Economia Aziendale Online

Business and Management Sciences
International Quarterly Review

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Pavia, December 31, 2021
Volume 12 - N. 4/2021

www.ea2000.it
www.economiaaziendale.it

PaviaUniversityPress

Electronic ISSN 2038-5498
Reg. Trib. Pavia n. 685/2007 R.S.P.

Economia Aziendale Online – Business and Management Sciences International Quarterly Review
Vol. 12-4/2021 - DOI: 10.13132/2038-5498/12.4.545-567

The Behaviour of the Efficient Organization. Intelligence, Learning, Experience

Piero Mella

Professor
Department of Economics and Management. University of Pavia, Italy

Corresponding Author:

Corresponding Author:
Piero Mella
University of Pavia, Via S. Felice 5, 27100 Pavia, Italy
Email: piero.mella@unipv.it

Cite as:

Mella, P. (2021). The Behaviour of the Efficient Organization. Intelligence, Learning, Experience. *Economia Aziendale Online, 12*(4), 545-567.

ABSTRACT

This work is part of a series of articles whose aim is to present teachers and students with theoretical notions useful for examining certain technical themes, concepts, or theories that form the basis of a wide-ranging business economic literature but are not specifically treated in it. Specifically, this article aims at highlighting the basic systemic notions needed to understand the logic of "permanent organizations" viewed as *autopoietic, teleonomic, cognitive,* and *efficient* systems. An elementary symbology is used to present the characteristics that define "for-business organizations", and, within this class, to distinguish the "for-profit" from the "not-for-profit organizations". The concepts of *production* and *market efficiency* are specified, and from these the notions of TEVA, TEVAP, TEVAM, and EVA are derived. The work concludes by linking the concept of "autopoiesis" to those of Intelligence, Learning, and Experience, which characterize the management of efficient organizations.

Questo lavoro entra a fare parte di una serie di articoli programmati con il fine di presentare a docenti e studenti nozioni teoriche utili per esaminare alcuni temi tecnici, concetti o teorie che sono alla base di un'ampia letteratura economico aziendale ma che in essa non vengono richiamati. Questo articolo, in particolare, vuole mettere in luce le nozioni sistemiche di base per comprendere la logica delle "organizzazioni permanenti" quali sistemi *autopoietici*, *teleonomici*, *cognitivi* ed *efficienti*. Con una simbologia elementare si presentano le caratteristiche che definiscono "for-business organizations" e, in questa classe, per distinguere le "for-profit" dalle "not-for-profit organizations". Sono specificati i concetti di *efficienza produttiva* e di *mercato* e da questi sono derivate le nozioni di TEVA, TEVAP, TEVAM ed EVA. Il lavoro si conclude connettendo il concetto di "autopoiesi" con quelli di Intelligence, Learning ed Experience che caratterizzano la gestione delle organizzazioni efficienti.

Keywords: autopoiesis, teleonomy, teleology, efficiency, cognition, intelligence, learning management capabilities.

Section: *Refereed Paper*
Sezione Didattica - Didactic Area

Received: August 2021
Published: 31/12/2021

1 – Introduction

Accepting the assumption that the activity for the "production of value" is carried out by *permanent organizations* (Mella, 2012, 2021b), I propose several basic, concise definitions to show how, on the one hand, production organizations can be considered as "autopoietic systems" which are coupled to the environment, as well as "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; and on the other hand, how we can define the efficiency of the production organization, as revealed by the latter's economic and financial performance.

A set of precise definitions and models permit us to examine how the structure of the *production-oriented organizations,* considered as *cognitive systems*, realize their structural coupling with the environment by developing their Learning Management Capabilities and their autopoiesis. To develop knowledge, the organization and its management must undertake a process of collective learning, thereby transforming itself into a learning organization and a learning management.

The work is structured as follows: Section 2 defines organizations as *autopoietic* systems; Section 3 defines organizations as *teleonomic* systems; Section 4 distinguishes between business and non-business, profit and non-profit organizations; Section 5 defines the permanent organization as a "cognitive system" and discusses structural coupling; the behaviour of the cognitively efficient organization is defined in Section 6; Section 7 defines their intelligence, learning and experience processes; and Section 8 highlights "managerial qualities" and "entrepreneurship" in business organizations; the structural coupling of production organizations in the Information and Internet Age is the object of Section 9.

2. Organizations as autopoietic systems

> DEFINITION 1 – An organization is a "social system" that forms when several individuals (or agents, in general) choose, for their own particular reasons, to be (or be part of) typical organs in terms of function, functionality functioning, topology and control, which are linked by organizational relationships and structural ties that force them to carry out specialized, coordinated and cooperative behaviour – thus accepting certain objectives, programmes, rules and responsibilities – in order to undertake long-lasting processes aimed at a common end (Mella, 2021a, p. 466).

The *aims* those individuals, through organizations, can pursue are fourfold:

1) *individual internal,* for which individuals are willing to participate in the organization, accepting its constraints and rules (for example: altruism, retribution, job interest, socialization, etc.);

2) *common internal,* or *institutive*; that is, the common aims for which the organization is created (for example: realizing a project, carrying out a production process for goods or services, etc.);

3) *individual external;* that is, the advantages individuals gain from the operating organization (for example: fruition of the results of the instrumental processes, awarding of goods or services, etc.);

4) *common external,* or *social;* that is, the advantages that the environment receives from the behaviour of the organization (for example: reduction of needs, spread of welfare, increase in the quality of life, etc.).

Organizations are "autopoietic systems", in that they self-organize to maintain their existence for a long time. For this reason, they carry out three types of interconnected processes (figure 1):

a) *cognitive,* through which "representations" of the external environment are formed through a system of "data gathering" that obtains data and transforms it into information and decisions; in this sense organizations are "organizationally-closed" *cognitive systems*, since the cognitive activity derives from the entire network of cognitive connections of the individuals that form it;

(1) 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; the process of cognition is the actual (inductive) acting or behaving in this domain. Living systems are cognitive systems, and living as a process is a process of cognition. This statement is valid for all organisms, with and without a nervous system. (2) If a living system enters into a cognitive interaction, its internal state is changed in a manner relevant to its maintenance, and it enters into a new interaction without a loss of identity (Maturana & Varela 1980, p. 13).
>
> Observers know and create their environment through interactions with it. This interaction involves an explicit or implicit prediction about the environment (Uribe 1981, p. 51).

b) *metabolic*, through which the structure maintains, strengthens, and improves over time the network of internal processes, conserving the organizational relationships among "organs" despite changes in the individuals that make up the latter; in this sense, organizations are *autopoietic "living" systems* (Varela, 1979; 1981, p. 38; Uribe, 1981, p. 61; Vicari, 1991), in that they self-organize and continually reproduce themselves – regenerating the network of processes and processors – in order to extend the length of the *collective life* for periods that go beyond the "life" of the components" (Maturana-Varela, 1980: 82; Zeleny, 1981, p. 2);

> Autopoietic machines are homeostatic machines. Their peculiarity, however, does not lie in this but in the fundamental variable which they maintain constant. *An autopoietic machine 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*. It follows that an autopoietic machine continuously generates and specifies its own organization through its operation as a system of production of its own components, and does this in the endless turnover of components under conditions of continuous perturbations and compensation of perturbations. Therefore, 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 and Varela 1980, pp. 78–79).

c) *operational*, through which they control the pursuit of the institutional aims that justify their autopoiesis; in this sense organizations can be viewed as "instrumental open transformation systems" (Scott, 1992), since they transform input from the environment into output of some type required and valued by the environment.

> … open systems models conceive organizations as both systems of internal relationships and as inhabitants of a larger system encompassing the environments in which they operate and on which they depend for resources. Organizations are conceived of as a through-output model, obtaining resources from the environment, processing them and distributing the output back to the environment (Baum **&** Rowley, 2005, p. 16).

As an *autopoietic system* (Bednarz, 1988; Luhmann, 1995) the "organization" *produces itself* by searching for the *metabolic* and *energy inputs* in the environment which are useful for *autopoiesis*, fleeing from those inputs which are damaging (Zeleny **&** Hufford, 1992; Mingers, 1994).

> The agents and organs they constitute can be considered processors that allow the structure to produce a network of recursive micro processes – financing, investment, production of value, disinvestment and reinvestment, reimbursements and refinancing, etc. – which tend to maintain and perpetuate themselves over time, continually adapting to the environment. Such micro processes, in an holonic structure, form larger processes, managed by higher level organs which tend to recursively regenerate themselves over time, to the point of forming a macro process (attributable to the organization as a whole) which transcends the micro processes produced by the organs, in that it represents the emerging result of the network of micro processes. In this sense the cognition activity is necessary for existential

success (Mella, 2021a, p. 467-468)

The relations between components that define a composite unity (system) as a composite unity of a particular kind, constitute its organization. In this definition of organization the components are viewed only in relation to their participation in the constitution of the unity (whole) that they integrate. This is why nothing is said in it about the properties that the components of a particular unity may have other than those required by the realization of the organization of the unity. The actual components (all their properties included) and the actual rela- tions holding between them that concretely realize a system as a particular member of the class (kind) of composite unities to which it belongs by its organization, constitute its structure (Beer 1987, p. XIX-XX).

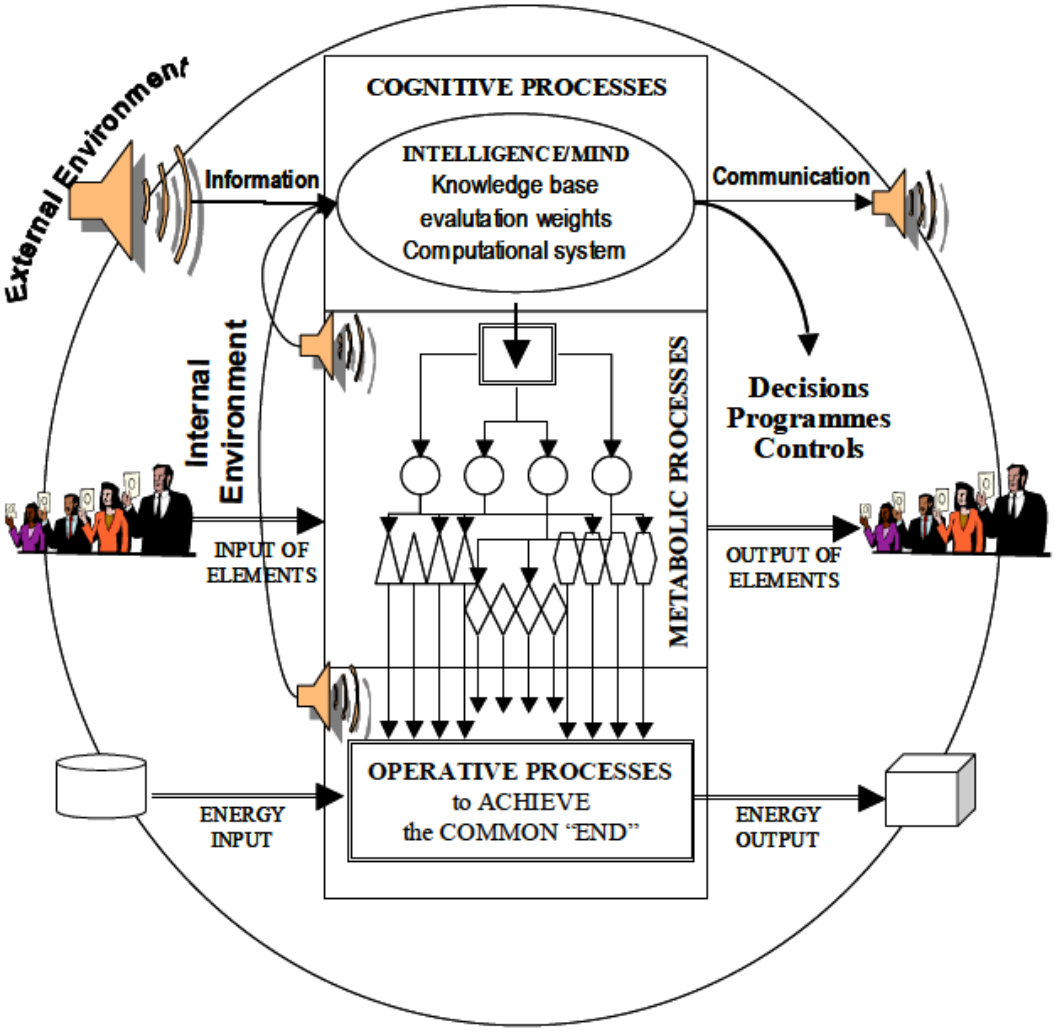

Fig. 1 – Processes and flows of a typical organization

3 – Organizations as teleonomic systems

DEFINITION 2 – An organization is a *goal-setting* "teleonomic system" in that it maintains its own autopoiesis by carrying out "cognitive processes" to search for the conditions that allow individuals to benefit, directly or indirectly, from the achievement of a common end that defines its teleology

In effect teleonomy is teleology made respectable by Darwin, but generations of biologists have been 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 concept of teleonomy was proposed by Jacques Monod in his famous work, *Le hazard et la nécessité* (1970). After pointing out that all living beings (autopoietic) are oriented to realize some existential project, Monod specifies that:

> Rather than refusing to accept this idea (as some biologists have tried to do), it is instead indispensable to recognize it as being essential for the definition of living beings themselves. We can say that the latter are distinguished from all other structures of systems in the universe by this property that we will denote as teleonomy. We arbitrarily choose to define the essential teleonomic project as consisting in the transmission, from one generation to the next, of the unvarying contents characteristic of the species. 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).

Goal setting theory asserts that all living organisms – plants, human beings and production oriented organizations – are characterized by goal directedness (Binswanger, 1991); in particular, human action is purposeful, directed at a conscious goal; consequently, individuals engage in "continuous learning" in order to maintain their autopoiesis (Bandura & Cervone, 1986; Latham & Locke, 1991; Tocino-Smith, 2021) and believe that rationale behaviour is more effective than behaviour they consider as not being rationale (Locke & Latham, 1990, 1991). The term "self-efficacy" describes the confidence individuals feel about doing a particular task. Self-efficacy is influenced by ability, experience, training, past successes, internal attributions, and information about task strategies ((Bandura, 1982; Hollenbeck *et al.*, 1989).

If we consider "teleonomy" as the attitude of the organization to "maintain its existence by regenerating its autopoietic processes", thereby showing "resilience", then we can distinguish between:

a) endogenous teleonomy, which depends on the ability to pursue internal goals, that is to develop a teleology, considered in the traditional Hegelian meaning of purposeful activity directed towards an "End" (Dennet, 1988, Van de Ven & Poole, 1995); that is, to achieving a common aim and satisfying individual internal motivations;

b) *exogenous* teleonomy, which depends on the organization being appreciated by individuals not belonging to it but who gain external advantages, individual or social, from its existence (Monod, 1970: 124; contra, Maturana & Varela 1980; 1987; Brooks & Wiley, 1986, Mayr, 1989).

> Resilience (from the Latin etymology resilire, to rebound) is literally the act or action of springing back. As a property, two strands can historically be identified: a) in social psychology […], where it is about elasticity, spirit, resource and good mood, and b) and in material science, where it is about robustness and elasticity. The notion of resilience has then been elaborated [...] A common point to the above senses of the notion of resilience is the ability to successfully accommodate unforeseen environmental perturbations or disturbances (Laprie, 2008).

While *endogenous* teleonomy characterizes the internal structural dynamics, *exogenous* teleonomy characterizes the environmental dynamics of the organization; the organization has a high degree of endogenous teleonomy if it continues to exist despite the unfavourable structural disturbances from the environment by developing processes of *adaptation*; it is characterized by a high exogenous teleonomy if the environment itself sets the conditions that favour its autopoiesis, and thus a lasting existence, as a unit as well as an organizational type (Toffler, 1985).

We can distinguish between "teleonomy" and "autopoiesis" in the sense that *teleonomy* – understood as a species' *self-preservation* – can be considered the phenomenology, with respect

to the species, that corresponds to *autopoiesis* – understood as *self-production* – which refers both to each individual and to the organization (Mella, 2021a).

With regard to the *length of life* we can distinguish among (figure 2):

A. *occasional organizations:* these are created for the pursuit of common institutive goals, and often individual goals are not stressed; their genesis is predominantly spontaneous and non-programmed and operate by establishing *ad hoc* operative programmes; they have no social aim, and are characterized by low teleonomy, both endogenous as well as exogenous;

B. *organizations with a limited life or organizations for individual projects:* these are created for the pursuit of individual goals that give rise to the institutive plan for the achievement of the common end; because of their limited, predefined life there is no stress on the social end. They are above all characterized by endogenous teleonomy;

C. *permanent* or *autopoietic organizations,* or those having a *non-predefined* (unlimited) *life:* the common end is joined to the individual goals. Their lengthy life also assumes the satisfaction of social interests or ends, as well as a system of operative objectives, and they are also characterized by their exogenous and endogenous teleonomy (Paetau, 1997; Mella, 2021a).

	Individual goals: - very intense - judged positive	***Individual goals:*** - not very intense - judged negative
Social goals: - very intense - judged positive	***I* – PERMANENT ORGANIZATIONS** High exogenous and endogenous teleonomy Permanent autopoiesis Renewal of components slow or absent *Examples*: churches, states, professional armies, families	***II* - *PERMANENT ORGANIZATIONS*** High exogenous but low endogenous teleonomy Difficult autopoiesis Renewal of components high *Examples: armies, service associations*
Social goals: - not very intense - judged negative	***III* – *ORGANIZATIONS FOR PROJECTS*** Low exogenous but high endogenous teleonomy Low renewal of components Difficult autopoiesis *Examples*: criminal organizations, useless organizations, sports associations	***IV* – *OCCASIONAL ORGANIZATIONS*** Low exogenous and endogenous teleonomy Renewal of components unfeasible Autopoiesis impossible *Examples*: volunteers firemen, a pick-up game of football

Fig. 2 – The teleonomy of permanent organizations

4 – Business and non-business, profit and non-profit organizations. Some relevant formal relations

DEFINITION 3 – A "permanent organization" whose common goal is the production of goods and services through a network of instrumental transformation processes of *factors* into *products*, is a "production-oriented organization" (Figure 3).

To carry out the productive transformation and obtain the quantity of goods QP_θ, at a given level of quality θ, Material and Services (M) and Labour (L) (these are the operative factors), together with Machines and other structural factors (S) (that is, production capacity factors), must be obtained from the environment at a cost equal to $CF_{M,\ L,\ S}$, whose sum is the full production cost for QP_θ (Mella, 2005):

$$CP_\theta, = \Sigma_{M,\ L,\ S}\ CF_{M,\ L,\ S}$$

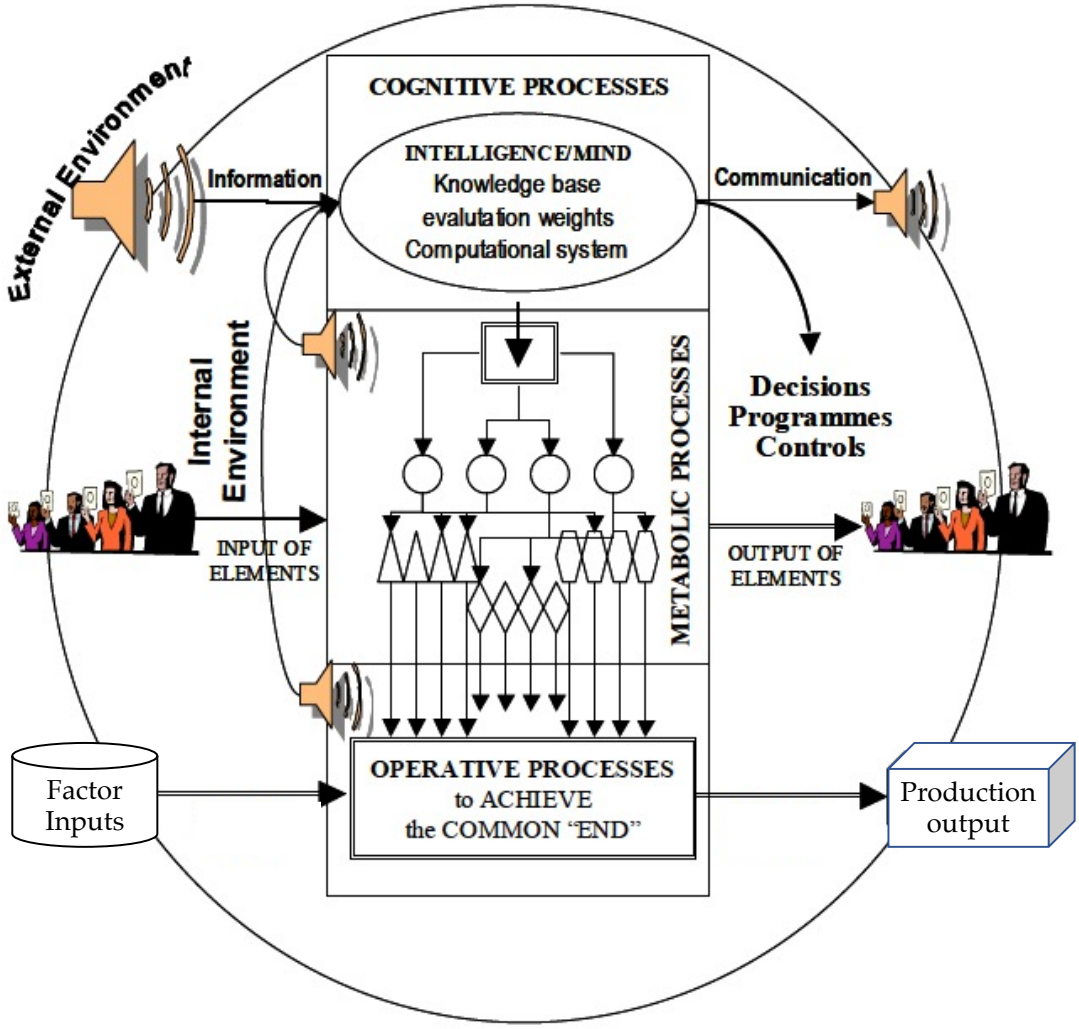

Fig. 3 – Production-oriented organization

Autopoiesis derives from the capacity to produce "useful" goods and services that possess value for consumers (Mella, 2021a) and to continually renew their demand by users, so that it is possible to hold back *labour* (metabolism) and reacquire the other *factors*. If the production is consumed by the individuals that make up the organization, the latter enjoys a prevalently endogenous teleonomy. If the production is destined for the environment, then the exogenous teleonomy depends on the capacity to produce customer satisfaction, and therefore value, so as to cover production costs and to reacquire from the environment the resources necessary for autopoiesis by renewing the productive processes. This implies the capacity to offer users products and services considered useful by feeding their desire to maintain the existence of the production organization, thereby reintegrating the production costs with contributions of various kinds (taxes, associative shares, sunk capital contributions, etc.).

DEFINITION 4 – A production-oriented organization which is preordained to sell its production in markets at prices at least equal to the average unit cost of production is a "(for-) business organization". If preordained to give up its production without a price, or to recover only a share of the production cost, it is a "(not-for-) non-business organization" (Figure 4).

The business organization whose operative programme leads it to pursue the maximum economic efficiency by seeking the maximum gap between average unit

production costs (to be minimized) and average selling prices (to maximize) is a "for-profit organization"; otherwise, it is a "not-for profit organization".

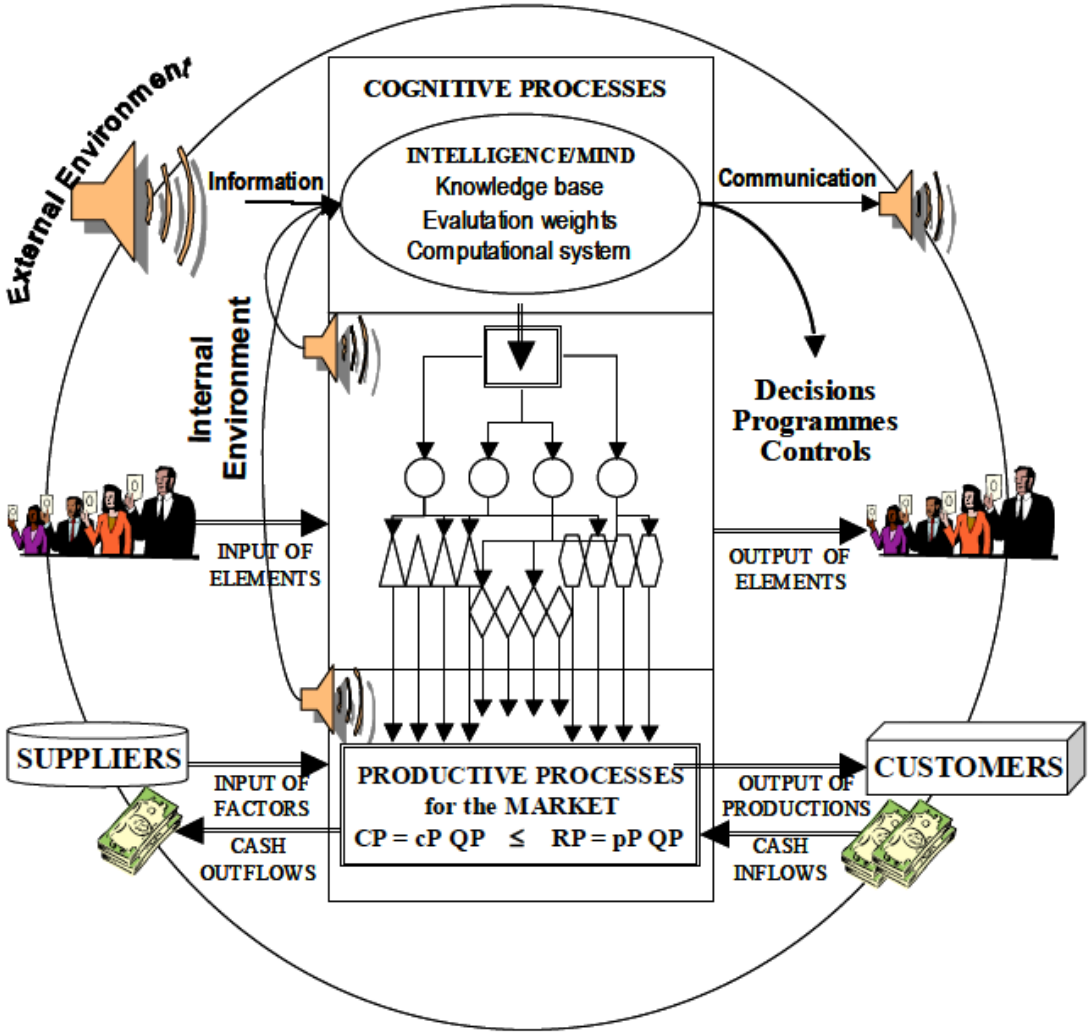

Fig. 4 – Business-oriented organization

If we let $cP_\theta, = CP_\theta / QP_\theta$ be the average unit production cost, then the business organization reintegrates the cost $CP = cP\ QP_\theta$ by selling its production at price $pP \geq cP$, thereby gaining revenues of $RP = pP\ QP_\theta$.

The business organization's autopoiesis is based on *economic efficiency*, that is, on the possibility of *covering costs* through revenues or containing costs within the limits of its revenue, so that in any event: $CP \leq RP$ (Mella, 2005).

Exogenous teleonomy is connected to the capacity to create value for the environment: on the one hand, by limiting or reducing the costs of production, and on the other by obtaining production with a value at least equal to the value of the factors used to produce it, so that customers are willing to pay a price at least equal to the unit production costs. This is equivalent to stating that these organizations are preordained to achieve a non-negative operational income, that is: $OI = RP - CP = QP_\theta\ (pP - cP) \geq 0$. If the operating logic of the business organization is to achieve $\{[max]\ (pP - cP) > 0\}$ then it becomes a "(for-) profit organization"; if, instead, the operating logic of its processes is to achieve $\{[min]\ (pP - cP) > 0\}$, then it becomes a "(not-for-) non-profit organization".

If we assume we want to establish a fair pP* and a fair cP* – that is, production and sales values compatible with normal supply and sales conditions – then we can determine the fair Operating Income (OI*) produced by the organization: OI* = QP (pP* - cP*), which physiologically is zero in non-profit organizations and at its maximum positive amount in profit organizations.

The difference: *TEVA* = [OI – OI*] represents the "Total Economic Value Added" by the organization compared to the *fair return* that the environment could have (fairly) expect from the organization.

If the business organization has a *productive efficiency* higher than the *fair* one – so that cP < cP* – then OI > OI* and the difference [OI – OI*] represents the "Total Economic Value Added of Production", *TEVAP* = QP [cP* - cP] with *product qualities* being equal.

If cP = cP* but *market efficiency* is higher than the fair one, so that pP > pP*, then the *TEVAM* = QP [pP – pP*] represents the "Total Economic Value Added by the Market", which is obtained from the price side, with sales volumes being equal.

If cP < cP* and pP > pP*, then OI > OI* and OI – OI* = *TEVAP* + *TEVAM* = *TEVA*.

In the "non-profit organization", OI must tend toward zero by definition; thus, the TEVAM must tend toward zero (no increase in prices), with the *TEVAP* obtained from the production side and tending toward zero by a reduction in pP*. The entire *TEVAP* benefits the user of the products and services; thus in the "non-profit organization" the *exogenous teleonomy* depends on the capacity to produce values from the increase in the *productive efficiency*, since with each reduction in cP with respect to cP* there is a corresponding reduction in pP with respect to pP*. Since it cannot produce value by increasing pP but only by trying to reduce cP, we can see immediately that the operating logic of the "non-profit organization" must be based on the standardization of production over time and the constancy in its quality and process.

In the "profit organization", the TEVA is obtained by increasing both the *productive* as well as the *market efficiency*. Its *exogenous teleonomy* is linked to the capacity to produce the maximum TEVA, whose use for the *capitalist firm* will be examined in detail in the subsequent definition.

> DEFINITION 5 – A profit organization that "finances" its economic processes with *external capital* in the form of Equity [E] and Debt [D] is a "capitalist firm". The capitalist firm must produce an OI at least equal to the fair return which capital suppliers require (fair cost of capital for the organization) if they are to keep their capital invested; that is: fair return [R*] to remunerate E and fair interest payment [I*] to remunerate D (figure 5).

The capitalist 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] – necessary for structural investments – by means of an adequate "financial leverage" (Debt/Equity ratio, or *der*); but this requires that the suppliers of both *Debt* and *Equity* financial capital – D and E – receive a *fair remuneration*, defined as a remuneration at least equal to their *opportunity cost*. If we let R* and I* represent the remuneration judged to be *fair* by capital providers, then the financial circuit is renewed if the following economic condition holds: $OI \geq R^* + I^*$. In particular, the difference [OI – (R* + I*)] = EVA represents the "Economic Value Added", that is the *surplus value* produced in terms of the full cost plus financial charges, which is composed of the operating costs CP (necessary to produce) as well as the financial costs (necessary to obtain and hold the capital E and D). Since the "profit organization" is preordained so that {[max] (pP – cP) > 0}, then it follows that EVA = [max] as well.

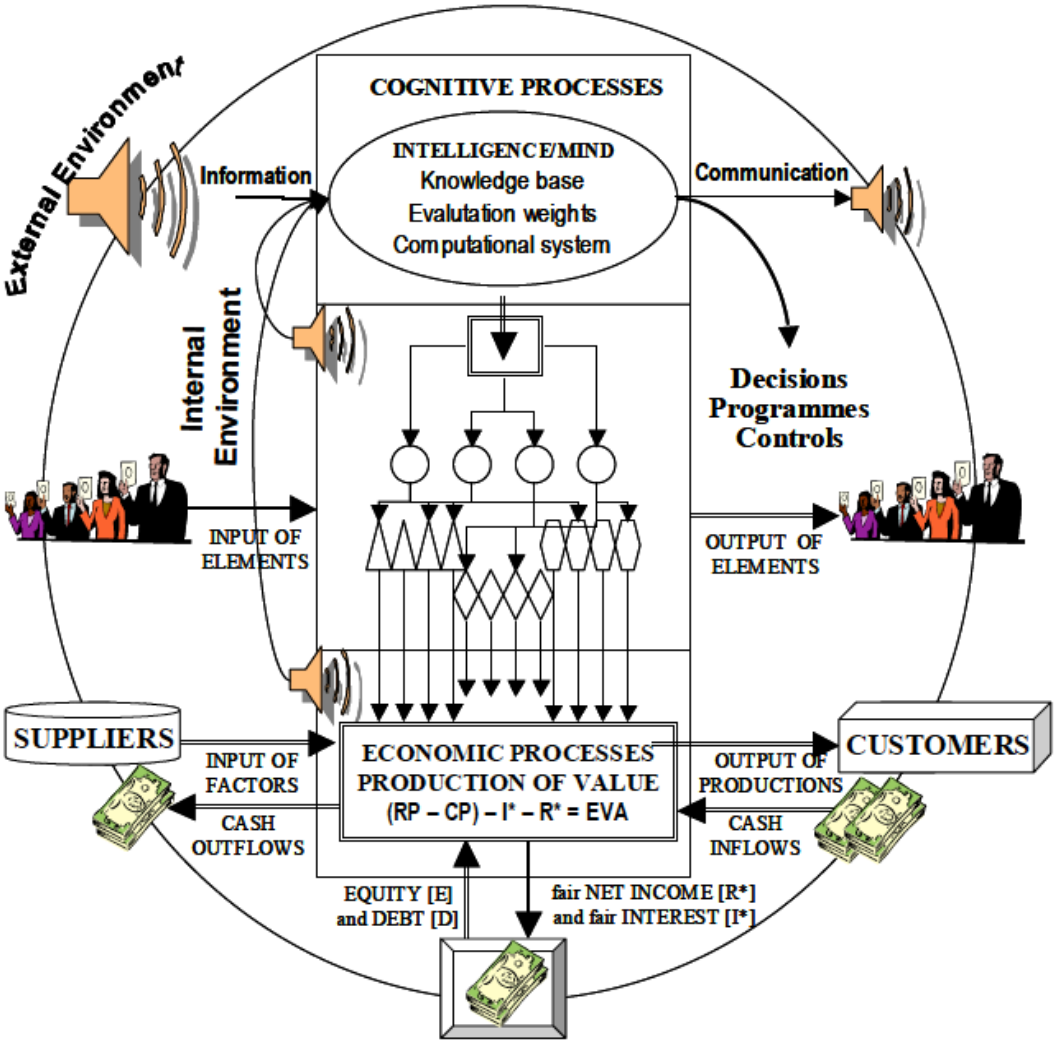

Fig. 5 – Capitalistic firm

We can easily prove that if EVA > 0, then the firm's economic value EVF is greater than E, with the difference representing the "value of knowledge" (human capital) as well as the value of "goodwill" (Mella, 2005).

Having demonstrated that OI = OI* + TEVAP + TEVAM = OI* + TEVA, it follows that:

EVA = [OI* + TEVA – (R* + I*)].

The capitalist firm produces an EVA only if it succeeds in producing a TEVA which is sufficient to provide a fair return on the capital necessary for the productive processes.

Thus, the *first condition for autopoiesis* is that the capitalist firm produce values in terms of TEVA – and thus in terms of EVA and EVF – since only by producing in an efficient manner can it maintain its Equity and Debt while at the same time remunerating its shareholders and financers.

In fact, if the TEVA were insufficient to remunerate (I* + R*), then the *capital would go toward other investments* and the organization would break up.

Nevertheless, *autopoiesis* depends on the organization's capacity to develop economic processes capable of achieving an OI > [I* + R*]; but this implies that economic efficiency must be sufficient to permit an ROI greater than the fair ROD*, so that by taking advantage of the financial leverage, ROE > fair ROE*.

Since OI = QP (pP – cP), *autopoiesis* is achieved if the *economic circuit* is continually renewed at sufficient *sales volumes* and at adequate *prices* to cover the *factor costs* under *fair* conditions, so as to continually reintegrate the factors necessary for a new production cycle.

We observe, therefore, that in order for there to be *teleonomy* the search for TEVA and EVA by the organization must be perceived as positive by the environment. In particular, the TEVAP must be obtained under fair conditions of use of the factors of production and by maintaining the volumes of supply and the fair remuneration for the suppliers and workers; otherwise, the contraction in the costs of production would be considered as unfavourable for the organization's *teleonomy*.

Similarly, the TEVAM 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.). In the opposite case, the consumers would perceive the price surcharge as unjustified with regard to the fair measure, and this would lead to a reduction in the market shares.

The capitalist firm maintains the conditions for *exogenous teleonomy* only if it tries to maintain prices as close as possible to the *fair* price, or even by lowering the latter through price reductions justified by cost reductions. On the other hand, it must try to reduce the cost of production below the *fair* cost, so as to reduce the latter as well.

Maintaining the conditions for teleonomy thus implies:

1. searching for the maximum exploitation of the present market and enlargement toward new markets;
2. the continual improvement in the quality of production θ in order to increase QP_θ and pP;
3. the continual increase in the variety of products in order to reach new consumers;
4. an increase in the *productivity* of the processes to reduce the *unitary factor requirements*, qF, on which depend the purchased volumes: $QF_{M,\,L,\,S} = qF_{M,\,L,\,S}\ QP$;
5. in particular, the increase in the "productivity of labour", πL, through an increase in the quality of the human factor of the organization (skill, motivation, incentives) and its work efficacy (fertility, equipment, software) (Mella, 2018);
6. the search for supply markets where the factors have a higher quality θF, but above all lower purchase prices, since the level of factor costs depends on prices and, as a result, the cost of production, with: $CP = QF_{M,\,L,\,S}\ pF_{M,\,L,\,S}$.

Autopoiesis thus implies both attaining a high degree of *endogenous teleonomy* – with the search for internal conditions for survival through an optimal mix of creativity, productivity, and a proper incentive system – and a high degree of *exogenous teleonomy*, which guarantee the external conditions for survival and an increase in customer satisfaction – obtained from the optimal mix of quantity, quality, variety, and price of production – as well as social satisfaction, deriving from the valued social impact of the organization (spread of employment, rise in average income, payment of taxes, environmental care, etc.).

5 – The permanent organization as a cognitive system. Structural coupling

> Definition 6 – A permanent organization, profit or non-profit, may be viewed as a "conscious cognitive system" because it must develop processes capable of both perceiving stimuli and giving them a significance as "external" or "internal", "favourable" or "unfavourable", and of transforming them into dynamic representations of the *internal* or *external environment* on the basis of which decisions are made and programs built, in order to develop behaviour which is reactive (based on causes) and pro-active (based on objectives) with regard to environmental changes for the purpose of maintaining its autopoiesis (figure 6).

A *conscious cognitive system* – to an outside observer – is a system structurally coupled to the environment.

Autopoietic systems may interact with each other under conditions that result in behavioral coupling. In this coupling, the autopoietic conduct of an organism A [individual or organ] becomes a source of deformation for an organism B [individual or organ], and the compensatory behavior of organism B acts, in turn, as a source of deformation of organism A, whose compensatory behavior acts again as a source of deformation of B, and so on recursively until the coupling is interrupted. In this manner, a chain of interlocked interactions develops such that, although in each interaction the conduct of each organism [individual or organ] is constitutively independent in its generation of the conduct of the other, because it is internally determined by the structure of the behaving organism only, it is for the other organism, while the chain lasts, a source of compensable deformations which can be described as meaningful in the context of the coupled behavior (Maturana & Varela 1980, pp. 119–120).

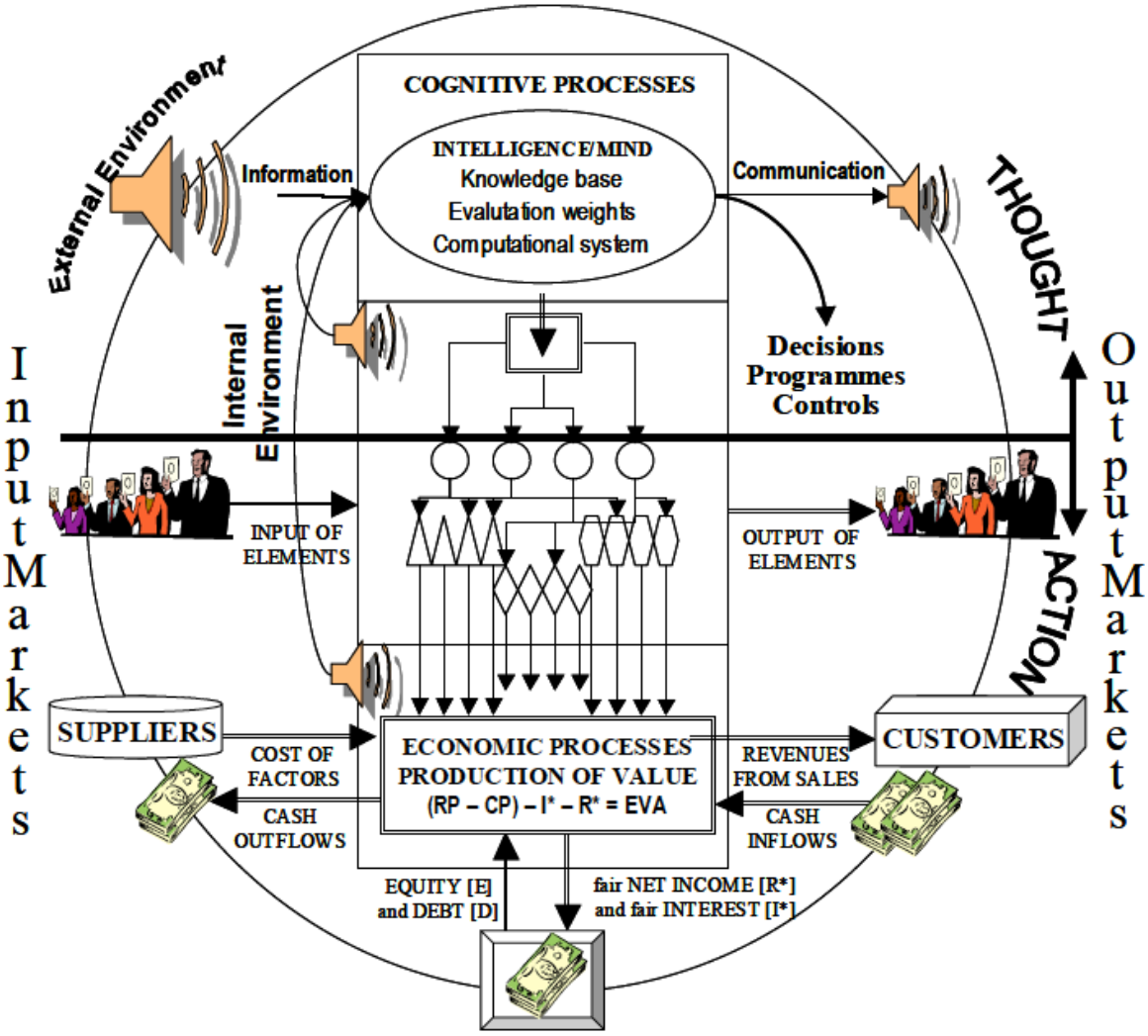

Fig. 6 – Structural coupling of a capitalistic firm

The system coupling implies the presence of internal organs that produce *cognizance* and *preferences* in the system that successfully link up *with* and *within* the environment in order to "survive" by maintaining the system's "identity" – that is, the organization of the autopoietic processes – even while the system modifies its own structure (Von Krogh & Roos, 1995). Maturana and Varela distinguish between two forms of system coupling: one with the environment and one with another system (Maturana, 1980; Varela, 1979).

Man, as a living being, not only is an autopoietic system but can also be considered (to an outside observer) as a conscious cognitive system, since, with internal organs for memory, computation, and evaluation (preferences), he is able to compare objects, calculate information, and construct representations in order to couple himself successfully to the environment and survive, even by modifying his own structure in line with the variations permitted by his genetic and operative program (Walsh 1995; Lewin *et al.*, 1999).

A "conscious cognitive system" (Sect. 2) links itself to the *environment* through a system of processed, up-dated, and evaluated information which we can define as the "representation of the external world" (Terreberry, 1968).

It follows from the definitions that a *permanent organization* must be structurally coupled with the environment, and its structure must at least include:

a. *sensory interface* organs, by which the system links itself to the environment in order to perceive *environmental stimuli*; that is, the *data* (signs, signals);

b. *internal sensory* organs to perceive the *vital* parameters; that is, the disequilibrium stimuli in the autopoietic network (pain, disease, weariness, needs, etc.);

c. organs to select and memorize the stimuli and transform these into meaningful *information*;

d. computational organs (computational system) to systemize the information and create *representations* of the environment;

e. organs for the *comparison* and *evaluation* (weights) of the information and the representations;

f. *effector* organs to intervene in the environment (or in the niche), searching for adaptation and producing ordered actions as part of activities that make up the processes.

In the *permanent production organizations*, be these *profit-* or *non-profit oriented*, the structural coupling is achieved through (Figure 6):

a. *data gathering organs* (*sensory interface*), whose function is to perceive the data from the external environment (purchase orders and sales potential; supply of provisions; legislation) and the internal one (production and personnel trends, state of the processes, etc.), which are used by the mind of the organization;

b. organs that connect production with the markets: supplies, finance and marketing;

c. agency organs (legal entities):

d. operational internal organs that can be divided into:

d.1. the *mind of the organization*, which we define in general as the management that transforms the data into information from which the representations are constituted (market and sectoral structures; threats, opportunities, strong and weak points), based on which the economic-financial calculations are made for decisions, to arrange programs, and to achieve the organizational activity, thereby ensuring it conforms to the programs and decisions (Beer, 1981);

d.2. the *process organs*, which we define as executive, which transform the programs into actions, carrying out the provisioning and productive transformations, and the sales and the financial operations (cash-flow management).

However *cognition* is formed, each action carried out by a *permanent organization* can be provoked by both *causes* and *objectives*, and can be conditioned by *constraints*. The behaviour that is *caused* is typically *reactive*; that which has an *aim* is proactive (Mella, 1997).

6 – The behaviour of the cognitively efficient organization

> DEFINITION 7 –The "permanent production-oriented organization" – profit or non-profit – can be conceived of as an *efficient transformer* of *representations* from the environment (cognitive base) into *decisions* and *programmes*, producing a recursive dynamics (the behaviour of the organization) by means of a continual feedback between acts of thought (mental activity) and actions directed at the environment (institutional activity), which leads the organization toward the continual change of its perceived position in the environment and the gradual widening of its cognitive base, from which subsequent actions depend.

Mental activity uses *cognitive resources* to produce *cognitive processes* that allow the organization to construct *representations* of the environment on which to base its own actions (Hejl, 1984). The *cognitive resources* are represented by an *information* (data gathering) system, by a system of *weights* – that is, preferences (evaluations) – and by a *computational system* to process the information while considering the weights (decisions) (Mella,1997).

The *weights*, or preferences, represent the intensity by which *thought influences action* and constitute the basis for the formation of *judgements*, allowing the cognitive system to evaluate the stimuli and classify them as positive or negative as a function of its own survival; thus, every *observation* can be transformed into a *judgement* if it is joined to a *preference*. The weights condition the actions, since they select (classify according to a value) the information that the cognitive system considers useful for survival. The system of weights is dynamic and usually structured into levels. The highest level of the system of weights in the organization, from which the system of weights at the lower levels derives, is defined as the *system of values*, or *ethical system*; a *system of knowledge* and representations to which a system of weights is associated is defined as a *cultural system* (Hampden-Turner, 1990). The *computational system* is the cognitive resource needed to transform the stimuli into *symbols*, these into information, and the information into representations (models), taking into account the weights.

In terms of behaviour, a *cognitive system* can thus be represented (Figure 6) as a *system of transformation* of *symbols* into *action* (interaction with the environment) through a *knowledge base* that is continually adapted to maintain its own identity in a changing environment. The knowledge base is arranged into preferences by the *system of weights*, and its formation, as its subsequent dynamics, is a function of the power of the *computational system*.

Learning from experience is the process of the (i) formation, (ii) preservation, and (iii) evolution of the *cognitive base* (representations, decisions) and the cognitive resources (concepts, weights, computational capacity) through *behavior*; that is, successions of "cycles of thought/action". Thus, the cognitive resources and the knowledge base are *conditioned* by the *experience* of the cognitive system; that is, by its behaviour (Weick, 1990). As a consequence, the efficient behaviour of the permanent organization depends on both the capacity to perceive and significantly represent the environmental stimuli and the quality and quantity of the "accumulated experience" (internal cognitive state), and thus on the learning capacity of the system. If we consider "experience" as the internal state of the cognitive system, then from this perspective the organization can be conceived of as an open, dynamic system having a memory, according to a typical vision of the general theory of systems.

The *cognitively efficient organization* is thus one that:

a) develops the sensory organs in order to increase the spectrum of perceived *stimuli*;

b) develops the *attention organs* in order to improve the representation of the environment;

c) favours the sharing of the representations (formation and use);

d) improves the perception of the internal *vital* parameters, by broadening the range of the *internal performance* indicators;

e) refines the *system of weights*; that is, the criteria for evaluating risk and trust (decision criteria);

f) develops the *computational system* (potency, speed, and quality of processing);

g) widens the range of *external performance* indicators in order to make the *effector* organs more efficient;

h) strengthens the effector organs in order to improve the pursuit of institutional aims.

7 – Intelligence, learning, experience

> DEFINITION 8 – In order for the *permanent organization* to maintain its *autopoiesis*, it must produce an "intelligent behavior" based on a continual learning and experience-forming process. The *permanent organization* where there is the maximum degree of "pooling" of individual intelligence so that all the individuals collaborate to learn together and, above all, to learn to develop a common learning process becomes a "learning organization" (Senge, 2006; Rheem, 1995).

The "intelligence" of the organization is the capacity of the cognitive system to acquire and utilize *knowledge* to make rational decisions, develop programmes that are compatible with the structure and adequate in terms of the available resources, act in a manner coherent with the programmes, and carry out effective performance controls, all the while tending to achieve the maximum "existential success" without reducing the options for survival (Drucker 1989; Gephart *et al.*, 1996). On the other hand, the "intelligence" of the organization is the capability of its components to build on a *common experience* (Kock *et al*., 1996; Kock *et al.*, 1997).

To maintain its autopoiesis and renew the financial and economic cycles, it is vital for the intelligent autopoietic organization to produce a continual *learning process*; that is, one with formation, accumulation, structuring, and self-confirmation of *knowledge* so as to broaden the *experience* (formation) and use it (utilization) to modify the evaluation criteria for the purpose of improving the decision-making and planning processes and the control procedures (Boland and Tenkasi, 1995, Argyris, 1977; 1992; Walsh, 1995).

The fundamental *learning processes* are:

1) *observational* or *indirect learning:* here *thought* is mainly involved, while *action* is limited to directing the sensor organs;

2) *operational* or *direct learning: action* is also involved here;

3) *cooperative learning*: the organization learns because its structural elements collaborate to learn together, share information, *work as part of a network*, or build *virtual operating units*, or virtual organizations (Tonchia, 1996).

Operative learning by *cause and effect* (Argyris 1991) and by *objectives, which until yesterday was considered* the most powerful way to develop accumulative experience by gathering information on the successes and failures (errors) of actions directed at removing causes or achieving objectives, has today become the least efficient. Operative learning must transform itself into a shared learning in which causes and objectives exchange roles among individuals that operate from opposing points of view which at times do not coincide.

The intelligent *behaviour* of the "permanent organization" is principally manifested in four ways:

a) automatic behaviour: this is a non-conscious behaviour that depends *totally* on operational, behavioural experience and is directly accumulated in the past history of the system;

b) adaptive, conscious behaviour: this is achieved through a constant recourse to conscious care and attention and depends on the *behavioural experience* in addition to the *operational experience;*

c) explorative behaviour: this cannot count on direct operational experience and is typically *feed forward*, trying to foresee errors and avoid them;

d) generative (or innovative-creative) behaviour: this is typically *feed-forward*, trying to "create" errors that can turn into advantages and to break free of memorized models and form representations on the basis of elements generated by the same cognitive base (ideation, invention).

In a highly dynamic environment, where past experience has an increasingly smaller role and an explorative and innovative-creative behaviour becomes essential, the organizations with a higher *endogenous teleonomy* will be those which are transformed into a *learning organization*, providing themselves with organs, procedures, and awards to learn more quickly, react promptly, avoid repeating the same errors, and create innovation (Garvin, 1993, 2000; Senge, 2006). The permanent organization, being a unitary cognitive system, has its own emerging intelligence which derives from the "pooled" intelligence of the individuals that make up its structure (Hejl, 1981).

8 – Managerial qualities and entrepreneurship in business organizations

> DEFINITION 9 – In "business organizations", the construction of representations of the internal and external environment, and the other cognition processes, are carried out by the *management*, which produces the thought of the organization (rational calculations for decision-making, programmes, and controls) from which the organization's actions derive. The production and financial processes, which are instrumental for achieving a common end, are carried out by the effector organs, which produce the action of the system, guided by those representations.

Management must formalize its mental representations by constructing formal, verifiable, transmittable, and utilizable models:

a) *market and sector models,* to know the competitive structure of the external environment the organization operates in (present sector, present and potential competition, markets, profile of potential consumers, profile of customers, etc.);

b) *organization models*, through which the internal organic structure is known (formal and informal structure, information flows, internal competition, incentive system, etc.);

c) *balance sheet models*, which represent a summary of past trends in the economic and financial processes, and of the organization's impact on its environment; these models determine the economic output, the capital, and the overall surplus;

d) *programme models,* which represent the future trends that result from the forecasts and decisions;

e) *control models,* such as analytical accounting and the *tableau de bord,* which monitors the performance variables judged to be significant indicators of the organization's vital parameters (efficiency, efficacy, quality and, in particular, economic efficiency, profitability, length of processes, potency of the organs, etc.), since the organization can maintain its identity only if it remains vital: that is, it manages to maintain the vital parameters at levels that impede its break-up.

We can distinguish between two types of management behaviour:

1) *procedural* or *conservative behaviour*, typically automatic or adaptive. Managerial thinking is typically directed at determining objectives, making plans to achieve these, and controlling for any problems by identifying errors or deviations to be corrected in the spirit of *carrying out only successful actions and never repeating the same error twice*;

2) *entrepreneurial* or *creative behaviour*, typically explorative or generating innovation. Actions by management attempt to avoid known types of behaviour in order to produce new ones; in this case, managerial thinking is typically *creative*, in the spirit of *never repeating successful actions* but purposely producing errors in order to break free from known schema.

In non-business and non-profit organizations, a conservative managerial behaviour prevails, since the exogenous teleonomy implies that the organization must maintain the efficiency of its processes and seek to produce value from the cost side. Product innovation is not possible, or in any case is rare; the constancy of production quality that continues unchanged over time is rewarded.

Control appears to be the crucial cognitive activity to maintain quality and reduce production costs; conservativeness is the crucial cognitive resource.
In "profit organizations", especially "capitalist firms", the achievement of *exogenous teleonomy* is based on "customer satisfaction", (Wellemin, 1990) as defined in ISO 9001:2000, and the conditions of autopoiesis impose an innovative business behaviour that supplements the conservative behaviour.

The ISO 9001:2000, known as "Vision," states:

> … if before Quality meant satisfying all the Customer's expectations, now the concept of "expectations" is broadened and enriched through adjectives such as "explicit" and, above all, "implicit", with regard to both the external Customer – the recipient of the products – and the internal Customer – the department that receives the components and services of the other departments (ISO 9001 2000).

The crucial cognitive activity appears to be innovative decision-making, and the crucial resources creativity and motivation; the former is necessary to produce diversification and innovation, the latter to reduce production costs.

9 – The structural coupling of production organizations in the Information and Internet Age (suggestions)

The preceding definitions and models permit us to examine how the Information Technologies (*ITs*) can integrate the structure of the "production-oriented organizations", considered as "cognitive systems", by strengthening the forms by which they realize their "structural coupling" with the environment by developing their Learning Management Capabilities and their "autopoiesis" (Hammer & Champy, 1993; Boland *et al.*, 1994; Nonaka, 1994; Nonaka & Takeuchi, 1995).

A) CONNECTOR SENSORY ORGANS. Definition 7 stated that it is fundamental for the organization to be able to develop efficient data gathering processes to transform data into information and representations. The sensory organs have the role of perceiving the data from the environment that the internal computational system processes and inserting this into information flows that allow the external and internal environment to be represented.

The spread of *ITs* has led to both the strengthening of the *sensory capacity* of the organization and the refinement of *monitoring techniques*. In fact, the use of web techniques – in particular, building usable websites and efficient search engines and devoting sufficient time daily to attracting visitors to the website – permits the organization to receive a much higher number of external stimuli (passive contacts and received data), enter into contact with a much higher number of data sources (active contacts and researched data), and broaden the spectrum of obtained and transmitted data (Hagel & Armstrong, 1997).

Even though guaranteeing the anonymity of the visitor, the by-now widespread techniques of web design also make it possible to come up with profiles of potential clients and identify their social position, preferences, and potentialities through an analysis of contacts and of the pages visited. Therefore, the "big data era" modifies not only the search for information but also

the construction of representations of the economic and financial environment in which the company operates.

B) CONNECTOR EFFECTOR ORGANS. Business organizations are created for the purpose of producing goods and services for output markets. To carry out the production processes, they use effector organs, which can be external (connection with the markets) or internal (transformation). Due to the conditions of *autopoiesis* and *exogenous* teleonomy (Definition 2), the use of *ITs* facilitates the two-way connections between the agents in the input and output markets, on the one hand, and the organization on the other, both from the active as well as passive side, in order to reach a truly mobile environment that concentrates on visual mobile messaging (Pallot & Sandoval, 1998).

This leads to an enlargement of the geographic areas that can be reached by the organization and a reduction in the connection times, with the possibility of modifying the sales and supply mix in order to attain a true web-based Customer Relationship Management (CRM). By means of CRM, organizations can learn more about customers' needs and behaviours to develop stronger relationships with them, bringing together a great amount of information about customers, sales, marketing effectiveness, responsiveness, and market trends (Newell, 2000).

Of particular significance are several recent start-up phenomena, whose growth tendencies seem clear-cut:

a. *advertisement* on the web, which makes the connection more precise and facilitates the understanding of the needs of potential clients (Goldhaber, 1977);
b. *telematic work*, which reduces the internal operating structure and makes production more flexible;
c. the *outsourcing* and externalization of functions, with a resultant rationalization of production costs;
d. *integrated logistics*, which permit a more efficient connection between the organization and the market agents.

C) INTERNAL PRODUCTIVE PROCESS ORGANS. The function of *ITs* is not only connection; they also represent a potent means of strengthening the internal effector organs, that is, the process organs: supply, storage, production, sales (Davenport, 1993; Davenport & Stoddard, 1994).

The larger organizations are usually structured according to *divisions* that carry out particular functions (functional organization), pursue particular objectives (linear organization), or develop certain products (matrix organizations). One of the problems of such organizations is the coordination of activities to avoid duplications or asynchronies and strengthen the knowledge of the state and the dynamics of all the processes. The use of *ITs* can be intuited, but I would mention in particular (Kock & McQueen, 1996) the reduction of waiting times for clients and users through the redistribution of user requests among the service centers and the activation of a secure on-line payments system.

In addition to what has just been discussed, *ITs* also offer a new and potent opportunity for production organizations: creating a network to reorganize and strengthen the processes for the *production of value* and create true *value-creating systems* where the cognitive organs of the various businesses (enterprises, firms, concerns) are interconnected in such a way as to represent a "collective mind" able to *globally* improve the processes while acting and deciding *locally*.

D) INTERNAL ORGANS OF COGNITION AND COMMUNICATION. It is above all the internal organs of cognition and communication that gain the greatest advantages from the use of *ITs* that can transform the Internet into a semantic Web, or Web 3.0, a Vision of information that is understandable by computers. so that they can perform more of the tedious work involved in finding. Sharing and combining information on the web, with the aim of facilitating the search of knowledge on the Web, adding meaning to data, organizing, interpreting and making use of that meaning (Daconta *et al*., 2003; Verley *et al*., 2006) to permit the automated use of disparate,

distributed Internet information sources and services as well as favor cooperative learning (Berners-Lee *et al*., 2001).

Since the function of cognitive processes is to *construct quantitative models* that provide the knowledge for decisions and control, it seems clear that the first important cognitive advantage is the strengthening of the processes for understanding the external and internal environments. Through the connector organs, both the sensory and effector organs, management can construct more complete, timely, and significant models of the supply markets by identifying the potential suppliers, rationalizing their requests, comparing the offers, and segmenting the orders. Even the construction of sector and competitor models can be made more effective. The study of sites of producers of similar or substitute goods allows management to identify possible threats as well as concentrate on opportunities. The greatest potential for *ITs* today is probably linked to the development of models regarding the knowledge of the emergence of strong and weak points in the structure, as has occurred, for example, with the new means of Performance Management, including the balanced scorecard.

Management control benefits from *ITs*, since such technologies allow for the continual monitoring of the processes of supply, logistics, and factor consumption by also constructing continually-updated *analytical accounting systems* together with systems for the determination of costs based on cost driver dynamics capable of modifying the process mix while the latter is being carried out, in order to take into account demand trends. In particular, it is possible to refine models for the determination of the parameters of *factor use* and *cost* and the *internal transfer* of resources, as well as models of efficiency and quality with regard to resource use.

A specific application made possible using *IT*s is the creation of a *tableau di bord* – or *dashboard* – to keep under control the variables management considers fundamental for monitoring the state of the autopoietic processes of the organization (Mella, 2021a, Sect. 9.9.5). The *Tableau de bord* (performance measures, balanced scorecard, pilotage, organizational cockpit), in addition to being an information instrument for short-term decisions, also represents a fundamental self-coordinating instrument, since its information can permit the development of a *combinatory system of improvement* and progress (Mella, 2017, Sect. 2.6), on the condition that an internal *system of communication* is created that allows all the members of the organization to perceive positive and negative gaps in their performance measures with respect to those indicated in the *tableau* di bord. The best practices are communicated and shared by producing progress in the operating efficiency of the entire structure.

E) BUSINESS INTELLIGENCE. Business Intelligence (or Decision Support Systems) includes software applications, technologies, and analytical methodologies that perform data analysis, and it includes data mining, web mining, text mining, reporting and querying, and data visualization. More generally, *ITs* permit the creation of a system of *business intelligence* tools, such as Online Analytical Processing, or OLAP systems – Systems designed to handle the queries required to discover trends and critical factors – query/reporting, and data mining in order to enable organizations at any level to acquire and process information to measure, analyze and optimize business performance (Harrington, 1991; Biscobing, 2020). While *business intelligence* tools can be segmented by technology (such as data mining or OLAP), *analytic applications* can be segmented by business function (such as finance or marketing) and structure, and they can coordinate business activities to achieve a particular result (such as producing a budget or assessing the performance of key suppliers)

10 – Conclusions

Many decades have passed since Systems Theory entered the world of science, with its methods, logic, formal models, and worldview. Systems Theory is still evolving, expanding its general "logical framework" to investigate systems in every discipline and all new "variants": from structural to dynamic systems, from micro and macro biological systems to social systems,

autopoietic systems to combinatoriy systems (Mella, 2017), mechanical to complex systems, holonic systems (Mella, 2009) to so-called complex adaptive systems, to name but a few.

Even the "world" of organizations and companies – and, in general, the corporate literature – has widely adopted systemic paradigms, representing organizations and companies in terms of open, closed, autopoietic, teleonomic, teleological, operational, cognitive, exploratory, transformational, control, combinatorial, stratified, tracking systems, etc., just to cite a few types from a long list.

Without even the slightest *basic knowledge* of the various "types" of systems, it can be difficult to deal with many studies that make extensive use of the systemic approach in its various ramifications. This paper offers a first, concise, but documented introduction to the systemic notions widely used in the organization literature, in all its facets, precisely to make it easier even for the reader with a minimal wealth of knowledge to understand the systemic approach in the business field.

A neutral "style" was employed, presenting the concepts through a succession of interconnected definitions, without expressing value judgments about the concepts themselves. The quotations are intended to convey directly to the reader the thinking of the different authors to allow him or her to appreciate their meaning without the intermediation of interpretations, syntheses, and subjective perspectives.

This paper certainly does not exhaust the theme of applying systemic notions to the business area but represents the basis for the future examination of other systemic models of firms, organizations, and their processes.

11 – References

Argyris, C. (1977). Double loop learning in organizations. *Harvard business review*, 55(5), 115-125.

Argyris, C. (1992). *On Organizational Learning*. Backwell, Cambridge, MA.

Argyris, C. (1991). Teaching smart people how to learn. *Harvard business review*, 69(3), 99-109.

Bandura, A. (1982). Self-efficacy mechanism in human agency. *American psychologist*, 37(2), 122-147.

Bandura, A & Cervone, D. (1986). Differential engagement of self-reactive influences in cognitive motivation. *Organizational Behavior and Human Decision Processes*, 38, 92-113.

Barrows, E. M. (2001). *Animal behavior desk reference: A dictionary of animal behavior, ecology and evolution*. Boca Raton: CRC Press.

Baum, J. A. C., Rowley, T. J. (2005). Companion to Organizations: An Introduction. In Baum J.A.C., (Ed.), *Companion to Organizations*. Blackwell Publishing: Malden, (pp. 1–34).

Bednarz, J. (1988). Autopoiesis: The Organizational Closure of Social Systems. *Systems Research*, 5(1), 57-64.

Beer, S. (1981). *Brain of the Firm*. 2nd edition, Chichester, New York, Wiley.

Beer, S. (1992). *Preface*. In H. R. Maturana, & F. J. Varela (1980).

Berners-Lee, T., Hendler, J., & Lassila, O. (2001). The semantic web. *Scientific american*, *284*(5), 34-43.

Binswanger, H. (1991). Volition as cognitive self-regulation. *Organizational Behavior & Human Decision Processes*, *50*(2), 154-178.

Biscobing, J. (2020 Online). *OLAP (online analytical processing)*. https://searchdatamanagement.techtarget.com/definition/OLAP.

Boland, R. J. & Tenkasi, R. V. (1995). Perspective Making and Perspective Taking in Communities of Knowing. *Organization Science*, *6*(4), 350-372.

Boland Jr, R. J., Tenkasi, R. V., & Te'Eni, D. (1994). Designing information technology to support distributed cognition. *Organization science*, *5*(3), 456-475.

Brooks, D. R. & Wiley, E. O. (1986). *Evolution as entropy: towards a unified theory of biology*. University of Chicago Press, Chicago and London.

Daconta, M. C., Obrst, L. J., & Smith, K. T. (2003). *The Semantic Web: a guide to the future of XML. Web services, and knowledge management*. John Wiley & Sons.

Davenport, T. H. (1993). *Process Innovation*. Harvard Business Press, Boston

Davenport, T. H., & Stoddard, D. B. (1994). Reengineering: business change of mythic proportions?. *MIS quarterly*, 121-127.

Dawkins, R. (1982). *The Extended Phenotype*. W.H. Freeman and Company, Oxford.

Dennett, D. C. (1988). Précis of the intentional stance. *Behavioral and brain sciences*, *11*(3), 495-505.

Drucker, P. F. (1989). *The New Realities*. Harper & Row, New York.

Garvin, D. A. (1993). Building a learning organization. *Harvard Business Review*, 78-91.

Garvin, D. A. (2000). L*earning in Action: A Guide to Putting the* L*earning Organization to Work*. Harvard Business School, Press.

Gephart, M. A., Victoria, J., Marsick, M., Van Buren, E. & Spiro, M. S. (1996). Learning organizations come alive. *Training & Development*, *50*, 45.

Goldhaber, M. H. (1997). *The attention economy and the Net*. http://www.firstmonday.dk/issues/issue2_4/goldhaber/.

Hagel, J. & Armstrong, A. (1997). *Net gain: expanding the markets through virtual communities*. Harvard Business School Press.

Hammer, M. & Champy, J. (1993). *Reengineering the Corporation*. Harper Business, New York.

Hampden-Turner, C. (1990). *Charting the corporate Mind, from Dilemma to Strategy*. The Free Press, New York.

Harrington, H. J. (1991). *Business Process Improvement*. New York, McGraw-Hill.

Hejl, P. (1981). The Definition of System and the Problem of the Observer: The Example of the Theory of Society. In *Self-organizing systems: an interdisciplinary approach*, 170-185.

Hejl, P. M. (1984). Towards a theory of social systems: self-organization and self-maintenance, self-reference and syn-reference. In *Self-organization and management of social systems*, 60-78). Springer, Berlin, Heidelberg.

Hollenbeck, J. R., Williams, C. R & Klein, H. J. (1989). An empirical examination of the antecedents of commitment to difficult goals. *Journal of Applied Psychology*, *74*, 18-23.

Kock, Jr. N. F., McQueen, R. J. & Baker, M. (1996). Learning and Process Improvement in Knowledge Organisations: A Critical Analysis of Four Contemporary Myths. *The Learning Organization*, *3*(1), 31-41..

Kock Jr. N. F. & McQueen, R. J. (1996). Product Flow, Breadth and Complexity of Business Processes: An Empirical Study of Fifteen Business Processes in Three Organisations. *Business Process Re-engineering & Management, 2*(2), 8-22.

Kock, N. F., McQueen, R. J. & Corner, J. L. (1997). The Nature of Data, Information and Knowledge Exchanges in Business Processes: Implications for Process Improvement and Organizational Learning. *The Learning Organization*, *4*(2), 70-80.

Laprie, J. C. (2008). From dependability to resilience. In 38th *IEEE/IFIP international conference on dependable systems and networks (*pp. G8–G9).

Latham, G. P. & Locke, E. A. (1991). Self-Regulation through Goal Setting. *Organizational behavior and human decision processes*, *50*, 212-247.

Lewin, A. Y., Long, C. P. & Carroll, T. N. (1999). The Coevolution of New Organizational Forms. *Organization Science*, *10*(5), 535-550.

Locke E. A & Latham G. P. (1990). *A theory of goal setting and task performance*, Prentice-Hall, Englewood Cliffs, NJ.

Luhmann, N. (1995). *Social Systems*. Stanford CA, Stanford University Press.

Maturana, H., & Varela, F. (1980, 1st Ed. 1972). *Autopoiesis and Cognition: The Realization of the Living*. Boston Studies in the Philosophy of Science (Cohen, R. S., & Wartofsky, M. W., (eds.)), Vol. *42*, Dordecht (Holland), D. Reidel Publishing Co.

Maturana, H. R., & Varela, F. J. (1987). *The tree of knowledge: The biological roots of human understanding*. New Science Library, Shambhala Publications.

Mayr, E. (1989). *Toward a New Philosophy of Biology: Observations of an Evolutionist*. Harvard UP., Cambridge, Mass.

Mella, R (1997). *Management Control* [Original: Controllo digestione]. Utet, Torino.

Mella, P. (2005). Performance Indicators in Business Value-Creating Organizations. *Economia Aziendale 2000 Web*, *2005(2)*, 25-52.

Mella, P. (2017). *The Combinatory Systems Theory. Understanding, Modeling and Simulating Collective Phenomena*. In Contemporary Systems Thinking Series. Springer Nature, Switzerland.

Mella, P. (2018). The law of increasing productivity. *Int. J. Markets and Business Systems*, *3*(4), 297-316.

Mella, P. (2021a, 1st Ed. 2014). *The Magic Ring. Systems Thinking Approach to Control Systems (Second Edition)*. Springer Nature, Switzerland.

Mella, P. (2021b). L'Azienda quale Organizzazione Permanente nel Pensiero dei Maestri Italiani. *Economia Aziendale Online-*, *12*(3), 375-397.

Mingers, J. (1994). *Self-Producing Systems: Implications and Applications of Autopoiesis*. New York, Plenum Publishing.

Monod, J. (1970). *Le hazard et la nécessité*. Paris, Le Seuil.

Newell, F. (2000). *Loyalty.com: customer relationship management in the new era of Internet Marketing*. NY, McGraw-Hill.

Nonaka, I. (1994). A dynamic theory of organizational knowledge creation. *Organization Science*, *5*(1), 14–37.

Nonaka, I., & Takeuchi, H. (1995). *The knowledge-creating company: How Japanese companies create the dynamics of innovation*. Oxford: Oxford University Press.

Paetau, M. (1997). *Organizations as self-referential and autopoietic social systems,* GMD - FIT-KI.

Pallot, M., & Sandoval, V. (1998). *Concurrent enterprising: toward the concurrent enterprise in the era of the Internet and electronic commerce,* Kluwer.

Rheem, H. (1995). The learning organization. *Harvard Business Review*, *73*(2), 10.

Scott, R. (1992, 2nd Ed. 1998). *Organizations: Rational, Natural and Open Systems Perspectives*. Prentice Hall: Englewood Cliffs, NJ.

Senge, P. M. (2006, 1st Ed. 1990). *The Fifth Discipline*. Doubleday, New York.

Terreberry, S. (1968). The Evolution of Organizational Environments. *Administrative Science Quarterly*, *12*, 590-613.

Tocino-Smith, J. (2021 online). What is Locke's Goal Setting Theory of Motivation? https://positivepsychology.com/goal-setting-theory/.

Toffler, A. (1985). *The Adaptive Corporation*. McGraw Hill, New York.

Tonchia, A. (1996). InterNotes e l'Azienda Virtuale: La Creazione di un'Infrastruttura di Comunicazione per un Nuovo Business Model. *Informatica & Unix*, Gruppo Editoriale Jackson.

Uribe, R. (1981). *Modeling autopoiesis*. In M. Zeleny (Ed.), Autopoiesis: A theory of living organization. New York: Elsevier-North Holland.

Van De Ven, A. H. & Poole, M. S. (1995). Explaining Development and Change in the Organizations. *Academy of Management Review, 20*(3), 510-540.

Varela, F. J. (1979). *Principles of Biological Autonomy*. North Holland, Elsevier, Amsterdam.

Varela, F. (1981). *Describing the logic of the Living*. In Zeleny, *Autopoiesis,* (1981).

Verley, G., Al-Hajj, M., & Cardot, H. (2006, November). Constitution et utilisation d'une terminologie en vue de l'extraction de la sémantique des liens hypertextes sur le web. *In International Conference on Terminology.* Anvers 2006.

Vicari, S. (1991). L'*impresa vivente*. Etas, Milano.

Von Krogh, G. and Roos, J. (1995). *Organizational Epistemology*. New York: St. Martin's Press.

Walsh, J. P. (1995). Managerial and Organizational Cognition: Notes from a Trip Down Memory Lane. *Organization Science*, *6*(3), 280-321.

Weick, K. E. (1990). *Cognitive Processes in Organizations*. In L. L. Cummings and B. M. Staw (Eds.), Information and Cognition in Organizations, Greenwich, CT: JAI Press.

Wellemin, J. H. (1990). *Customer satisfaction through quality*. Chartwell-Bratt (Publishing & Training) Ltd.

Zeleny, M. (1981). *Autopoiesis, a theory of living organization*. Elsevier, North Holland.

Zeleny, M., & Hufford, K. D. (1992). The Application of Autopoiesis in Systems Analysis: Are Autopoietic Systems Also Social Systems? *International Journal of General Systems*, *21*(2), 145-160.