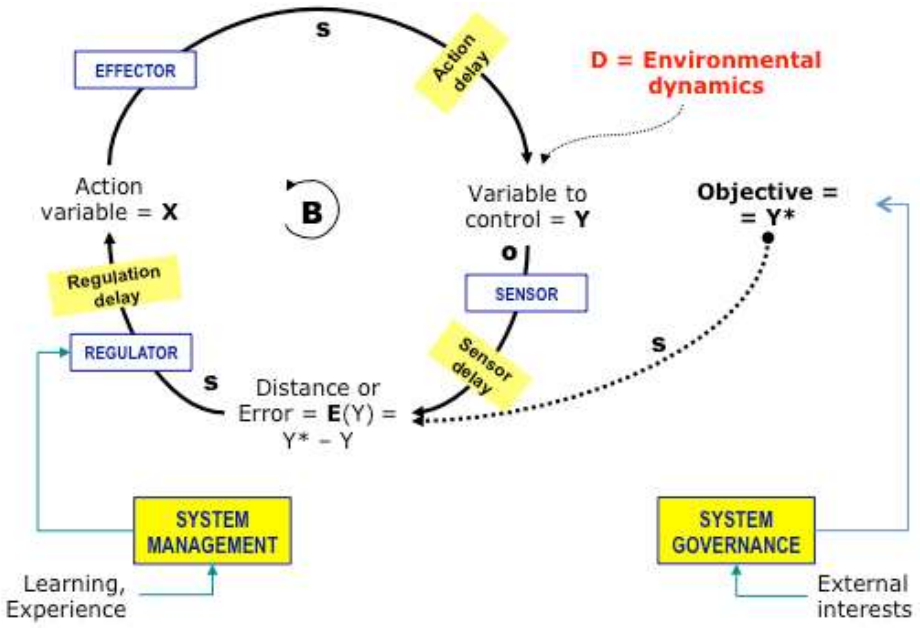

Figure 8. Standard Model of a one-lever Control System (Mella, 2014, p.49)