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Selfish Orgonic Networks

The Holonic Viewpoint of Productive Networks

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Abstract: This conceptual paper will examine productive networks, whose nodes are composed of production organizations and whose links are represented by production flows (materials, components, machines and equipment of all kinds) that are at the same time outputs of an antecedent (earlier in the process) node and inputs of a subsequent (further along in the process) one. I have felt it useful to adopt the holonic viewpoint (introduced by Koestler in 1967), according to which the nodes of the networks are, in all respects, holons, understood as viable systems (according to Beer's (1979, 1981) sense of the term), since they possess the dual tendency to preserve and assert their individuality. For convenience sake I have introduced the term org-on (or orgon) to indicate a production organization viewed as a vital and semi-autonomous holon. Each production network is thus interpreted as an orgonic network whose functioning is entirely similar to that of an Autonomic Cognitive Computer (Shimitzu, 1987) or of an Holonic Manufacturing System. According to the holonic perspective orgons – as vital entities – have the unique property of producing a cognitive activity (attributable to management) that leads them to behave in an exclusively selfish manner (according to Dawkins' interpretation, 1995: 4). I have identified 10 "rules of selfish behavior" on the part of the orgon, whose application necessarily and inevitably produces three evolutionary laws of the production networks: continual expansion, elasticity-resiliency, and continual improvement in performance. Paraphrasing Koestler (The Ghost in the Machine, 1967), it seems there truly is "a ghost in the production machine", whose invisible hand produces increasing levels of productivity and quality; increases the quality and quantity of satisfied needs and aspirations. There is nothing metaphysical about this evolution: it is produced and governed by selfish orgons and by the laws of orgonic networks.

Keywords: Productive Organization, Holonic Network, Orgonic Network, Holon and Holarchy, Autonomic Cognitive Computer, Holonic Manufacturing System, Bionic Manufacturing System

Prologue: A Change in Perspective

IN THIS THEORETICAL study I will examine "complex production systems" – which produce the flows of goods and services on which the continuity of the "*subtle film of material called life*" (Brown, 1954:3; Cipolla, 1962) depends – from a typical systems perspective, placing myself at a "*sufficient height*" (Senge, 1990) to take in the macro and micro dimensions and, at the same time, their reciprocal interaction.

In order to understand the formation and development of a complex production system, composed of elements which are both autonomous as well as dependent, we must above all *radically modify* our ideas about the concept of production.

We are used to thinking about the production of a good or service as the result of the activity of a specific producer: clothes, perfumes, cold cuts, automobiles, films, cell phones, health services, university courses, etc., are always produced by some firm, organization or institution that is easy to identify. This is the *ato m istic* way to conceive of production at the *micro level*. Is it the right way?

Things are not like this in reality.

Suppose I am wearing a double-breasted winter wool suit. I immediately realize, following a typical *atomistic* view, that in order to discover the producer I only need to read the label on the inside of the jacket. This is true; but one thing is the final producer, another is to understand the complex processes and activities that have gone into clothing manufacture.

We assume that the suit has only four components: the wool fabric, the internal cotton lining, the special sewing thread, and the buttons.

In order to have the wool fabric we of course need sheep farmers, and the sheep must be periodically sheared with the appropriate tools, which have been manufactured "who knows where and by who knows whom".

The raw wool must be collected, packaged and transported for washing, scouring, bleaching, carding and, finally, spinning; all these operations require machines of varying complexity produced by specialized firms that, in turn, need electric motors, steel and plastic components, cables, monitors, security systems, etc.

The spun wool finally reaches the dyeing stage, with colors that require producers of chemical components, metal or plastic packages, thinners and all kinds of accessories. The dyed wool, in skeins of wrapped around spools, produced "who knows where

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and by who knows whom", moves on to the weaving stage, with its modern robotic machines produced by super-specialized firms able to obtain fabric of any kind of weft and pattern.

Finally, the long rolls of fabric are packaged and bought by the clothing manufacturer, who then must cut and sew them with the appropriate specialized machines; the lengths are sewn with a special thread, after which the inside cotton lining is applied.

Here, too, we can imagine a vast and varied production network, if only for the simple fact that the cotton comes from cultivation and not animal breeding, and that the harvesting, spinning and weaving processes require completely different machinery and are in turn carried out by other firms. The reader can add to these two networks the one that provides the thread and the buttons.

What is the meaning of manufacturing and acquiring a suit? The article of clothing represents the output of a terminal process of several wideranging production networks that had to be active and activated in order to provide the components to manufacture it.

Buying the suit means benefiting from the output of the entire *network*. The suit is the output of a complex network of production organizations, not that of a single production firm.

We need only visit a hypermarket to fully appreciate the number, variety, interconnection and complexity of production networks.

Production Networks

If we change our perspective, it is clear that any kind of production flow is obtained not from individual production organizations but from a more or less widespread *production network* of interconnected units located in different places and times, all of which, consciously or not, are necessarily connected, interacting and cooperating in a coordinated way in order to combine and arrange, step by step, the factors, materials, components, manpower, machines and equipment in order to obtain flows of products and to sell these where there is a demand for them [1]. We shall refer to this in general as a *productive network* [2].

We can make a generalization: all production networks represent an efficient system of "micro-local" transformation and organization processes for resources for the purpose of producing flows of goods or services to satisfy the demand for final consumption goods, which represent the global output of these processes [3].

The production units that carry out these processes are the nodes (or modules) of the network. The relations among the nodes take the form of *real flows* (goods and services) and *financial flows* (capital and earnings) from the exchanges and investments undertaken, more or less stably, among the various nodes (in order to simplify, we can consider the information as inputs and outputs that are included in the real and financial inputs and outputs).

There are no autonomous nodes: in the networks all the nodes are dependent on others (Barabási, 2002) and form various-sized links.

Production networks are found wherever man acts to satisfy his needs and aspirations. They concern not only production but also consumption; *there is no co n sumption without production, but at the same time there is no production without consumption.*

A brief technical note [4]. The term *network* is correctly preferred to the term *sy s tem, or structure*, since it brings out three aspects. First, that among

[1] The concepts of final good and component must be viewed in the widest possible sense: material and immaterial goods, and services; individual or collective consumer goods; goods to satisfy needs or aspirations, either individual or collective.

[2] *"The term networks refers to exchange relationships between multiple firms that are interacting with each other."* (Wilson & Möller, 1995).

"The propositions of the network model refer to situations and cases in which the environment of the organizations is of a concentrated and structured kind [...] As a result of an organization's interactions and exchange processes with any of these, relationships develop that link the r e sources and activities of one party to those of another. The relationships are generally continuous over time, rather than being composed of discrete transactions." (Hakansson & Snehota, 1999: 23).

[3] *"Once we admit that business relationships of a company are connected and that this applies for companies in general we have to consider possible chain dependencies between relatio n ships. [...] Generalized connectedness of business relationships implies existence of an aggregated structure, a form of organization that we have chosen to qualify as a network. Because of the connectedness a relationship is a part of a larger whole. Relationships are parts of the broader structure that links its elements – the actors (companies)."* (Hakansson & Snehota, 1994: 19).

"In order to obtain necessary resources, the organization is seen to develop relations with a number of other organizational units and thus it enters into a network of relationships. Two a s pects of this network have mainly been studied. Firstly, the characteristics of the different organ i zations have been investigated as they relate to the other organizations within the same network. Secondly, the links between the units have been analysed in terms of, for example, formalization, intensity, and standardization. The parallel to these studies in the marketing area are those that form a 'distribution system perspective'. In this, the field is viewed as a system of interconnected institutions performing the economic functions required to bring about exchange of goods or se r vices." (Hakansson, 1982: 11, 12). I have chosen to focus attention on the productive network rather than the distribution one, which we can think of as being included in – or a particular case of – the former.

[4] I define a *standard productive node* as an entity, or *operational module*, endowed with initial resources that, on the basis of requests from a given "reservoir of demand", transforms *external re-sources* – which have their own value, measured by standard procedures – into certain types of *production* – with their own value, measured according to homogeneous standard procedures – under the survival condition that the *value* of the output is not below that of the inputs; and, if it is below this, that the difference is not greater than the amount of the initial resource endowment (invested capital).

the nodes – that is, the production units – there must always exist necessary and stable connections, which originate from the exchange and information processes. Second, that the network functions if all its components act, according to their appropriate times and at an appropriate space, simultaneously and in a coordinated way, revealing a *selfish behaviour* aimed at its survival within the network. Third, that the network operates to produce flows and not individual products; thus, the unitary activity of the network must be observed over a *meaningful time span*, in which we can identify the flows of interconnection among the nodes and among the external reservoirs.

The demonstration of this assumption represents the heart of this study.

Production Organizations as Network Nodes

The nodes of a production network are production organizations of some type, which can also be quite different in terms of legal status (public or private entity, association, individual company, professional group), size (large- and small-sized companies and craft companies), organizational structure (unitary, divisional and group structures), management approach (business and non-business, for-profit and not-for-profit organizations), and location and area of operation (local, regional, international, global).

The economics literature gives various names to these entities, adopting terms widely used in business terminology: production units, organizations, firms, corporations, etc. I prefer the more general term *production organizations* since, apart from their formal and managerial characteristics, the network nodes are still stable *organizations* that possess at least the following characteristics:

1. *spontaneous genesis*: they arise spontaneously – based on a decision by some person or group – when they can link up with some "demand reservoir", which already exists or is created by the same organizations; I define *demand reservoir* as a number of entities – individual or organizational – which, as a whole, represent a potential demand for goods;
2. *autonomy and durability:* through their own *management* they *produce cognitive* processes aimed at survival; once created, the production organizations tend to remain viable indefinitely by modifying their production processes in order to satisfy demand or by looking for other forms of demand; in this sense, they are *viable systems* according to Beer's definition (Beer 1979, 1981; Espejo & Harnden, 1989), and *autopoietic systems* as defined by Maturana & Varela (1980);
3. *need to connect*: their natural tendency is to *link up* with other production organizations when this is deemed necessary or useful for survival; the connection occurs through real or monetary flows. I will consider as prevalent the real connections in terms of relatively stable flows of material, labour, services, and other goods;
4. *specialization*: they tend to specialize their productive transformations and their products (Snow et al., 1992), limiting the range of possible processes and adopting only those required by the production network, of which they represent one segment of the overall process; the production units linked to the consumption reservoirs are *terminal production nodes*; the others, linked to these in an instrumental and specialized way, are *intermediate nodes*.

The Holonic View of the Production Network. Orgons

If we accept these *minimal properties* then we can acknowledge that the network nodes have a double meaning: on the one hand, they are *autonomous units* that carry out a specific process in order to obtain the finished products, and on the other they are *interconnected parts*, in that they are linked to other *antecedent* nodes – on which they depend – and to *successive* nodes, to which their production is aimed.

Thus we can fully consider the nodes from the holonic perspective.

The term "holon" was coined by Arthur Koestler (1967) to indicate any object, concept or system that, though observable as an autonomous and independ-

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A *modular network* is defined as an organized dynamic system whose elements, or organs, are represented by input-output *modules*. The *operational modules* form the network in that they are interconnected by *organizational relations* that define the direction of the input/output interactions among the modules that compose the structure of the system.

Initial modules are those that receive external inputs, those that give off outputs to the environment are called *final* ones. The others are intermediate modules.

Associated with each connection between two modules is an *internodal indicator* that specifies a given condition necessary for the *downstream* module to produce its output after having received input from an *upstream* module.

We can assume that these indicators are *flow* requirements that specify to what extent the upstream module must contribute its output to produce that of the downstream module.

Networks can have an *invariable* organization or an *adaptive* one; in the former case the modules and their interconnections are stable, with only the *internodal indicators* changing; in the latter the nodes and their connections can vary as well. For more detail on this see Mella, 1997, section 2.7.

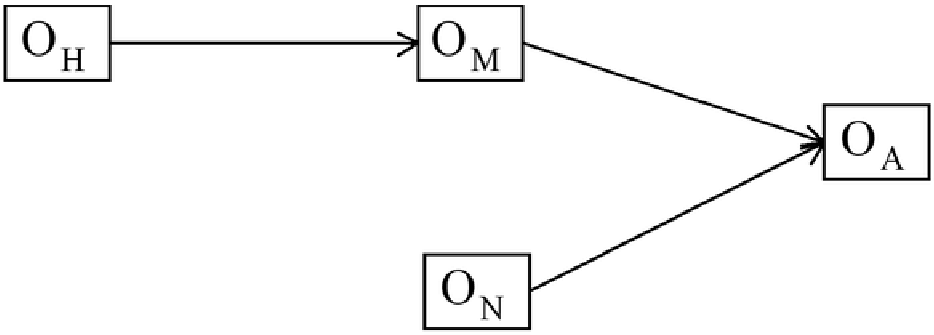
ent entity, is composed of parts and, in turn, is part of a vaster whole[5].

> Thus, the holon shows the tendency for both survival (being a viable system) and integration: "Every holon has the dual tendency to preserve and assert its individuality as a quasi-autonomous whole; and to function as an integrated part of a larger whole. This polarity between the Self-Assertive and Integrative tendencies is inherent in the concept of hierarchic order; a universal characteristic of life." (Koestler, 1967: 343).

Holons are arranged in *levels* and are interconnected in a hierarchical ordering that can be vertical, called a *holarchy*, or horizontal, defined as an *holonic network*. A network composed of more limited networks is a *reticular holarchy*.

In order to point out the correspondence between production organization and holon, I have (Mella 2005c) introduced the terms *org-on* (or more simply *orgon*) and *Orgonic Network*, to refer to an *org*anization-hol*on* and a production network.

Since the vertical and horizontal hierarchies, while different in structure, can be considered equivalent in their operational logic, I propose to use the term *antece-dent* to O_A (or "connected before" or "upstream" to lower-level holons) for the holons O_M and O_N, and, similarly, for the holons O_H relative to O_M (see the following diagram); obviously O_A is *subsequent* to (or "connected later", "downstream", or at a higher level) O_M and O_N.



[Model 1]

If we assume that the small network/holarchy is complete [Model 1], then the holons O_H and O_N are *base*, or *primal* holons. O_A is defined as a *terminal*, or *top holon*. O_M is an *intermediate* holon as well as the *head holon* of the branch [$O_H \rightarrow O_M$]. Obviously, not only the holons that are directly connected *before* but all the branches that are subtended to these are considered as occurring *earlier in the process*.

Koestler conceives of the holarchy that orders all the biological beings or the social organizations as an *Open Hierarchic System* (OHS), a type of *machine* that produces general progress in living things through the self-organization of the holons, as if there were a *ghost manipulating the machine (The Ghost in the Ma-chine).* In the OHS, all the holons of a given level include and coordinate, by means of their cognitive processes, the holons of the lower level, as well as transmit the necessary information to construct the superordinate holon, which transcends them, thereby producing different processes which *trigger* a dynamic evolutionary process.

> Thirty years later, Ken Wilber (1995)[6] tried to generalize the concept of holon, stating clearly: "*The world is not composed of atoms or symbols or cells or concepts. It is composed of holons.*" (Wilber, 2001: 21).

The Minimal Structure of Orgons

If "node A" represents a generic "*orgon* A", or even "O_A", we can represent an *orgon*, viewed as an autonomous and vital node, by the simple *standard module* in Fig. 1.

[5] For more on the concepts of holon, holarchy, holonic network and reticular holarchy, see Mella (2005a).

[6] *"It is not by accident, I believe, that the two founders of holon theory [Koestler and Wilber] have both come from outside of academia. One from the world of journalism and real politic [Koestler] and the other [Wilber] from the world of contemporary spirituality and the human potential movement."* (Edwards, 2003).

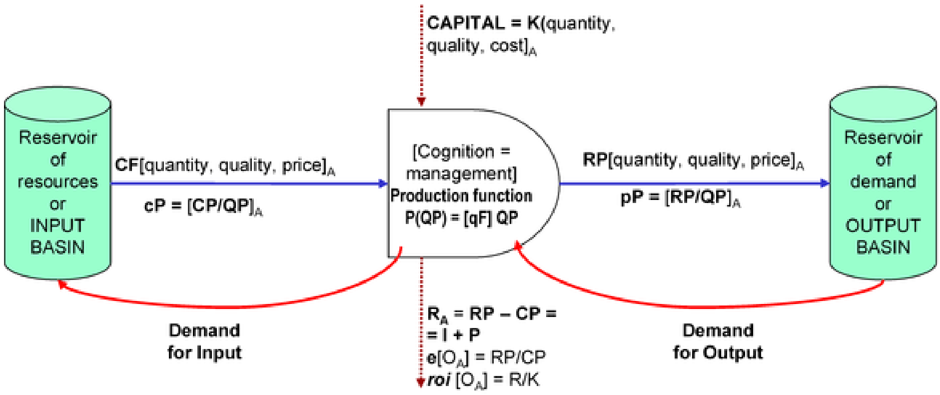


Fig. 1: Orgon (Standard Module)

As a production organization, the *orgon* transforms factor or input costs, CF, that form the cost of production, CP = Σ CF, into output values, or revenue, of the production RP, according to given levels of economic efficiency **e**[O_A] (naturally we must specify a reference period, T). R_A represents the operating results, while I and P indicate interest and profit, as a return on K.

The factors and the production are represented by vectors that show the quantity, quality and price for factor inputs and for each production output. cP and pP express, respectively, the average unit cost and the average unit price for the volumes Q in period T.

K indicates any capital necessary for the investment needed to start up and actively maintain the production processes; this capital can be both monetary, as in the modern economies, and non-monetary, in the form of advances regarding various types of factors.

More elaborate models of *orgons* are possible, but the simple one proposed above serves our purpose in showing all the main variables in the transformation processes of a production organization considered as an *orgon*.

In primitive economies, where self-production prevails, as well as in *non-business organizations*, the value of production is equal to its *utility* for the final consumer or user; thus pP = 0 and CP is always the responsibility of the entire organization.

In business organizations, pP represents a price.

For-profit organizations or companies seek the maximum differential between price and average unit cost of production; or equivalently, the maximum economic efficiency, or the maximum R_A.

Non-profit organizations, on the other hand, seek the minimum gap between pP and cP, which is equivalent to producing an R_A that tends to zero.

Capitalist companies are characterized by an input of Equity (E); in non-capitalist companies, like those composed of pure labour – cooperatives, professional offices – E tends to zero and K is mainly composed of Debt (D).

The capital, K, has a return of R_A = (RP-CP) = I + P, based on the level of financial efficiency expressed by *roi* = R_A/K and by *roe* = P/E.

Thus capitalist companies not only must tend in general to having a (pP – cP) = max, but also a *roe* ≥ *roe**, where *roe** is the return on E deemed just or desirable for keeping the capital invested and enabling the orgon to exist (for more details: Mella, 2005b).

Selfish Orgons. The First 5 Rules of Selfishness

In the diagram of the standard module in Fig. 1, I have generically included the *cognition processes*; that is, the processes involving decision making, planning and control that characterize all organizational activities and which represent the "engine" behind all the flows.

It is not necessary to look further into how the *orgon* produces these processes, but at the very least we must assume that management, following its tendency to strive for *self-affirmation* and *existence*, must necessarily follow the "*selfish rules*" indicated below.

The Operational Logic of the Orgon Viewed as an Autonomous Entity

Rule 1) – *Reservoir of demand*: the *orgon* seeks (identifies or creates) a reservoir of demand compatible with its output vector (volume, quality and price of the resulting production) and connects with this in order to transform production into output, under the condition that it maintains the minimum level of economic efficiency deemed to be appropriate.

Rule 2) – *Increase in size:* if it succeeds in connecting with a given reservoir of demand, the *orgon* tries to attain the maximum size; that is, it tries to satisfy all the possible demand by increasing its production processes in line with its input vector (volume, quality and price of the utilized factors) and the available capital.

Rule 3) – *Readjustment of its* output *vector:* if it cannot connect to a reservoir of demand – or if the reservoir to which it is connected is no longer compatible with the processes carried out – then the *orgon,* in order to continue to survive, must try to modify its output vector by adapting its internal processes, in accordance with the input vector and the available capital.

Rule 4) – *Productive efficiency*: in any event, the *orgon* must *always* try to improve its input vector in order to reduce the cost of production – by increasing productive efficiency – and/or to increase the quality of the factors. Fig. 1 clearly shows that the reduction in the unit cost of production implies, on the one hand, the continual search for higher technical returns from the factors and from labour productivity – in particular in order to reduce the unitary input – and, on the other, the search for new *resource reservoirs* in order to reduce unitary prices of factors and/or increase their quality.

Rule 5) – *Extinction*: if the management (cognition activity) cannot connect the *orgon* in a convenient manner to a reservoir of demand or modify its internal processes to the extent necessary to repeat its autopoietic processes (due to a lack of sufficient capital, technical reasons, or constraints of varying kinds), the *orgon* is extinguished.

RULES 2), 3) and 4) produce a *physiological improvement in performance* and are the logical consequences of Rule 1), which states the tendency toward autogenesis and the survival of any kind of *orgon*; in particular, Rule 4) lays out a basic principle: the *orgon* must try to achieve a continual adaptation of the cost of production independently of the need to connect with the reservoir of demand. This is true for any type of *orgon*, from those created for self-production to those that follow a *no-profit* logic, and even more so for the *profit-oriented* capitalist firms.

The Reservoir of Demand and the Resource Reservoir

With regard to what is stated in Rules 1) and 2), rather than simply refer to the traditional notion of *demand* for a given good I will propose the concept of *reser-voir of demand*, which better represents the idea that the potential consumers or users can also have a geographic reference rather than a merely quantitative one, and that the *orgons* may have a tendency to connect with the reservoir rather than simply satisfy a certain stock of requests.

The *reservoir of demand* can be represented by a trapezoid similar to the one in Fig. 2; the horizontal axis indicates the volume of potential demand (P_{max}) of the reservoir for the good produced by the *orgon* at a value between a maximum and a minimum, with the quality level (qlP) assumed constant.

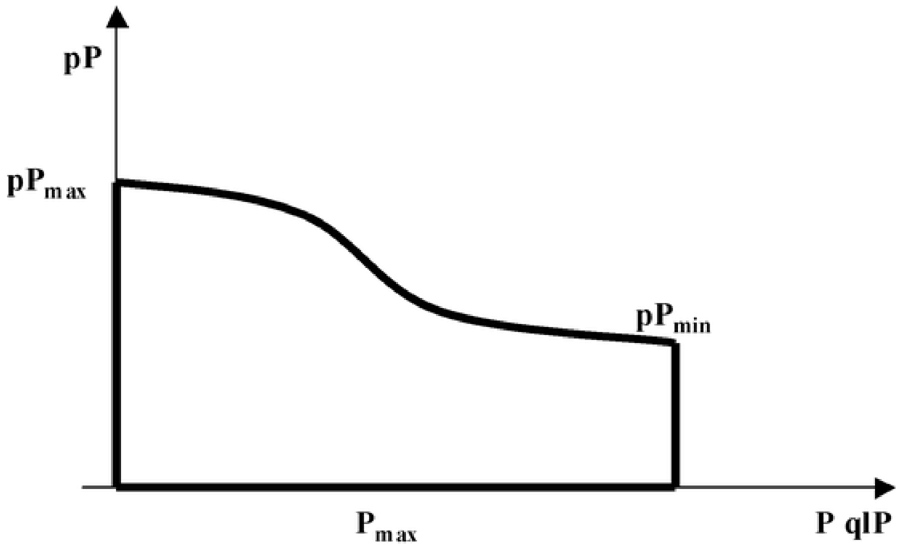


Fig. 2: Reservoir of Demand

Each *reservoir of demand* – let us assume reservoir β for product A – is thus characterized by the vector $\beta_A = [P_{max}, pP_{max}, pP_{min}, qlP]_A$. In order for the *orgon* O_A (I have used the same notation as that for the product) to be able to connect with β_A the quantity in output to discharge (sell) must not be greater than P_{max} and must be offered at a value between the admissible minimum and maximum for β_A. It follows that if the *orgon* identifies a reservoir of demand in which other orgons already discharge their output, for example O_M and O_N (Fig. 3), then it must sell its production at a value no greater than that of the orgons that have preceded it, obviously for the same level of quality and with any other discriminating conditions being equal. However, it is possible that the amount produced by O_A exceeds P_{max} of β_A. In this case the *orgon* can, and must connect with other reservoirs.

Price competition appears to be a necessary factor for Rules 1) and 2). Clearly it is possible to consider tendencies toward monopoly positions and multiple pricing policies, but I do not feel it appropriate to go further into these aspects, since they are well described in the literature.

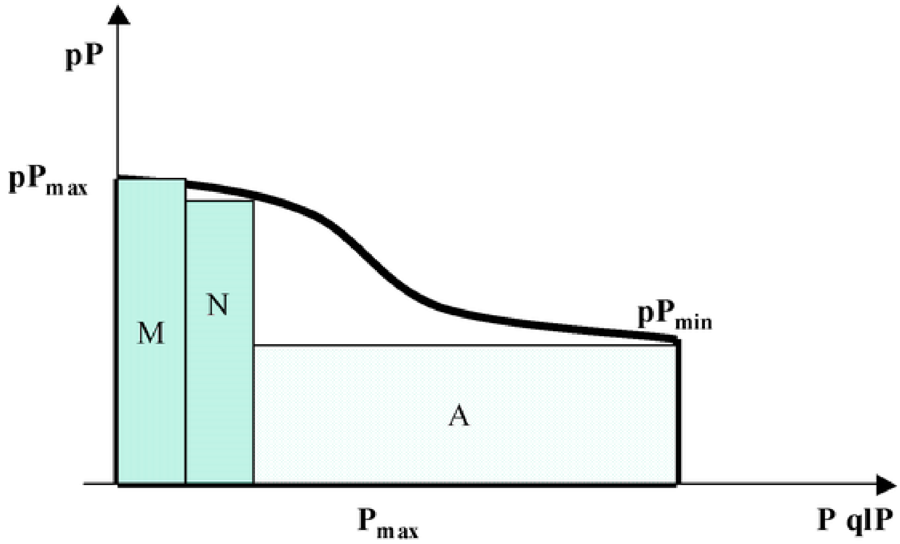


Fig. 3: Reservoir of Demand to which Orgons are connected

The idea of a reservoir of demand requires additional comment.

1. the reservoirs of demand do not correspond to reservoirs of needs or aspirations; the presence of needs must correspond to the ability of potential consumers (without considering any specific geographic reference) to acquire the goods of the *orgon* at a significant value or price;
2. a reservoir of demand does not necessarily concern final consumption products; for a component-producing *orgon*, the reservoir of demand is represented by other *orgons* that use those components for their products;
3. while in most cases the reservoirs of demand predate the *orgon* that wants to connect to them, in other cases it is the *orgon* itself that creates, or develops a reservoir of demand;
4. the concept of the connection of an *orgon* to a certain reservoir of demand does not also imply, except in particular cases, the physical location of the processes in the attracting areas; instead, the contrary is usually the case;
5. nor does this necessarily imply a direct connection, as occurs in the case of the "travelling salesmen", factory outlets or e-commerce; most of the time other *orgonsdownstream* arise to create the most appropriate distribution channel formed by commercial firms specialized in distribution.

We can consider the concept of *resource reservoir* as being symmetric to that of a *demand reservoir*, with the difference that we can consider a resource reservoir both as a *site* where resources are present – a stretch of sea rich in tuna or seals, or an area rich in oil, water, gold-bearing metals, etc. – and as a *set of orgons* earlier in the process that can supply, competitively or as an alternative, materials, components and structural factors.

A particular resource reservoir is represented by a *reservoir of labour*, which can be understood as an area with a certain quantity and quality of manpower availability at a given unit cost.

Referring by analogy to Fig. 1, we can characterize resource and labour reservoirs by a vector that indicates the availability, unit value and quality of the available resources.

Rules 3) and 4) require the *orgons* to identify the resource and labour reservoirs and to connect with those that promise an improvement in their input vector.

The Formation of Orgonic Networks

An *Orgonic Network* forms when several nodes connect to one another through their input and output according to the Rules of *selfish survival*.

In this sense the following analyses refer to *real* or *factual* productive networks and are not limited to *rational networks* that derive from voluntary agreements among firms to pool together resources and skills in order to form *holonic*, *virtual or extended enterprises* [7].

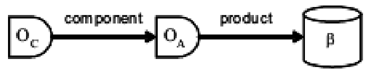
The holonic nature of the *orgon* means that, for all *orgons* which are not *primal* and *final holons*, each output of an *orgon* is at the same time an input of some other *orgon*.

Only the chain of connections – more generally, the *network* – takes on full significance as a system for the production of goods.

The history and direct observation of primitive economies clearly shows that the first *orgons* were *final holons*, spontaneously arising from *self-production* by seeking and transforming resources through the labour provided by the consumers themselves.

Rule 3) guarantees that even these elementary production organizations manifest the continual search for higher levels of efficiency through the progressive learning on the part of the organization.

This spontaneous genesis makes it likely that, external to O_A, a new *orgon*, O_C, will be created, capable of producing with greater efficiency, and thus at a lower cost, some components (materials or equipment) already internally produced by O_A. It can then be convenient for O_A to connect *serially* to O_C to obtain the factors it needs at a lower cost or at a higher quality [Model 2].



[Model 2]

O_A is connected to the demand reservoir β, but at the same time it represents the demand reservoir for O_C.

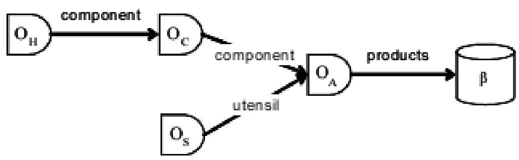
The outputs of O_C are inputs that O_A combines with other internal resources to obtain products.

The process can repeat itself serially or in parallel.

If a new *orgon*, O_H, should more efficiently produce several components needed by O_C, then the branch may lengthen (serially) [Model 3].

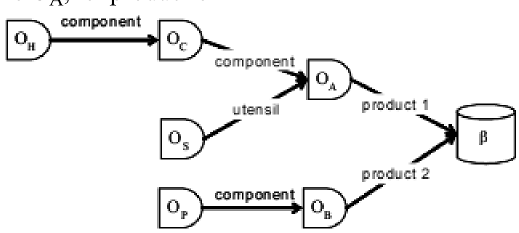
[Model 3]

If an *orgon*, O_S, produces a high-quality utensil, tool or machine useful in the production process of O_A, then we can have an enlargement in parallel of the *Orgonic Network*, with a ramification [Model 4].



[Model 4]

If O_A produces various products, P_1 and P_2 for example, it may be convenient to generate a specific autonomous *orgon*, O_B, parallel to O_A, for production P_2, thus creating two independent branches of the overall network [Model 5].



[Model 5]

O_A and O_B connect to the same demand reservoir, creating *collaboration*, or *com-pete* with each other for connection to β.

In fact, according to Rules 3) and 4) each producer *orgon* must always, when it has to evaluate the adequacy of its own input *vector* – that is, the quantity,

[7] Real productive networks have been the subject of a number of studies. For example, Michael Porter's work on the *Value Chain*, where it is easy to discern the vision of the productive network when he considers the inevitable relations between different Value Chains (Porter, 1985: 11-15; Powell, 1990); or the related studies on Supply Chain Management (Mentzer, 2000; Copacino, 1997). More recently, though also from the managerial point of view, we have the studies on inter- and intra-firm holonic networks, where the holonic network is viewed as a new form of productive organization, voluntarily formed to manage complex businesses under conditions of extreme environmental variability and managerial complexity (Grandori and Soda, 1995; Gulati, 1998; Goldman et al, 1995; Kinoshita et al, 1997).

unit value and quality of the productive factors – decide whether or not to *make* or *buy*.

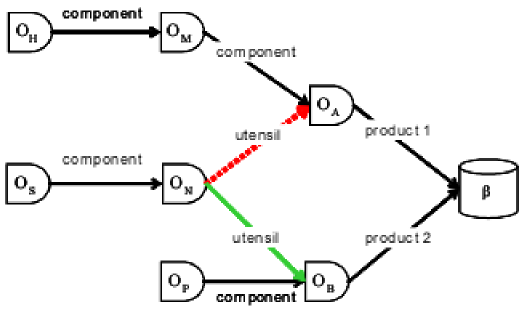
If the decision is to *buy*, then some specialized *orgon* must exist *upstream* and connect with one *downstream* to supply this with the materials, components and machines it has given up producing internally.

There is also the reverse case: according to Rule 2), each *orgon* must always evaluate the adequacy of its own output vector, and it may be convenient for it to modify its own connection when this brings an improvement in the volume and/or in the unit value of the products.

Let us suppose [Model 6] that O_N, previously connected (downstream) to O_A, disconnects from O_A to connect with O_B.

This decision can be considered as the shifting from O_A to O_B not only of O_N but also of the entire branch below it.

As a result [Model 6], the branches of the network can vary their connections both *upstream* and *downstream*.



[Model 6]

Obviously the connection of O_N to O_B causes problems in the production process of O_A; if O_A is not able to replace O_N, then it must modify its input or output vector; if this does not work, then O_A must disappear, with consequent difficulties for the entire antecedent branch formed by O_H and O_M.

The genesis of new orgons capable of increasing the efficiency of the processes carried out by other already-connected orgons enables the *orgonic network* to develop and extend itself in terms of size (parallel *orgons* that connect to the same demand reservoir) as well as depth (specialized *orgons* that connect serially).

It is also possible for *orgons* to merge in order to create a larger *orgon*.

Finally, let us consider the more complex case that occurs when, due to the specificity of its production, an *orgon* employed in the production processes of several *orgons* or networks is connected at the same time to a number of other *orgons downstream*. Such an *orgon* can be fully considered as a *hub* (Lorenzoni & Lipparini, 1999), in that it is the center of connection for many other *orgons* and branches that are variously situated in the network or that even make up different networks.

The more numerous are the hubs between different Orgonic Networks, the more these networks become integrated, to the point of becoming a single network.

Precisely due to the presence of *hubs*, the *Orgonic Network* can also become a complex behavioural network, since some *orgons* can have circular connections and generate dynamic or stable loops, even giving rise to evident paradoxes. This makes observation and modelling difficult; but this does not mean the *orgonic* network loses its features as a modular system.

The presence of *hubs* should not be considered a special case but rather the norm; according to Rule 2), each production *orgon* must try to connect to the largest possible number of other orgons *downstream*, since these represent its demand reservoir.

Five Additional Rules of Selfish Behaviour of Orgons as Nodes in Orgonic Networks

In the progressive expansion of orgonic networks, it is not difficult to perceive the economic dynamics of mankind.

The competition between orgons that produce the same good leads to improvement in the manufacturing process and thus to an increase in the quantity and quality of the final goods, as part of a natural *selection process* that – while displaying the clear differences due to the typical nature of orgons – presents principles similar to those of Darwinian evolution: *the network is an environment that produces selective tendencies in the orgons that spontaneously arise; requiring ever greater efficiency, the network favours random creative mutations in the production processes that raise the level of efficiency.*

It is even more evident today that there is a tendency for modern economies to move toward production specialization and the expansion in network connections (Dyer, 1997): *each Orgonic Network which is not too elementary will be com-posed of orgons specialized in the production of materials, components, services, energy and machinery orgons,* *all aiming at the production of final consumption goods.*

> From a "sufficient distance" the *Orgonic Network* thus appears as an entity with a dynamic structure, whose branches continually remodel their connections as a consequence of the cognitive activity that is rationally undertaken by the management of the *nodes*, which can be viewed as egotistical or opportunistic entities that tend to survive, according to Richard Dawkins' analysis: *"An entity… is said to be altruistic if it behaves in such a way as to increase another such entity's welfare at the expense of its own. Selfish behaviour has exactly the opposite effect. "Welfare" is defined as "chances of survival", even if the effect on actual life and death prospects is small […] It is important to realize that the above definitions of altruism and selfishness are behavioural, not subjective."* (Dawkins, 1976: 4, 5).

In order to survive, the *orgons* that make up the network must continually maintain or improve their performance by remodelling their connections according to a few additional simple *rules of selfishness* that can be summed up as follows (the numeration follows on from above).

Operational Logic of the Orgon Viewed as a Janus-faced Holon

Rule 6) – *Serial connection*: the *orgon* $O_A(t)$, at time (t) [8], appropriately connects to the *orgon* $O_M(t)$ to form, at (t+1), the chain $[O_M(t+1) \rightarrow O_A(t+1)]$, if at the same time[9]:

1. $e[O_A](t+1) \geq e[O_A](t)$,
2. $e[O_M(t+1) \rightarrow O_A(t+1)] \geq e[O_A](t)$,
3. $e[O_M](t+1)$ satisfactory for O_M.

Condition I. means that the *serial* connection must improve the economic efficiency of the *orgon earlier in the process*, O_A; at the same time condition II. requires[10] that the connection produce a chain $[O_M(t+1) \rightarrow O_A(t+1)]$ where overall economic efficiency is greater than O_A's would have been if the chain with O_M had not been created. Condition III. specifies that O_M, which was spontaneously created, must assess whether its own economic efficiency is at satisfactory levels. If O_A should see its economic performance worsen, then the connection would not be advantageous and it would probably be convenient for O_A to *make* and not to *buy*, or even to seek a connection with another *orgon* that can offer it more adequate inputs. If the conditions for economic efficiency were not satisfied but O_A had been created through a contribution of capital, then the connection could still be convenient for O_A if the decision to *buy* should reduce the amount of its own invested capital, thus allowing for an improvement in roi_A.

Rule 7) – *Parallel connection*: it is convenient for the *orgon* $O_A(t)$ to split in two *orgons* $O_P(t+1)$ and $O_Q(t+1)$ if:

1. $e[O_P](t+1) \geq e[O_A](t)$, and also:
2. $e[O_Q](t+1) \geq e[O_A](t)$, and subordinate to this:
3. $e[O_P(t+1) \parallel O_Q(t+1)] \geq e[O_A](t)$.

This rule states that the break up is advantageous above all if it improves the economic efficiency of both the *orgons* that result from the disjunction; if one of the two *orgons* should have an economic efficiency below that of $O_A(t)$, then the disjunction would still be advantageous if, on the whole, the two *orgons* that are placed parallel to each other, though considered as a unit, have an overall economic efficiency greater than that of the original *orgon*. This rule is followed when it is necessary to assess the advantages of a break up of firms and the formation of a corporate group; even if some units from the break up have a lower economic efficiency, the break up would still be convenient if the entire group maintains its economic efficiency unchanged or improves it, as if it were a single *or-gon*.

Rule 8) – *Connection and disconnection of branches*: the preceding rules can also be applied, with appropriate adaptations, to understanding the reconfigurations that follow from changes in the connections among branches in the *Orgonic Network*. Since each branch is connected or disconnected depending on whether or not its *head orgon* is connected or disconnected, the preceding rules apply in the sense that the operation must, in any event, improve both the performance of the *head orgon* that is reconnected and that of the *orgon* that enables the *successive* connection. According to Rule 6), the *orgon* $[\rightarrow O_M(t)]$, at time t, and thus the underlying chain, appropriately connects to the *orgon* $[O_A(t)\rightarrow]$,

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[8] The time reference "t" must be appropriately specified in the various networks.

[9] I have used the following symbols: "→" indicates a *serial* connection; "‖" indicates a *para l lel* connection; "→O" indicates an *orgon* which is a head holon of an *antecedent* branch; "O→" indicates an *orgon* which is a primal holon of a *successive* branch.

[10] "[…] *increased specialization within a production network cannot be achieved without a cost. When transactors make investments in specialization, transaction costs arise because of the fear of opportunism. A central premise of transaction cost theory is that transaction costs i n crease as transactors make greater asset-specific investments. The standard reasoning is that as asset spec i ficity increases, more complex governance structures (i.e., more complex contracts) are required to eliminate or attenuate costly bargaining over profits from specialized assets (O. E. Williamson, The Economic Institutions of Capitalism, Free Press, New York, 1985). Thus, transaction costs are presumed to increase with an increase in asset specificity"*(Dyer 1997: 535).

and thus to the successive chain, in order to form the new chain [$\rightarrow O_M(t+1) \rightarrow O_A(t+1) \rightarrow$] if at the same time:

1. $e[\rightarrow O_M](t+1) \geq \rightarrow e[O_M](t)$, and also:
2. $e[O_A](t+1)\rightarrow \geq e[O_A](t)\rightarrow$.

Rule 9) – *Incorporation and merger*: the preceding rules can also be inversely applied to justify the incorporation and merger among *orgons* or branches. The incorporation transforms the chain [$O_M(t+1) \rightarrow O_A(t+1)$] into the single *orgon* $O_{[M\&A]}(t+1)$. The merger transforms the parallel *orgons* [$O_P(t) \parallel O_Q(t)$] into the unitary *orgon* $O_{[P\&Q]}(t+1)$. Mergers and incorporations imply an increase in the economic efficiency of the new and larger *orgon* with respect to that of the incorporated or merged orgons, considered individually or together.

Rule 10) – *Competition and collaboration*: the preceding rules, with appropriate adaptations, are valid for the *competitive* and *collaborative* behaviour between *or-gons* and the *antecedent* subtended branches. In principle [$\rightarrow O_A$] and [$\rightarrow O_B$] *compete* if, having the same potential demand reservoir, under Rule 2) they want to increase their size in order to maintain or increase their economic efficiency; they *collaborate* if, based on rule 4), the collaboration improves their input vector by increasing productive efficiency. We can also imagine a collaboration between [$\rightarrow O_A$] and [$\rightarrow O_B$] to improve their output vector (which also appears as part of the input vector of *successive* orgons), but this collaboration would not be easily accepted by the *successive orgons*, since rule 4) states that they would not accept a worsening of their input vector.

The Holonic Nature of Production Networks

Following the holonic view, a *production network* thus has all the features that, in theoretical terms, distinguish every *holarchy* and have been systematized by Koestler in Appendix A) of his book (1967, ch. 2, § 4) and by Wilber in his *Twenty Tenets* (1995)[11], to which I will now refer, limiting myself to the more immediately applicable principles.

Wilber calls the Kosmos the general holarchy that makes the universe evolve toward self-awareness.

Both Koestler and Wilber postulate that holons form spontaneously and order themselves naturally in a holarchy or an holonic network. In Tenets 3 and 4 Wilber clearly states: "3. *Holons emerge*. - 4. *Holons emerge holarchically*.".

A form of holarchy that is particularly interesting comes from Shimizu's idea (1987), which theorizes the *Autonomic Cognitive Computer* (ACC), a concept that interprets in holonic terms the processes of gradual informational synthesis through parallel processing by cognitive entities.

In simplified terms, an ACC is made up of a parallel set of processors which are arranged on various levels. A certain number of processors from *level 1* process basic information, with autonomous significance (for example, colored pixels), which are transmitted to a *level 2* processor for processing, thus leading to a synthesis of information that is significant in itself (for example, a letter of the alphabet); a certain number of *level 2* processors process the information previously received from the lower-level processors and transmit this to a *level 3* processor, which synthesizes this into new information (for example, a sentence); the information thus obtained is sent to higher level processors for further synthesis, and so on, until a *final level* processor is reached that

[11] The Twenty Tenets are classified as follows (it is necessary to also consider the sub-numeration):
"1. Reality is not composed of things or processes, but of holons, which are wholes that are simultaneously parts.
2. Holons display four fundamental capacities:
a. self-preservation (agency)
b. self-adaptation (communion)
c. self-transcendence
d. self-dissolution.
3. Holons emerge.
4. Holons emerge holarchically.
5. Each holon transcends and includes its predecessors.
6. The lower sets the possibilities of the higher; the higher sets the probabilities of the lower.
7. The number of levels which a hierarchy comprises determines whether it is 'shallow' or 'deep;' and the number of holons on any given level we shall call its 'span'.
8. Each successive level of evolution produces greater depth and less span.
9. Destroy any type of holon, and you will destroy all of the holons above it and none of the holons below it.
10. Holarchies co-evolve. The micro is always within the macro (all agency is agency in communion).
11. The micro is in relational exchange with the macro at all levels of its depth.
12. Evolution has directionality:
a. increasing complexity
b. increasing differentiation/integration
c. increasing organization/structuration
d. increasing relative autonomy
e. increasing telos."

processes the information from the immediately preceding level to obtain final information with autonomous significance (for example, a sentence, a concept, a story). The number of levels and the number of processors at each level obviously depend on the type of information to be processed and on the operative program of the ACC.

Observed from a sufficient distance, a *production network*, defined by a certain basket of output goods, must not be considered only as a *global producer* composed of interconnected *orgons* that selfishly try to maximize their internal efficiency, but appears as an *Integrated Production System* that operates according to the logic of an *Autonomic Cognitive Computer*, carrying out progressive syntheses of labour and value (Fig. 4) through its *successive* connection with a *demand* reservoir for final goods, which satisfy needs and aspirations, and its *antecedent* connection with a *labour* reservoir.

> Following Wilber, I also propose calling this a Production Kosmos (Mella, 2006).

Shimizu's construction presents us with two interesting productive applications in organizations that carry out complex processes: the *Holonic Manufacturing Sys-tem* (HMS) and the *Bionic Manufacturing System* (BMS) [12].

An HMS (Adam et al., 2002; Kawamura, 1997) is conceived of as a holarchy of modular production units – groups of similar machines (modules or cells) that carry out basic processes, together with groups of organizational units engaged in supply or selling activities and units of coordination – that constitute a complex process that is broken up into different levels through the successive syntheses of basic processes, in order to obtain a final product.[13]

A BMS considers a final product as a *model* to be achieved (Okino, 1989; Tharumarajah et al., 1996), subdivided into autonomous segments to be obtained over various levels; it is not the processors which are considered as holons but rather the segments of the model to be achieved – called modelons (*mode*ls as ho*lons*) – which are carried out through the gradual accumulation of previous segments in order to obtain the *final modelon*.

If we adopt the holonic vision of production networks – whose logic is the development of multi-level processes that integrate in order to produce finished products (final processes or final *modelons*) – then we can immediately interpret these as ACCs, and in particular as HMSs or BMSs.

In this sense the Production Kosmos (Fig. 4) – as an *Integrated Production System* acting according to the logic of an HMS or a BMS – is capable of:

1. locally perceiving the needs and aspirations in the demand reservoirs,
2. determining the labour availability in the labour reservoirs,
3. carrying out successive syntheses through a parallel information processing that extends vertically and horizontally through the entire orgonic network,
4. finding the best dynamic pairing between the demand for goods as information input, on the one hand, and consumer satisfaction and labour employment as an operational output, on the other.

As Wilber explicitly notes (Tenets 9 to 11), the bi-directional influence of the holons, the interrelation between *micro* and *macro*, between *all* and *parts*, produces the basic *property of continual improvement* that distinguishes each production network.

This characteristic is so evident that there is no need for further consideration; nevertheless – leaving a more in-depth treatment for the next section – I would like to observe how the technological, technical and scientific progress of mankind is the consequence of the *triggering effect* of the holarchy – the process of rapid diffusion of innovations along the orgonic chain – in cases where an innovation improves the input vector of *successive orgons* and the output vector of *antecedent orgons*, expanding in both directions of the branches in question, often with a *reinforcing loop*.

The cognitive capacity of the *orgons* thus becomes fundamental; the *orgons* must also continually develop *creativity* and undertake research and development. Important challenges today involve new materials, nanotechnologies, and alternative energy sources to oil, as well as progress in the fields of biology and genetics.

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[12] For more detail see Mella, 2005a.

[13] A consortium of firms has been created for the study and development of the HMS; details about this consortium can be found on the HMS Consortium Web Site (at: http://hms.ifw.uni-hannover.de). The consortium defines an HMS as: *"A Network of Excellence on Intelligent Manufacturing Systems (IMS NoE) defines a holarchy as a system of holons of various levels that, while autonomous, cooperate to achieve some objectives, even placing limits on their operational autonomy."*.

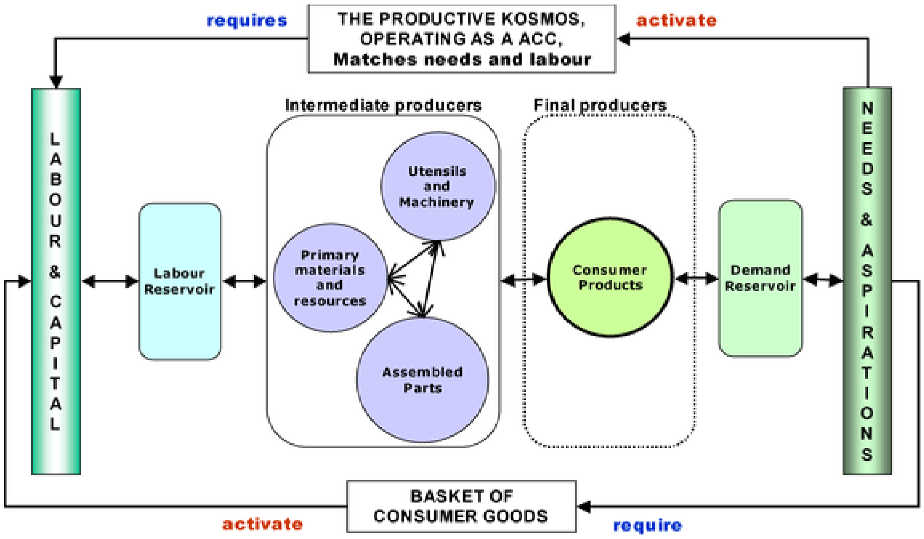

Fig. 4: The Productive Network Constituting the Production Kosmos, Source: Adapted from Mella, 2006

Each orgonic network, thanks to its *hubs*, with their *feedback loops*, enhances *self-organization* as well as a rapid and widespread *performance improvement* for *or-gons* at every level.

The changes that improve the holarchy are egotistically preserved and diffused, and they can also generate new branches; disadvantageous ones are eliminated or mitigated. In the contrary case, the branch of the holarchy in which they occur is eliminated.

Three "Laws of Production Networks"

The *cognitive* and *creative* processes that characterize orgons do not allow us to predict the actual evolution of production networks; nevertheless, if we assume that *orgons* – consciously or not – follow the selfish Rules of behaviour 1) to 10) above, then we can deduce several typical trends, or behavioural schema – perfectly in line with the laws of holarchies – which I have called *laws of networks*, in order to highlight their apparent inevitability and cogency.

First Law: Orgonic Networks Tend to Expand

This law states that networks tend to increase in depth (vertical expansion), in width (horizontal expansion), and in their ramification. The law is supported by the characteristics of the *orgons* – spontaneous genesis and tendency to connect – as much as by the basic RULES of behaviour: if at any level of the network the *or-gons* try to enlarge their demand reservoir, improve their own input vector and increase in size, then we can always assume an increase in connections both along the boundaries of the network as well as internally, with the formation of increasingly more connected branches at ever greater levels of productive specialization.

The expansion occurs in three ways:

1. the network *expands its own boundaries* and new links are added to the borders to enable connection to new demand reservoirs for final products;
2. the network *adds more levels*; productive specialization, creativity and research lead to the spontaneous creation of *orgons* whose outputs are the specialized inputs of *successive* orgons; the orgonic chain becomes longer as well as wider. Today, in modern economies, it is easy to recognize that even the smallest components of a product are acquired externally from ever new and specialized *orgons*;
3. *two or more networks merge*; many networks arise independently to produce distinct products aimed at differentiated demand reservoirs. When several final products are complementary and are obtained in an integrated manner from a single orgon; when an autonomous product becomes a component of a final product; or when several intermediate processes are centered on antecedent hubs, the networks can also be considered merged.

We can outline a dynamic trend by considering the gradual expansion of the networks to take on increasingly larger dimensions:

1. LOCAL MICRO NETWORKS that characterize production in families, in villages, in cities, and in small regions, since the *demand reservoir* and that for *resources* and *labour* are located in a single limited territory. Knowledge develops through observation and imitation.

2. LOCAL MACRO NETWORKS that extend to increasingly larger territories: the countryside, provinces, regions, which, in any case, are characterized by production from local resources of goods and services destined for local consumption. Physical markets arise as places for the concentration and supply of output of products to sell; production knowledge is accumulated and passed on orally as well as through apprenticeships.
3. BIPOLAR MICRO NETWORKS that expand beyond the original territory in order to seek resources in other territories: *consumption* and *production* refer to a given *demand reservoir* located in a territory, but the resources are imported by *resource reservoirs* situated in others. According to the RULE for the improvement of economic efficiency, *production* becomes increasingly separated from *consumption* and joined to *resources*. *Production* and *resources* are located in a territory; consumption remains in another territory.
4. MULTIPOLAR NETWORKS, where resources, production and consumption are in separate areas, which, however, are interconnected through a dense network of exchanges carried out by other connector *orgons*. Not only are the *production* processes separated from *consumption* and *resources*, but *production* itself is segmented into thousands, millions of specialized productive processes located in very diverse areas. Multipolar networks become *a-spatial* and *a-temporal*.
5. INTERNATIONAL AND GLOBAL NETWORKS that derive from the multipolar networks when the latter extend their links to different countries. Today these networks dominate the international economy and expand thanks to the *con-nection* process of the national networks.

Second Law: Orgonic Networks Tend to Increase the Quality of their Performance through a Non-linear Cumulative Process

This law derives from the tendency of *orgons* to improve their input and output vectors and from the general property of holonic networks to spread their individual improvements.

The network improves its performance even if a casual improvement occurs in the performance of only a single *orgon*; but Rule 3) leads all *orgons*, in order to improve their input and output vectors, to produce innovations and to make discoveries and inventions that, if useful, spread simultaneously to all branches of the network, though with differing intensity, thereby involving the most distant and unforeseen ramifications.

This law supports an important *corollary*: the improvement in the quality of the network's performance is *permanent* and *cumulative*, thus *path-dependent* and *non-linear*, and in general *exponential*, producing an increasing return (in the sense of Arthur, 1994) regarding the network's economic efficiency.

In fact, as the improvements are transmitted to the network branches they not only spread but, until substituted by other improvements, are *preserved in time and space*, producing a cumulative effect that leads to an acceleration in the progress of each sector. Each improvement derives from a creative or rational action based on a previous improvement. If this were not the case then we could not explain the monumental and accelerated progress in electronics, telecommunications, transport, war production, and biology.

There is no "natural" turning back from progress!

And even if Stanley Kubrick's prophecy in the prologue *The Dawn of Man*, which opened his famous film "*2001: A Space Odyssey*" (GB, 1968) – with the splendid fade-out "bone-spaceship", which embraces the entire parabola of mankind – should come true; and even if the following words from Albert Einstein prove true: "*I don't know which arms will be used to fight World War III, but the fourth will be fought with a club.*"; there is no doubt that, having returned to Kubrik's bone and Einstein's club, after a suitable period of evolution we would attain a state of progress similar to the present one.

Third Law: Orgonic Networks are Resilient Networks that Tend to Continue on as if they were Living Entities; but they Contain an Inertia that always Delays their Adjustment to Changes in Demand

This law is explained by the natural tendency of the *orgons,* as well as the branches that spread out from them in a *forward* direction, to survive through the adaptation of the input and output vectors, when this is necessary for their autonomy.

Thus, when an *orgon* is destroyed the entire successive branch – which remains functional for some time – tries, in order to avoid extinction, to adapt by connecting to another *orgon*; if this is not possible, the pressure to restore the antecedent branch is so intense as to make it likely that other *orgons* will be spontaneously created to substitute the destroyed one. If this spontaneous genesis does not occur, and if the *successive orgons* are also not able to internally produce the missing inputs, then it is likely that the input vector will be modified so as to substitute various components for the latter. If this, too, is not possible, then the network will be broken.

As a result, production networks are *resilient*; they can withstand damaging events and a lack of resources. They replace nodes with other ones and repair the damage (natural calamities cause damage that is immediately repaired to restore the functionality of the destroyed links) [14]; they replace parts that do not improve (inefficient *orgons* that cease their activities and others that are created and produce patents, inventions and know-how); they are strengthened through the creation of political and legislative superstructures that favor their existence, improvement and expansion. In other words, they try to survive [15].

> It is precisely this feature of networks to preserve and remodel themselves in order to survive, restoring any gaps in their links and replacing old links with new ones, that allows us to conceive of them as *Complex Adaptive Systems* in the economic environment (Gell-Mann, 1995/96; Holland, 1995).

Brian Arthur (Arthur et al., 1997) has identified *six* properties that characterize all economies: (1) widespread interactions, (2) the absence of a centralized and global control, (3) transversal hierarchical organization, (4) continual adaptation of the agents, (5) continual innovation and (6) dynamic progress far from the equilibrium.

> More than any other structure, *orgonic networks* present these properties since *orgons*, viewed as autonomous entities in terms of their cognitive function, represent a collectivity of agents that interact and exchange information with their environment in order to maintain over time their internal processes through adaptation, self-preservation, evolution and cognition, making individual and collective decisions as part of a network of micro behaviours (Allen 1997).

> We must also point out that networks also are able to survive because the *orgons* they are made up of not only produce the OUTPUT that is used for *successive orgons* but, through their production activity, maintain and continually regenerate the network of reticular relations that account for their existence. Orgonic Networks, viewed as structures that are self-contained within their self-organization – even if continually adaptive – can thus be conceived of as *autopoietic and living systems*, since they fall entirely within the basic definition proposed by Herberto Maturana and Francisco Varela (1980).

Conclusion: Networks need us

Productive networks are found wherever man acts to satisfy his needs and aspirations (Thorelli, 1986). They represent the system for the efficient transformation and accumulation of resources in order to obtain goods and services to satisfy a demand for final consumption (Powell, 1990). As a result they concern consumption as well as production; *there is no consumption without production*; but, conversely, *there is no production without consumption*.

> Paraphrasing Koestler (1967), it seems there truly is *a ghost in the production machine* whose *invisible hand* – acting on the individual nodes of the productive network – determines increasing levels of productivity and quality; increases the quality and quantity of satisfied needs and aspirations; and reduces the burden of labour, thereby producing ever higher levels of progress in the entire production Kosmos. This is clearly observable in all advanced economies, where, as Adam Smith observed, the dynamic trends are caused by the production organizations which, due to their constant self-interested effort to gain the most advantages for themselves, behave as if they were directed by an "invisible hand" in order to reach increasingly higher *standards: "It is not from the benevolence of the butcher, the brewer, or the baker, that we can expect our dinner, but from their regard to their own interest. By directing that industry in such a manner as its produce may be of the greatest value, he intends only his own gain, and he is in this, as in many other cases, led by an invisible hand to promote an end which was no part of his intention. Nor is it always the worse for the society that it was not part of it."* (Smith, 1776: 456).

There is nothing metaphysical about this evolution: it is produced and governed by *selfish orgons* and by the laws of *orgonic networks*.

Thus, I propose the following general conclusion: the *function* of each *Integrated Production System* is to maximize the efficiency of the process that transforms labour into the basket of final goods; the *functionality* of this system is to allow consumers to maximize the satisfaction of their needs and aspirations.

[14] Resiliency is the capacity of a material to resist deformation or dynamic breakage, or the capacity of yarn or fabric to return to its original form after deformation.

[15] *" We define survivability as the capability of a system to fulfill its mission, in a timely manner, in the presence of attacks, failures, or accidents. We use the term system in the broadest possible sense, including networks and large-scale systems of systems."* (Ellison et al., 1997).

That is why we need production networks.

But it is also clear that the *networks need us*, our consumption, our labour and, above all, our *faith in the future*, which leads us to consume more, to shorten the utilization time of goods, to replace goods that are still efficient with newer ones, and to invest our lives in education and our capital in new productive links.

Consumption and *production are inseparable*, but one thing is certain: the networks can guide consumption, but only *faith in the future* can feed the necessary flow of consumption to maintain and expand the production networks.

Some final thoughts. Will networks always expand? Will they cover the entire globe? Will they employ robots?

In principle, we can assume from the Three Laws of Networks that the answer is inevitably: "yes".

This "yes" contains the true significance of economic globalization, which has brought forth apocalyptic visions.

> We must be optimistic and trust in man's capacity to self-regulate his activities, since the *rules of selfish behaviour* of the Production Orgonic Networks indicate there is no other way: "The development of a people does not derive primarily from money, nor from material aid or technology, but rather from the formation of consciousness, from the advancement in intelligence and morals. It is man who is the main protagonist in development, not money or technology." (John Paul II, Redemptoris Missio. N. 58).

References

Adam E., Mandiau R. and Kolski C. 2002. *Une Methode de modelisation et de conception d'organizations Multi-Agents holoniques*, Hermes, Paris.

Allen P. M. 1997. "Cities & Regions As Self-Organizing Systems: Model of Complexity", *Enviro n mental Problems & Social Dynamics Series,* Vol 1, Gordon & Breach Science Pub., London.

Arthur B. W. 1994. *Increasing Returns and Path Dependence in the Eco n omy*, University of Michigan Press, Ann Arbor.

Arthur W. B., Durlauf S. N. and Lane D. 1997. "Introduction" In: *The eco n omy as an evolving complex system*. II. Reading (MA): Addison-Wesley: p. 1–14.

Barabási A. 2002. *Linked: The New Science of Networks*, Perseus, Cambridge, MA.

Beer S. 1979. *The Heart of Enterprise*. Wiley, London and New York.

Beer S. 1981. *Brain of the Firm* (2nd edition). Wiley, London and New York (first edition, 1972).

Brown H. 1954. *The challenge of man's future*, Viking Press, New York: p. 3.

Cipolla C. M. 1962, *The Economic History of World Population*, Penguin, Harmondsworth, Middlesex, UK.

Copacino W. C. 1997. *Supply Chain Management,* CRC Press, London.

Dawkins R. 1976. *The selfish g e ne*, Oxford University Press.

Dyer J. H. 1997. "Effective Interfirm Collaboration: how firms minimize transaction costs and maximise transaction value", in *Strategic Management Jou r nal*, Vol 18: 7, John Wiley & Sons.

Edwards M. 2003. *A Brief History of Holons*, at:

http://www.integralworld.net/index.html?edwards13.html.

Ellison B., Fisher D. A., Linger R. C., Lipson H. F., Longstaff T. and Mead N. R. 1997. "Survivable Network Systems: An Emerging Discipline"*, Survivable Network Technology Team CERT* ® (revised May 1999) at:

http://www.sei.cmu.edu/publications/documents/97.reports/97tr013/97tr013title.html.

Espejo R. and Harnden R. 1989. *The Viable System Model*, John Wiley & Sons, New York.

Gell-Mann M. 1995/96, *Complexity*, Vol. 1, no.5. at:

http://www.santafe.edu/sfi/People/mgm/complexity.html.

Goldman S. L., Nagel R. N. and Preiss K. 1995. *Agile Competitors and Vi r tual Organizations*, Van Nostrand Reinhold, New York.

Grandori A. and Soda G. 1995. "Inter-firm networks: Antecedents, mechanisms, and forms", *Organiz a tion Studies* 16/2: p. 183-214.

Gulati R. 1998. "Alliances and networks", *Strategic Management Jou r nal*, 19:293-317.

Hakansson H. 1982. "International Marketing and Purchasing of Industrial Goods", in IMP *Group, Inte r national Marketing*, New York. Wiley and Sons.

Hakansson H. and Snehota I. 1994. *Developing Relationships in Business Ne t works,* Routledge, London and New York, 1994.

Hakansson H. and Snehota I. 1999. *No business is an island: the network co n cept of business strategy*, in Pels, J. 1999. Exchange relationships in consumer markets?, in *European Journal of Ma r keting*, 33, n. 1/2.

Holland J. H. 1995. *Hidden Order: How Adaptation Builds Complexity*, Perseus Books, Cambridge, Massachusetts.

Kawamura K. 1997. "Holonic Manufacturing Systems: An Overview and Key Technical Issues", *4th IFAC Workshop on Intelligent Manufacturing Sy s tems: IMS'97*, Seoul, Korea, p. 33-36.

Kinoshita K., Takine T., Murakami K., and Terada H. 1997. *Holonic Ne t work : A New Network Architecture for Personalized Multimedia, Communic a tions Based on Autonomous Routing*, IEICE Transactions on Communications, Vol. E80-B, No.2, p. 282-288.

Koestler A. 1967. *The Ghost in the Machine*, Arkana, London.

Lorenzoni G., & Lipparini A. 1999. "The Leveraging of Interfirm Relationships as a Distinctive Organizational Capability: A Longitudinal Study". *Strategic Management Journal*, (20)4: p. 317-338.

Maturana H., & Varela F. 1980. "Autopoiesis and Cognition: The Realization of the Living". *Boston St u dies. Philosophy of Science*, (42).

Mella P. 1997. *From systems to system thinking* [Dai sistemi al pensiero sistemico], FrancoAngeli Ed., Milan [Italian edition].

Mella P. 2005a. *The holonic revolution* [La rivoluzione olonica. Oloni, olarchie e reti oloniche. Il fantasma del Kosmos produttivo], FrancoAngeli Ed., Milan [Italian edition].

Mella P. 2005b. "Performance Indicators in Business Value-Creating Organizations", *Economia Aziendale 2000 web*, 2/2005, at: www.ea2000.it: pp. 25-52.

Mella P. 2005c. "Organizations and Orgonizations. The Holonic View of Organizations", *International Journal of Knowledge, Culture and Change Manag e ment*, Common Ground,Volume 5.

Mella P. 2006. "The Production Kosmos", *Economia Aziendale 2000 web*, 1/2006, at: www.ea2000.it: pp. 87-99.

Mentzer J. T. 2000. *Supply Chain Management*, Sage Publications, Thousand Oaks, CA.

Okino N. 1989. "Bionical manufacturing systems", Sata T. (ed.), *Organiz a tion of Engineering* Knowledge for Product Modelling in Computer Integrated Manufacture, Elsevier, Netherlands.

Porter M. E. 1985. *Competitive Advantage*, The Free Press, New York.

Powell W. W. 1990. "Neither market nor hierarchy: network forms of organization", *Research in Organiz a tional Behavior*, Vol. 12, JAI Press Inc.

Senge P. M. 1990. *The Fifth Discipline: The Art & Practice of The Learning Organization*, Currency Doubleday, New York.

Shimizu H. 1987. *A General Approach to Complex Systems, Bioholonics' in Lasers and Synerge t ics,* by R. Graham & A. Wunderlin (eds.), Springer-Verlag, Berlin.

Snow C. C., Miles R. E. and Coleman H. J. jr. 1992. **"**Managing 21st Century Network Organizations", *Organizational Dynamics*, Elsevier, Winter 1992.

Tharumarajah A., Wells A. J. and Nemes L. 1996. "Comparison of the bionic, fractal and holonic manufacturing system concept", *International Journal of Computer Integrated Manufactu r ing*, Taylor & Francis, vol. 9, n 3.

Thorelli H. B. 1986. "Networks: between markets and hierarchies". *Strategic Management Journal*, Wiley & Sons, (7): 37-51.

Wilber K. 1995. *Sex, Ecology, Spirituality: The Spirit of Evolution*, Shambhala Publications, Boston & London (2nd edition, 2000).

Wilber K. 2001. *A Brief History of Everything*, Shambhala, Boston & London, 2nd edition.

Wilson D. T. and Möller K. 1995. *Business Marketing: An Interaction and Ne t work Perspective*, Kluwer Academic Publishers, Boston.

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Born in Pavia in 1946, I graduated in March 1969 with a first-class degree in Industrial Administration. In 1985 I was awarded a chair as a full professor and lecturer in Business Economics and Administration at the Faculty of Economics at Pavia University. In 1986 I was elected Head of the Department of Business Research at the University of Pavia. From 1987-88 to 1992-93 I was Dean of the Economics Faculty at the University of Pavia. I have been the scientific Director of the Masters in Accounting, Budget and Financial Control in profit organizations (set up by the University of Pavia) since its inception in 1990. In 1997 I became Co-ordinator of the Doctorate in Business Research at the University of Pavia. In 2000 I created the scientific web site www.ea2000.it. My interests also involve the fields of Complex and Holonic Systems and of Networks. In 1997 I formulated the Combinatory System Theory, described at the web site: www.ea2000.it/cst.

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