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The Production Kosmos[1]

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It does indeed seem there is a Ghost in the "Production" Machine, whose invisible hand produces growing levels of productivity and quality, increases the quality and quantity of satisfied needs and aspirations and reduces the burden of work, thus producing increasingly higher levels of progress in the entire Kosmos.

1 - The Production Kosmos as global org*o*nization

Business Economics deals with the observation of enterprises as *individual* organizations that are interconnected to the environment through a network of exchanges; it states that the entire production activity is carried out by various types of organizations-enterprises – business or non-business, profit or non-profit – that, by making autonomous decisions, transform factors into products through programmed processes for the purpose of satisfying the needs and aspirations of men (Mella, 2004).

The holonic view of the production system observes each production firm as an holonic organization with consciousness (conscious management, organization and information-gathering) and its own operational structure in order to achieve a given production that is useful for other firms (business to business) or for final consumption (business to consumer).

The *integrated production system* can be viewed as a vast *orgonic network* (D'Amours et al., 1999) where the (local) *nodes* are represented by the various orgonizations – that is organizations

[1] Translated from P. Mella, *La rivoluzione olonica*, Franco Angeli, Milano, 2005.

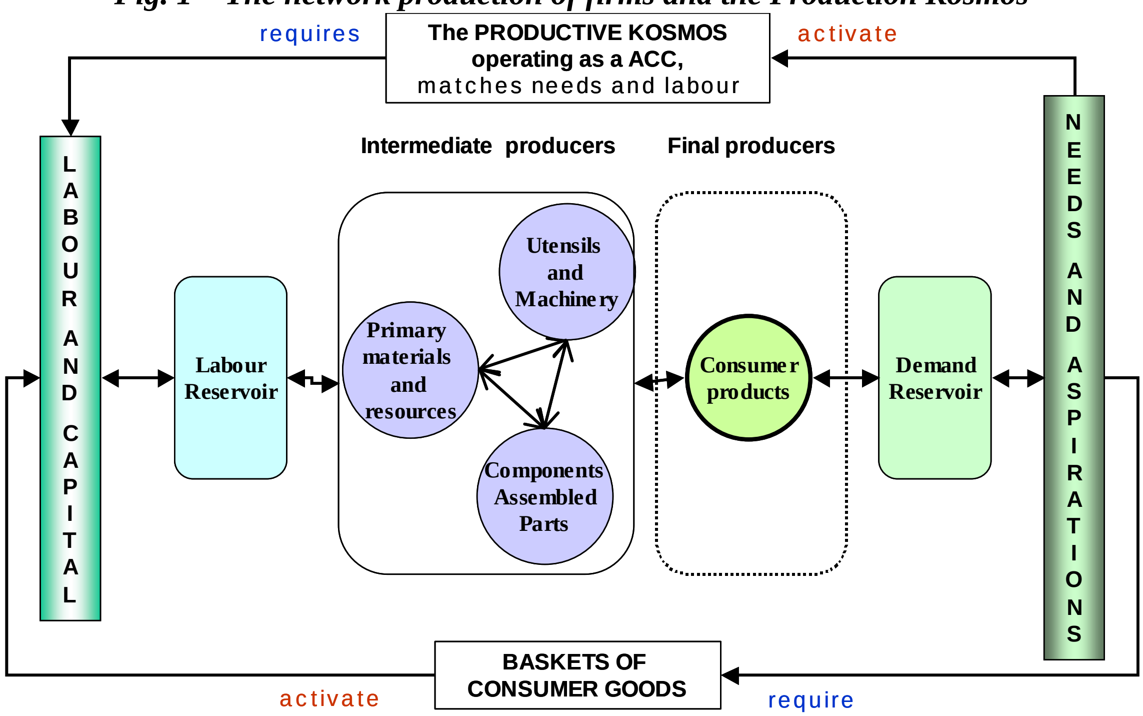
as orgons (Mella, 2006) – or by holonic production organizations[2] that are connected to form an *oriented, multi-level production network* (Mesarovic, 1970), which is connected and unitary and called a *Production Kosmos* – PK – (fig. 1), which is included in the vaster *Kosmos*. "*The world is not composed of atoms or symbols or cells or concepts. It is composed of holons.*" (Wilber, 2001: 21) [3].

Two aspects are worth considering:

a. at the *local level*, what function and functionality do the individual *holonic organizations* have as *orgons* of the *orgonic network*,

b. at the *global level*, what mechanisms does the progress dynamics produce in the Production Kosmos

Fig. 1 – The network production of firms and the Production Kosmos



[2] "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 aspects of this network have mainly been studied. Firstly, the characteristics of the different organizations 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 services". Hakansson H., (1982), [11-12].

[3] In what follows the *Production Kosmos* indicates the multi-level production (and thus holonic) network *formed* by production organizations or *orgonizations* arranged as nodes.

2 - PK as Holonic Manufacturing System

At the *local* level, in the Production Kosmos the individual viable (Beer, 1979; 1981), production firms, in so far as they are holonic organizations, function as production modules, nodes in the network, which are necessary to obtain goods and services that, together with the goods and services produced by the other holonic organizations (materials, components, parts, machines, operational structures), carry out a functional integration that produces the "basket of goods" necessary to satisfy the needs and aspirations of man [4].

The firms that are up the line supply the factors of production, which are destined for those down the line. It is clear that unless we consider the network of input and output relations among the firms in the network, the observation of the economic arrangement of the *individual production firm* does not acquire its full significance (Thorelli, 1986). [5]

At the *global level* the *Production Kosmos* thus appears as the largest production orgonic network and can be viewed as:

a. a Koestler's Open Hierarchic System (OHS) (Koestler, 1967), whose function is to carry out, *by means of continuous local adjustments* – involving individual nodes and network paths – the optimal matching of available labor and capital, on the one hand, to the needs and aspirations of mankind on the other [6];

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4 "The distribution of the goods and resources of the transnational society can be conveniently represented as an *integrated network*. This term reveals the important flow of components, products, resources, persons and information that must be managed in this type of organization. In addition to the rationalization of the physical resources, the firm must integrate the tasks and the prospects. What truly distinguishes the transnational society are the many and complex communications links, the operational interdependencies, and the existence of formal and informal systems. ...From quite different structural bases [we are] moving toward a common configuration, where increasingly more specialized entities are globally linked in an integrated network of activities that allowed them to obtain multidimensional strategic objectives of efficiency, reactivity and innovation. The strength of this configuration comes from its basic features: distribution, specialization and interdependence": (Translation from Bartlett & Goshal, 1990: 75).

5 "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 resources 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].

6 "Change in the substance of any of the relationships affects the overall structure. Since a change in any relationship affects the position of those involved, the whole set of interrelated relationships is subject to change and that has consequences for the outcome of a relationship for those involved. A dyad, a relationship, is a source as well as a recipient of change in the network. […] The essence of the network function of business relationships is that as they arise they form a structure of actor bonds, activity links and resource ties where third parties are integrated. How the relationships develop and unfold is important for the features of the actors' organization, activity pattern and resource constellation and thus for the properties of the networks structure, such as its stability. The emergent structure has in any given moment a limiting effect on its actors at the same time as it provides the base for future development.": Hakansson & Snehota (1994), [41].

b. a vast Autonomic Cognitive Computer (ACC) Holonic Manufacturing System (HMS) or a vast Bionic Manufacturing System (BMS) – whose blocks are production organizations-enterprises – that produces a cyclical process to transform labor provided by the base holons, the workers, into the production necessary to satisfy the needs and aspirations of mankind[7] (fig. 1).

A form of holarchy that is particularly interesting, which theorizes The concept of ACC comes from Shimizu's idea (1987), 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 transmits 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 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 depends on the type of information to be processed and on the operative program of the ACC.

In general the production network acts like Shimizu's ACC, since, through the production units, it carries out progressive syntheses of the factors necessary to obtain the finished products.

An HMS (Adam et al., 2002; Kawamura, 1997) is conceived as a particular ACC composed 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 together with units of coordination – that compose a complex process that is broken up into different levels through the successive syntheses of basic processes, in order to obtain a final product.

A BMS (Okino, 1989; Tharumarajah et al., 1996) considers a final product as a model to achieve, subdivided into autonomous segments to be obtained over various levels; it is not the

[7] If we ignore the holonic arrangement of organizations and only consider the local interactions, then the Production Kosmos could also be viewed as a Complex Adaptive System along the lines of Axelrod (1997), where the individual firms interact by adapting reciprocally in order to remain vital, thereby maintaining the global system

processors which are considered as holons but rather the segments of the model to be achieved – called modelons (models as holons) –, 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 – then we can immediately interpret these as ACCs, and in particular as HMSs or BMSs.

The *Production Kosmos* tends to continually improve in terms of the efficiency of production and exchange, which is revealed in the gradual increase in the *productivity* of the processes and in the *quality* of production (Heylighen & Bernheim, 2000).

This leads, on the one hand, to the gradual reduction in the labor used in production and, on the other, to an increase, over time and space, in the quantity and the quality of the needs and aspirations that are satisfied; in this way does it show its *functionality* for all of mankind.

3 - continuation: PK as an Autonomic Cognitive Computer

It is only left to clarify the functioning operational mechanisms that make possible such *functionality* at the local level (for the individual orgonization) and at the global level (for the production network).

At the *local* level we need only mention that the individual production firms can remain vital only if they produce *value* that represents an adequate return on the capital invested in the production processes.

Since the *value* depends on the quality of the production and on its cost it follows that, in order to carry out for a long time their function as nodes of the holonic network, the holonic organizations must continually "innovate" to gradually improve their *productivity* (increase in their production efficiency and a gradual reduction in the cost of production) and their *quality*.[8]

So now we see the *function* of the Production Kosmos: just like a OHS or an HMS it spreads

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vital, even if the idea of progress is not explicitly considered in the CAS (Goldspink, 2000; Holland, 1995; Mella, 2002; Mitleton & Kelly, 1997).

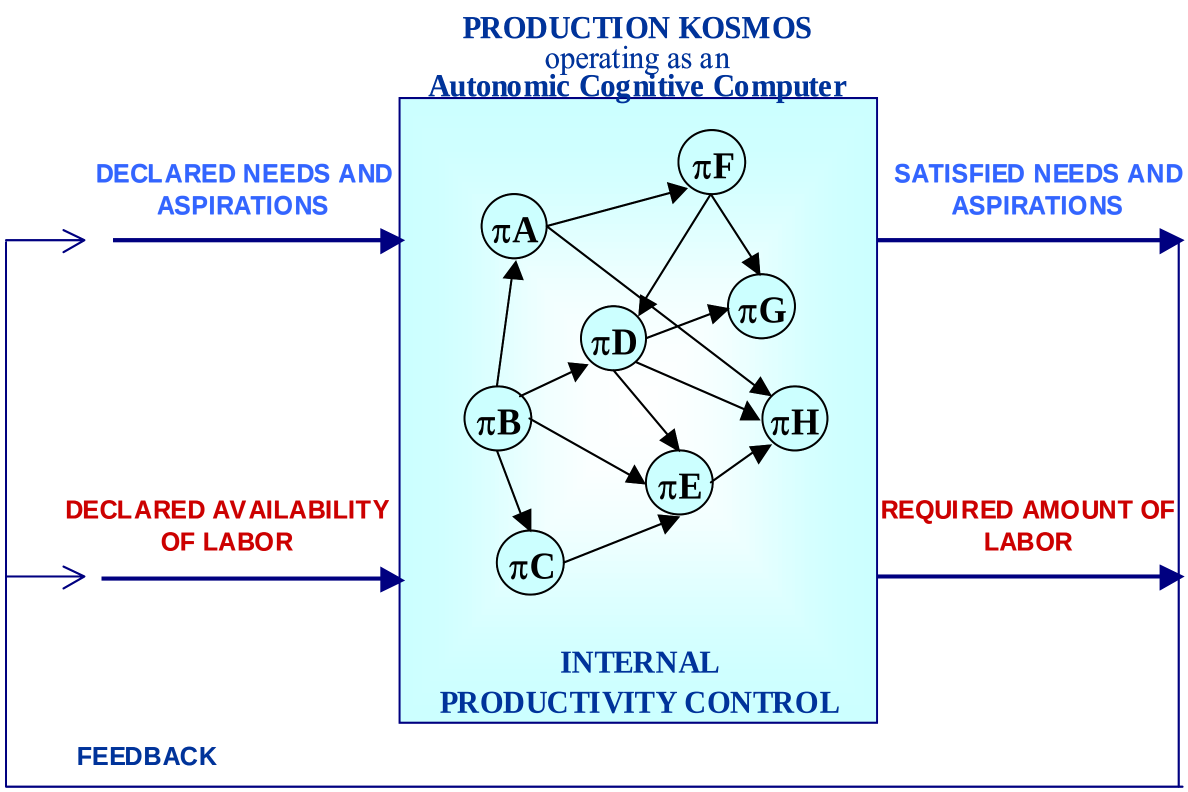
[8] "Economists have long recognized that 'resource owners increase productivity through cooperative specialization'. (A. A. Alchain and H. Demsetz, *Production, information costs, and economic organization*, American Economic Association, 62(5), 1972, [777]). Indeed, the value chain in modern economies is characterized by interfirm specialization such that individual firms engage in a narrow range of activities that are embedded in a complex chain of input-output relations with other firms. Productivity gains in the value chain are possible when firms are willing to make transaction or relation-specific investments (O. E. Williamson, *The Economic Institutions of Capitalism*, Free Press, New York, 1985; M. K. Perry, *Vertical integration*, in R. Schamalensee, R. Willig (eds), *Handbook of Industrial Organization*, North-Holland, Amsterdam, 1989, [185-225])**:** Dyer (1997: 7); the internal citations are from Dyer.

the improvements in productivity and quality, which occur at the local level, throughout the entire structure of the holarchy or along the entire network chain, both in a top-down direction (the improvements produce other improvements down the line) or a bottom-up direction (the improvements require other improvements up the line).

In order complete our look at the global view of the Production Kosmos we must take up a final point: what are the operational mechanisms that account for its *functionality*, which seeks to maximize the satisfaction of needs and aspirations and minimize the labor required to obtain the necessary goods.

In this sense the *Production Kosmos* must no longer be viewed simply as a global producer composed of interconnected modules that tries to maximize internal efficiency, but must instead be thought of as a system with the capacity to perceive, on the one hand, the requests for needs and aspirations to satisfy, and on the other the available labor supply.

Fig. 2 – The Production Kosmos as Cognitive Computer - Source: Mella, 2002.



We can thus compare the *Production Kosmos* to an *ACC* capable of:

- locally perceiving needs, aspirations and labor availability;

- effecting successive syntheses through parallel information processing, vertically and horizontally, by the entire orgonic production network;

- searching for the best dynamic match between the demand for needs and their supply, as an information input, and consumer satisfaction and increased employment, as an operational output (fig. 2).

4 - The operational program of the Production Kosmos

We can theorize the functioning of the Kosmos as an ACC by using the following operational program:

i. the orgons that produce final consumption goods act as *sensors*, in that they are matched with consumers that declare their needs and aspirations, in particular the desired minimum quality levels;

ii. the production orgons are also matched to the base holons – the workers – who state their availability to work, specifying the quantity (the length of time of the work) and the quality (skills, specialization, responsibilities, etc.);

iii. the ACC "knows" the productivity levels (π) of the individual firms in the production network and calculates the production volumes obtainable with the available labor;

iv. the ACC "knows" the consumption rates of consumers and thus determines the needs and aspirations that can be satisfied with the goods obtained from the available labor; or the quantities (and qualities) of labor required to produce the goods needed to completely satisfy the needs and aspirations;

v. the ACC, as a global correlator, tries to obtain an equilibrium between the stated needs and aspirations and the available labor, allocating the labor among the needs and aspirations according to the following rules:

   a. if the labor that is declared to be available is below that required in terms of quantity/quality, ask for more labor; or increase the productivity levels of the individual orgons in the network;

   b. if the declared needs and aspirations exceed those that can be satisfied by the available labor, try to reduce the needs and aspirations; or increase the productivity levels of the individual orgons in the network;

vi. when the firms in the network increase the quality of their production and the productivity of their processes – either based on a request from the orgons up the line or through creativity –

this improvement has repercussions for the entire branch of the network;

vii. a *feedback loop* of support is created: the increase in the needs and aspirations that are satisfied leads to an increase in the stated needs and aspirations;

viii. this forces the firms in the network to increase their demand for labor, with a consequent increase in employment or an increase in productivity.

The dynamics of progress in the Production Kosmos emerges: the individual human holons always operate in orgons of orgonizations that form a SOHO – which operate like an ACC or an HMS – in which every orgonization, orgon and holon carry out interrelated and hierarchical activities in the search for the maximum efficiency.

It does seem there is a *ghost in the Machine*, whose *invisible hand*[9] produces growing levels of productivity and quality, increases the quantity and quality of satisfied needs and aspirations, and reduces the burden of labor, thus producing ever higher levels of progress in the entire Kosmos.

5 - A simple linear simulator of the Production Kosmos

We assume that the Production Kosmos is an extremely simplified orgonic network (fig. 3), has a linear functioning, operates over a single time period, uses unitary average values, and contains only three orgons (or three classes of orgons):

1. ORG QP: the *sensor-correlator* that produces the final consumption goods (QP);
2. ORG QM: the *correlator* that produces materials and components (QM);
3. ORG QF: the correlator that produces production facilities (QF), plants and machines for the other orgons.

These orgons interconnect with three classes of holons: the Consumer Holon, which expresses the volumes of needs and aspirations (Qn&a).

The Labor Holon, that indicates the sensor that gathers and sums information referring to the labor requirements deriving from the three orgons; and the Worker Holons, which express the labor supply.

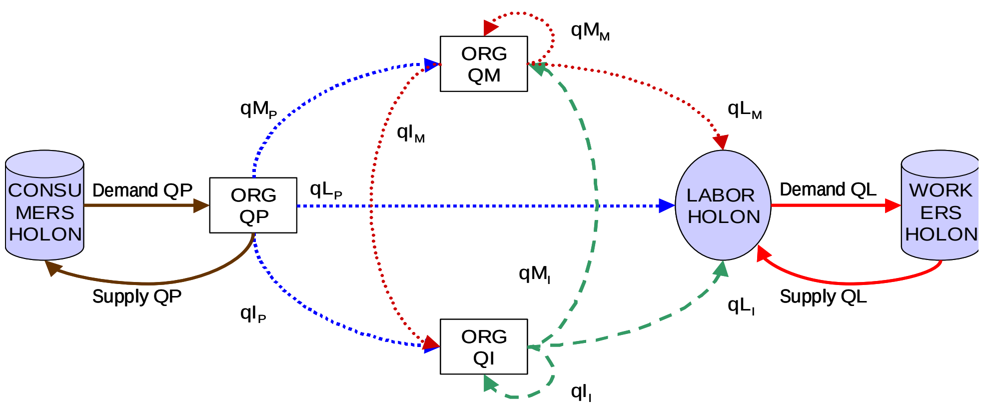
The three orgons are connected in a network; in order to produce QP, QM and QF are needed, but to produce QF, QM is needed, and to produce QM, QF is required. Naturally all three

9 The invisible hand also, and perhaps prevalently, operates among holons of the same level that can form Combinatory Systems of varying size. For more on this, see the Combinatory Systems Theory site at: www.ea2000.it/cst

orgons require the availability of labor, QL, which we assume is supplied by the base orgons that also represent the *consumers*, from whom, however, there are kept separate in order to simplify our model.

We can represent the production function of each of the three orgons by a vector that includes three parameters that express the *average* unitary quantity of materials, qM, of labor, qL, and of facilities, qF, respectively, needed to produce a unit of the good that each orgon is assigned to produce.

Fig. 3 – Model of the Production Kosmos with orgons and holons - Reference: fig. 1.



We will now simulate the Production Kosmos using the simplified model in fig. 4, which translates the model in fig. 3 into an accounting sheet.

The requirement vectors for each orgon are shown in the block representing them (the values represent only an example):

a. ORG QP = [qMP = 1, qLP = 2, QFP = 0,10],

b. ORG QM = [qMM = 0,10, qLM = 1, QFM = 0,10],

c. ORG QF = [qMI = 1, qLI = 1, QFI = 0,10].

We have omitted the variable that expresses the *quality* of the products and of the labor, assuming that this is contained in the above-mentioned unitary requirements.

The orgon that produces QP is also a *sensor* that measures the quantity of needs and aspirations to be satisfied (Qn&a), according to the demands of the holon consumers.

We agree that these demands can be abstractly quantified as Qn&a = 10,000, which *in principle* we assume can be determined.

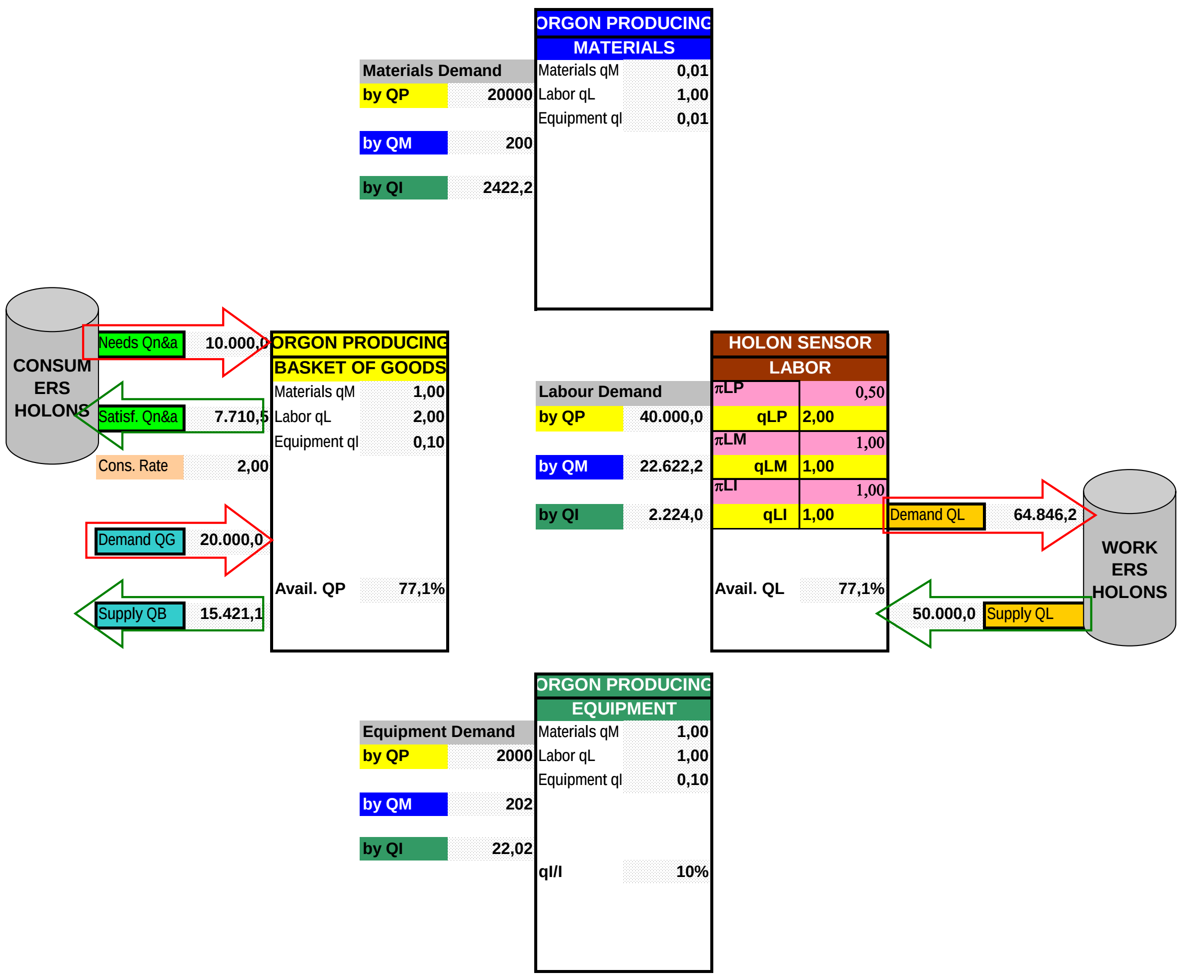
We observe that in reality this measure is not usually quantifiable, since needs and aspirations reveal themselves through the demand for goods and services.

Nevertheless, it has been introduced here to permit a wider range of simulations.

If we assume that Qn&a is known, then this is converted into quantities of goods to produce based on a conversion rate of Qn&a into QP, which takes on the meaning of an *average rate of consumption* per unit of need and aspiration, abstractly conceived of.

For simplicity's sake, in fig. 4 we have assumed a conversion rate equal to 2. This means that a declaration of Qn&a = 10,000 units desired translates into a demand of QP equal to QP = 20,000 units of product (obviously these are units of average *baskets of goods*, which *in principle* we assume to be determinable).

Fig. 4 – The simulator of the Production Kosmos - Reference: fig. 1 and fig. 3.



On the basis of the average unit requirements of factors that go into the production processes the three orgons, operating from left to right in the model in fig. 4, compute the quantities of materials and equipment needed to obtain QP and, taking account of the connection between these (which is shown in the model in fig. 3), the labor requirement is quantified, expressed in units: Demand QL = 64,846.22 units of labor (these figures are analytically shown on the left of the three blocks that represent Materials, Equipment and Labor).

If the worker holons could provide exactly this amount of labor then all the Qn&a would be satisfied.

In the block that represents the Labor Holon we can calculate productivity for the labor used in the three producer holons on the left (πLP, πLM, πLI); as we can see in the model in fig. 4, these productivity values are the inverse of the labor requirements indicated for each producer orgon (in the production function inside the block).

The model in fig. 5 allows us to now simulate the situation where the supply of labor is less than the necessary demand. Let us assume that the labor supply is only equal to: Supply QL = 50,000, which corresponds to a labour availability rate – calculated as a ratio of labor supply to demand – equal to: Avail. QL = 77.1%.

The Production Kosmos, operating as an ACC, utilizes the labor supply data, QL, to recalculate the quantity of products this supply can produce, Supply QP (arrow leading from the left of the first orgon), as well as the level of satisfaction of the Qn&a, indicated by Satisf. Qn&a. As a result of our simplifying assumptions these percentages are always equal to the rate of labor availability: Avail. QP = Avail. QL = 77.1%.

The Production Kosmos can use of mix of choices to optimize the demand and the supply of goods and labor, and thus the satisfaction of consumers and workers:

a. Try to increase Supply QL by raising it to a value greater than 50,000 units;

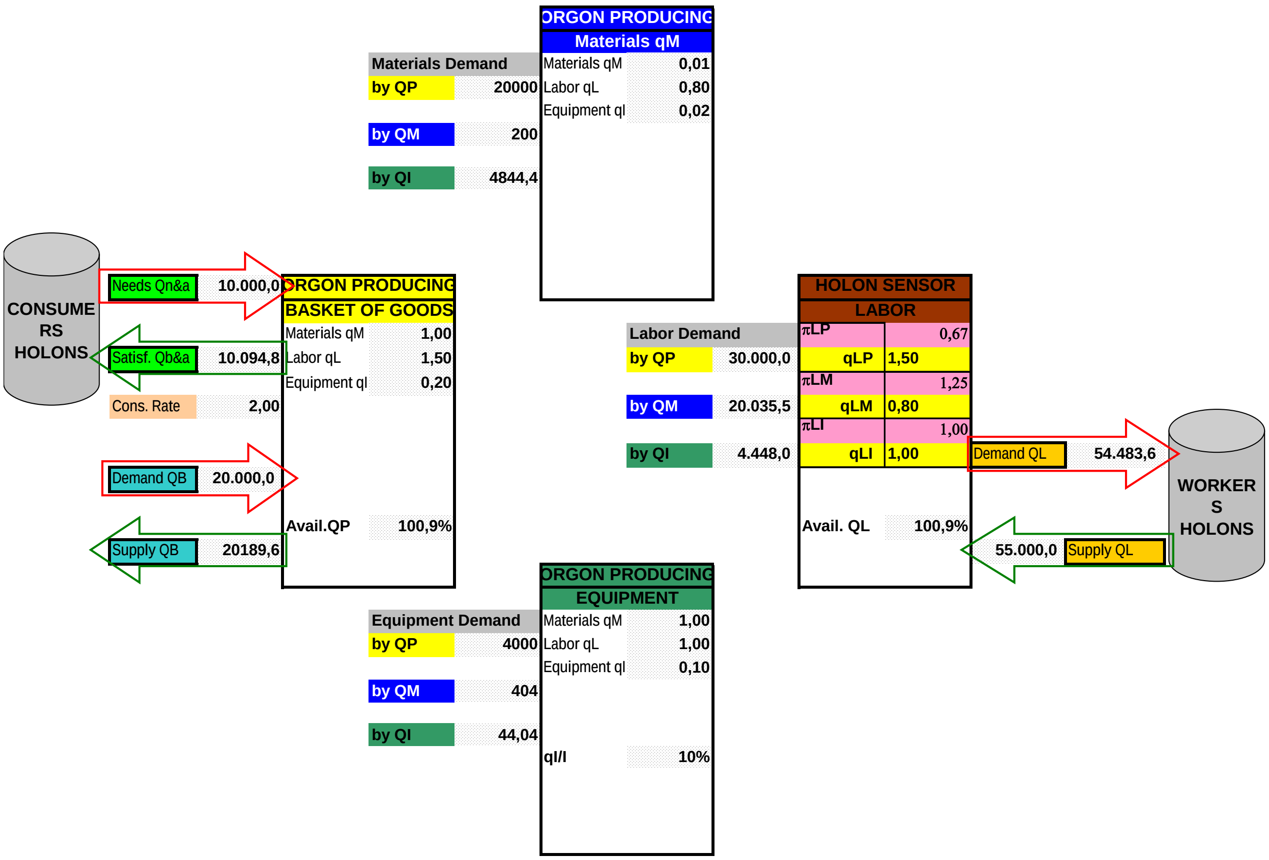
b. Try to reduce the demand, by bringing Demand Qn&a to a value below 10,000 units;

Try to increase labor productivity by reducing the coefficients: qLP, qLM, qLI that characterize the average production processes of the three orgons, possibly through new job-saving technologies.

With these adjustments (fig. 5) the Production Kosmos can more completely satisfy Demand n&a, bringing the availability of consumer products to a level equal to Avail. QP = 100.9%.

Future improvements can refine the model by introducing additional action variables that will allow simulations that more closely approach the *modus operandi* of the global Production Kosmos.

***Fig. 5 – Simulation of adjustments in the Production Kosmos - Reference*: fig. 4.**



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