

BUSINESS SUSTAINABILITY AND COLLECTIVE INTELLIGENCE

*Paulo Garrido
Algoritmi Centre and Industrial Electronics Department
School of Engineering
University of Minho
Portugal
pgarrido at dei dot uminho dot pt*

Abstract – In this paper one looks for contributions from the field of collective intelligence. Beginning with a preliminary analysis of businesses and their sustainability, the paper shortly defines collective intelligence and its potential contributions to organizations in general and businesses in particular.

Presented at the

First International Conference on Business Sustainability, 2008

Management, Technology and Learning
for Individuals, Organisations and Society in Turbulent Environments
Ofir, Esposende - Portugal 25-27 June, 2008

<http://labve.dps.uminho.pt/bs08/>

BUSINESS SUSTAINABILITY AND COLLECTIVE INTELLIGENCE

Paulo Garrido
 Algoritmi Centre and Industrial Electronics Department
 School of Engineering
 University of Minho
 Portugal
 pgarrido at dei dot uminho dot pt

new_organisational_models_or_paradigms; new_economy_business_enterprises;
 networked_economy; collective_intelligence.

1. INTRODUCTION

What has collective intelligence to contribute for the knowledge on business sustainability?

This paper gives some answers. They stand on engineer-minded, systemic and cybernetic points of view. As such, one devotes Section 2 and 3 to state the intended meanings of terms and a preliminary analysis of them, so that the answers given follow in Sections, 4 and 5, hopefully, in a deductively sound way. Section 6 concludes and sketches perspectives for development.

2. OF BUSINESSES AND SUSTAINABILITY

Businesses

In this paper, one understands a business as i) a human organization producing and delivering goods or services in exchange for money. Straightforward this definition may sound, it is clearly incomplete as non-profit organizations and states also satisfy it. Many non-profit, privately owned organizations exchange goods or services for money, both in a generalized as a specific sense. Also states or states' agencies exchange goods or services for money, both in the specific sense of a given service being got only through payment of a fee, as in the generalized sense that public servants produce services for the society in exchange for salaries deduced from the total amount collected as taxes.

So, what makes businesses different from non-profit organizations and states or states' agencies? The fact that, besides i), ii) business *owners* are entitled to appropriate a fraction of the money received by the organization, this fraction being termed *net profit*. Such appropriation is bound to rules, e.g., it can only occur if net profit is positive and it is distributed among owners

according to the percentage of ownership of the business each owner detains.

Differently, such an appropriation is by definition forbidden by law in a non-profit organization if it has owners at all, or its ownership maybe assigned to someone. In addition, in a state organization such an appropriation either is devoid of meaning (ownership of the state rests undefined) or simply not made effective (the assumption that citizens own the state seems to have no expression in thinking, discourse and practice).

The above expresses that the concept of 'owner of a human organization' is clearly defined only for businesses.

In an economy, one refers businesses as the private sector by contrast with the public sector (state) or the voluntary sector (non-profit) [1]. Although it was impossible for this author to get an assessment of the share of gross domestic products generated by businesses, it is clear that they are prevalent worldwide and so their sustainability is linked to the sustainability of the emerging global way of life or civilization as-we-know-it.

Roles

If, as by predicate i), a business is a human organization, who belongs to it? Or, in other terms, who are the people constituting the business? Thinking pragmatically, it seems inescapable to include in such a set of people owners and employees. If one takes out 'owners' one would fail to account for people who are essential to the concept of business as a distinct type of human organization and to the understanding of its behavior, as by predicate ii). If one takes out 'employees' then one would fail to account for the people that actually run the business, or are "orchestrated" by the organization in actually producing the goods or services.

In fact, one may find inside a business people that

- a) are owners but not employees;
- b) are owners *and* employees;
- c) are employees but not owners.

Being an owner or an employee corresponds to different functions or behaviors inside a business and to different drives or personal interests to participate in it. Given that these functions and interests may coincide in the same person, one makes resort in this paper to the concept of *roles*. One will say that inside a business a person may have the role of owner, of employee or both.

The concept of roles is not of course restricted to businesses and may be of interest to analysis elsewhere. In a country, a person may be a citizen but not a public servant (if not an employee of the state) or both a citizen and a public servant (if an employee of the state). In an economic analysis upon the notions of producer and consumer, a person may be a consumer but not a producer, or both a producer and a consumer.

A two-way perspective on human organizations

It is generally assumed that predicate i) expresses the reason to exist (“raison d’être”) of businesses, non-profits and states. They exist because their activity results in something sought useful for people in general. One may find or present counter-examples to such a reasoning in individual cases, but the argument is compelling¹ in a statistical sense, because one cannot see how human societies could persist in time if that was not so for the vast majority of cases.

Yet, this reasoning is incomplete. It sees organizations – businesses, non-profits and states – as sources of goods or services for people in general. That is a necessary social function they implement, but not the only one. Goods and services are not created out of nothing, but out of people creativity, knowledge, abilities, and work, coordinated through their participation in the organization. So, organizations are “sources” of goods and services as long as they are “sinks” for people’s activity and possessions, monetary or other. Accordingly, one must recognize that the social function of engaging people in socially

useful modes of activity is a necessary correlate of the production of goods or services.

And this has the following consequence. Organizations not only provide for goods and services for people in general but also for returns to their members, which can go from the rather objective making for a living or maintaining and accruing monetary wealth, to more intangible planes of self-realization. Being distinguished by the possibility (predicate ii) of making profit for owners does not take businesses out of this function.

It becomes difficult to understand the behavior of organizations – businesses in particular – if the correlation between the production of goods or services fulfilling needs of people in general and the generation of opportunities for fulfilling needs of people that in particular participate in the organization is not kept in mind.

Sustainability

Simply put, sustainability of something means persistence in time of the thing. If a building is left without maintenance, the aging of materials and the aggressions of environment will make the building enter a state where it cannot sustain itself and will collapse.

Human organizations are dynamic arrangements of living beings and these, in turn, are dynamic arrangements of molecules. Given the dynamic nature of the arrangements at stake, it will be more appropriate to say that sustainability of them means that they *re-produce* in time, rather than they persist in time.

Drawing on the autopoietic theory and interpretation of life [2][3][4][5][6] one will say that a living being is a molecular network of chemical reactions that continually remakes itself². This concept leads to the necessity of the living being having a *boundary* through which exchanges of matter and energy take place with the *environment*, a broad term to denote everything that is outside the boundary.

Because the molecular network continually remakes itself from itself no first cause can be devised for its functioning. Rather, if one depicts graphically the functioning of the network one arrives at a circle, as the form abstractly representing what is going on as in Figure 1. One may say that in a living being causality is configured in a closed loop.

¹ The fact that organizations must receive money in exchange for the goods or services produced as expressed by predicate i) is not truly essential to the argument, given that one reasons from an assumption of a monetary economy.

² An oversimplified description: ... DNA that makes PROTEINS that make DNA that makes PROTEINS that make ...

While internal conditions are maintained such that the loop goes on functioning, the being will live or one may say that the being (or its life) is sustainable.

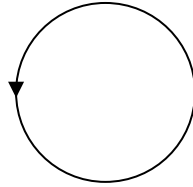


Fig. 1. Abstract illustration of causality in a living being.

When internal conditions diverge so much that the loop breaks, then the being dies or is extinguished, and one may say that the being (or its life) has become unsustainable.

One will refer to the maintaining of the internal conditions inside a domain compatible with the continuous re-producing of itself as *self-coherence*.

Self-coherence is a condition necessary for sustainability, but not sufficient. Because the being is in a constant process of exchange of matter and energy with the environment, the being triggers changes in the environment and the environment triggers changes in the being. Depicting graphically this process leads again to a circular diagram configuring a closed loop as in Figure 2.

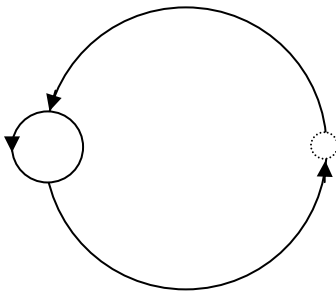


Fig. 2. Abstract illustration of causality in the relation between a living being and its environment.

It is true that the being will live only or will be sustainable as long this closed loop of causality goes on. If the loop breaks the being dies or becomes unsustainable. One will refer to the maintaining of the conditions inside a domain compatible with the continuous re-producing of itself as *coherence* of the being with the environment.

Coherence can be broken either by the being or the environment. This one continuously changes as the result of natural (non-living) forces, other beings and the being itself. To maintain coherence in an ever changing environment, the

being must *adapt*, tuning its internal functioning, or *evolve*, changing its structure to some degree.

The intrinsic constraints of multi-cellular living beings imply that they are not able to maintain self-coherence or coherence past a limited time span, measurable as life expectancy.

On the grounds of the observation that multi-cellular living beings are made of cells, it is tempting to consider species as living beings (of an upper order) made up of individuals (the individuals having with regard to the species a role analog of cells to the individual) [7].

Species have a much larger time span for their lives, possibly open ended, although they are prone to extinction, as individuals. But by their intrinsic nature they have a much broader potential to evolve than individuals – and for maintaining coherence. Evolution allows a species to transform itself, in the limit becoming another species.

Sustainability of life is surely a desirable property for any individual living being, but, if individual living beings were sustainable for an unlimited time span, evolution of species would be impossible – and one would not be here talking about sustainability. Evolution carries a deeper meaning than sustainability.

Sustainability of organizations

If, by analogy, one talks of the human species as a living being and of individual humans as their cells, what meaning can one assign to human organizations?

To answer this question, one must observe that the analogy is of great interest and functions very well in many areas, but it does not mean a complete equivalence. When one goes from cells to a human being, one goes from a living being to another, sharing some properties with the first including “liveness”, but also with different properties. When one goes from a human to the species, the same happens. For example, in a human, cells are physically connected in space. That is not the case for the species.

One could envision human species as a moving “liquid” at the surface of Earth³. Now a closer look to the “liquid” would reveal that its “molecules” present definite patterns of coordinated behavior. In particular, some of the patterns result in the production of goods and services for the consumption or benefit of other than the producing “molecules”. These patterns of

³ From which some very little “drops” suddenly step out in space shuttles...

activity are the human organizations one is talking about.

Having framed human organizations this way, framing sustainability of them may be understood as follows. If the human species is a living being it must be self-coherent (or cohere with itself) and coherent with the environment (or cohere with the environment). Otherwise the species will enter a regression⁴ or put its own sustainability at risk. From this standpoint, a human organization is sustainable if its net contribution to the self-coherence and coherence with the environment of the species is positive⁵.

The argument can be stated in a slightly different form. Let one consider how will be the species some time from now in the future. Taking out the limit case of being extinct or at risk of extinction, two cases may step out for consideration:

1. The species is healthier and more developed than now.
2. The species has regressed.

The second case is not furthered considered, as it is sought devoid of meaning. Does it really make sense to consider the sustainability of organizations if it is linked to the regression of the species?

If it is not the second case and the first case happens then self-coherence and coherence of the species must be greater than now. Organizations are key factors to this, so they must have evolved accordingly. This means that the organizations that will exist at that time to come are now those that are now sustainable or those that change to become sustainable or those to be born sustainable. In any case their sustainability is linked to their net contribution to self-coherence and coherence with environment of the species.

Yet, this should not be taken as an infallible specific criterion or prescription to test for or make a given organization sustainable against everything and for all, but just as a general guidance. First, because for a system with complex dynamics as a species, one can elicit general trends or properties, but one cannot predict local behavior. Second, because species have a long term genetic dynamics: patterns are formed, tested and recombined. Organizations that are only near-sustainable in the above sense may be very useful as components for a next generation of sustainable ones. Third, because species are a blatant example of the principle of requisite variety [8]: a system must have enough

variety to cope with environment disturbances. Species strive to maintain as much diversity as possible in order to augment the spectrum of environment changes to which they can adapt or for which they can maintain coherence. Organizations which do not present now a net contribute to coherence may be maintained in the expectation that they may become net contributors for coherence some time in the future⁶.

Sustainability of human organizations is often desirable, but it hardly can be taken as an absolute value. 'Evolvability' seems a more interesting concept⁷.

Sustainability, adaption and evolution

In a very *strict* sense, one may say that making an organization sustainable is *impossible*. By the simple reason that if an organization X_0 is unsustainable, making it sustainable means to *change* X_0 into an organization X_1 that is strictly *different* from X_0 .

The consequence of this comes as follows: to solve the (un)sustainability problem it is necessary but not sufficient to have a criterion to distinguish sustainable from unsustainable. One must also devise a 'roadmap for sustainability'. The meaning for this expression taken in this paper focus on change and the conditions for change internal to an organization. Furthermore, one distinguishes change as adaption or as evolution.

Both adaption and evolution have the effect of rising coherence of the individual living being or the organization with the environment. But adaption is reversible and stressing in general. Evolution is irreversible and prevents the need for further adaptation, actually relieving from the associated stress. In the way evolution is defined here, it be taken as a synonymous for learning. Some examples illustrate the idea.

An organism may be vulnerable to an infectious agent. This is incoherence with the environment that manifests if the organism is actually infected. Then it adapts through immediate changes, e.g., fever and cough. If given enough time its immune system eventually will

⁶ Although, such cases cannot be significant in a statistical sense, as it may become obvious.

⁷ The Roman state lasted for a little less than a thousand years, and the Chinese state allegedly has more than four thousand years of existence. Yet, it was from the ashes of the Roman state that evolved the civilization beginning, one thousand years past its end, the movement to the emerging global civilization. It could have happened the other way. Were the Chinese state more flexible and open to evolution and the discoveries and colonization could have happened in the reverse direction.

⁴ As when a person becomes ill or enters a worse period in his / her life.

⁵ And, presumably, above a given minimal threshold.

synthesize an antigen that will destroy the infectious agent. This change is evolutionary: it is memorized by the immune system, preventing any further infection by the same agent and the adaptive stress associated. The immune system has learned to deal with the agent.

For another example one may consider a business with an environmental aggressive practice. That will end up in protests from people, or the business incurring in legal prosecution. In a first phase, the business may adapt by opposing legislation, starting public relations actions, paying fines, or putting in effect immediate changes to its operations scheme. One may say that the business is adapting because all these moves are stressing to the business – they lead to extra costs without long term payoff – and reversible – if external pressure relinquishes, “business as usual” will go on. Eventually the business will revise deeply their practices, change culture and find technologies compatible with its functioning and non-aggressive to the environment. This change is evolutionary. The business has learnt to deal with the fact that environmental resources are finite.

Or yet for another example one may consider a state agency that indulged in a growing annual budget without a correlative bettering of quality of service. When the growing dissatisfaction of citizens turns into cuts in the budget, the first response of the agency may be to adapt with actions similar to the business as above. Eventually the agency may find a way to evolve, restoring coherence in the long term and will learn to deal with the fact that the social resources it may take are finite.

The relation between coherence with the environment, changes in this one lowering coherence and the dynamics of adaption is illustrated in Figure 3.

Capabilities of an organism to evolve are limited. An organism may evolve by growth, which is genetically determined, through learning of the immune system, or through learning of the nervous system. Capabilities of learning for organizations are wider. Organizations can change people, change culture or change technological process and artifacts – all giving a wider spectrum for evolution.

3. OF COLLECTIVE INTELLIGENCE

The reader may notice that the intended meaning assumed for adaptation in this paper has been set to a change that fosters coherence but only in a stressing, non-permanent way. And that the intended meaning for evolution has been set to equate with learning. Learning is an ability of a

system that is intelligent and maintains its intelligence in a changing environment.

In fact, what this paper proposes with regard to the roadmap of sustainability for businesses is this being searched through their intelligence – not in the restrict sense of gathering strategic information but in the wider sense that one deems of somebody as being intelligent.

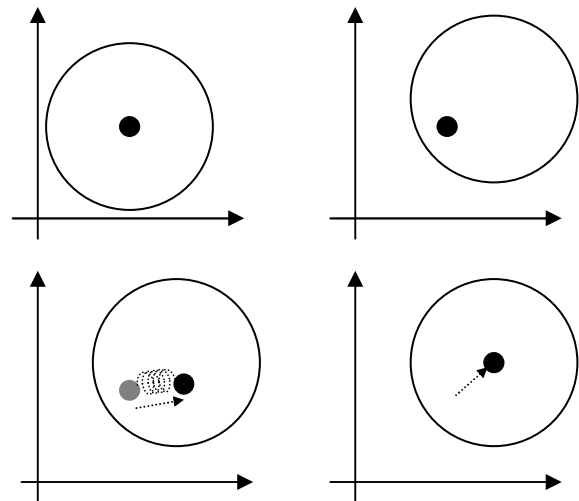


Fig. 3. One supposes that the plane represents the possible spaces of configurations for an organization in some suitable referential. The organization can only be inside a set of configurations that correspond to coherence with the environment. This set is represented by a circle; if the organization goes outside the circle it will be extinct. In the image up and left, the organization lies at the most comfortable configuration possible, i.e., at the center of the circle. Because the environment changes the organization finds itself nearer the critical limit. This is depicted in the image up and right. The organization reacts by adapting, which involves stress. This situation is depicted in the image down and left. If the organization evolves it can reach the center of the circle again and relief stress.

Intelligence

As in [9] “Intelligence is taken here as the ability for attaining goals or for solving problems that puts at work responsiveness of the solver to the situation where the goal or problem arises and use of its previous knowledge and experience.” This statement of the intended meaning of intelligence makes it relative to the goal or problem and to the previous knowledge or experience of the solver. Fabricating weapons may be very intelligent from the standpoint of one’s military capabilities but very stupid from the standpoint of peace. If a child solves a high school math problem with no perceived previous teaching or training he or she will be considered more intelligent than a graduate who solves the same problem.

Intelligence as a property of collectives

Usually one perceives intelligence as a property of individuals. Humans or other animals or even computer programs are common examples.

Research in the natural and social sciences has shown this conception to be too narrow. Intelligence is a property of collectives. For the purposes of this paper one takes a collective to be some entity distinguished as being non-atomic. Ant colonies, swarms, flocks or herds are examples among the non-human animals. Collectives of people may exhibit superior problem solving capabilities than any of their most intelligent members. Even individual intelligence may be conceived as the intelligence of the collective of neurons that constitute one person's brain.

Researchers in Artificial Intelligence (AI) have long proposed Distributed AI and Multi-Agent Systems (MAS), systems of running computer programs communicating through adequate channels, as more intelligent artifacts than single programs. In 1980 [10] presented a model for the mind as a society of interacting units or agents.

In recent years the concept of a Global Brain has been proposed as "a metaphor for the intelligent network formed by the people of this planet together with the knowledge and communication technologies that connect them together" [11]. These were some of the strands conducting to the emerging field of Collective Intelligence [9][11][12][13].

In the perspective of collective intelligence it becomes quite natural, when one thinks of a system – an interconnected set of parts –, a collective in general, to ask: how intelligent is it? Which is its intelligence?

4. COLLECTIVE INTELLIGENCE OF HUMAN ORGANIZATIONS

In [14], Noubel distinguishes the collective intelligence of human organizations (societies) to have undergone three stages of development. The first is 'natural collective intelligence' (Natural CI) or the collective intelligence of the small groups of hunter-gatherers prevalent as the social form of humankind organization at its origins. This form of collective intelligence manifests itself when the collective has a small number of people, as in jazz bands or sport teams, which allows for:

- The group being an emerging *whole* continuously (re)created by mutual trust and sharing of values among the members of the group;

- The group being a 'holoptical space', i.e., a space small enough and open enough so that all its members access a vision of the situation of all the other members and of the challenges the group faces, leading to the existence of a highly efficient 'collective mental map'.

- A polymorphic architecture which maximizes the probability of the best person for a given task coming into the lead when the situation arises.

- An object-link, i.e. a physical or symbolical object that catalyzes the collective and its intelligence, as a collectively pursued object, as the ball in a soccer game, the prey in a hunting expedition, an outstanding performance of a band, the goals of a meeting, the mission of an organization.

- The group being a learning organization whereas individual and collective errors are properly recognized and integrated into collective learning.

Natural CI breaks down when the number of people in the group augments past a given threshold, as the necessary communication and information exchange become physically impossible. When societies grew, they solved this problem by evolving to pyramidal intelligence, a type of social intelligence manifested in hierarchical modes of social organization. Pyramidal intelligence has prevailed by thousand of years, succeeding to coordinate hundreds of millions of people in societies, in the absence of the physical possibility of having people communicating enough for collective intelligence to exist.

The recent development of computer and communication technologies creates the prospect for the development of *Global CI*, the re-creation of Natural CI in groups, societies, collectives, many times bigger.

Drawing on [14] [15] Garrido has proposed in [9] a roadmap for fostering Global CI in organizations, supposing computer and communications support. The main points of it can be given in a wider formulation as follows.

1. To promote and implement a culture of mutual trust, contract of the individual with the collective, stewardship and organizational learning, the leaders being prime examples.
2. To cut hierarchical levels and to promote free flow and openness of information inside the organization so that:

- a) Decisions are more robust;

- b) The holoptical space and the associated mental map are continuously developed and enriched;

c) To prevent and better deal with collective disrupting modes of individual action.

Socially supported decisions

The 'apex' of intelligence comes as decision. An entity makes something intelligent if it takes the "right" decisions; it makes something "stupid" otherwise. What does collective intelligence views have to contribute to the decision process inside an organization?

Quality of decision rests on five processes of perception:

1. Perception of the goals to be attained;
2. Perception of both the environment and the internals of the organization whatever the decision is local or global;
3. Perception of the possible actions from which to select one or more for effective action;
4. Perception of the possible strategies to follow or course of actions to take;
5. Perception of the values of alternative actions or strategies.

The wider these perceptions are the greater is the probability to get a "right" decision. A knowledgeable or competent person is one that (besides eventually acting in a skilful way) takes the right decisions in general because it has enough wealth of the above five types of perceptions.

In the "pyramidal intelligence" culture legated by hierarchical dominated organizations, one tends to see decision as a process restricted to people in charge of taking decisions. This is not necessarily bad (although it can be quite bad), but it is less than collective intelligence has to offer.

From a collective intelligence stand, decision is to be seen as a distributed process inside an organization, those who decide having the role of collecting as much as information as possible to make sense of the results of the five perception processes among people, so as to arrive at the best decisions. Quality of decisions should augment as bigger pools of perceptions are made available.

Harnessing this "wisdom of crowds" [16] inside organizations was impossible before the computer and communications era. But since one has them available, software targeted for this aim may be developed. One arrives then to the concept of socially supported decision systems. These systems may be targeted for very large collectives, independent of its particular nature. Garrido and Faria report in [17] the development of a free / open source software system specifically designed

to be used in organizations for social support of the decision process.

Besides bettering the quality of the overall decision process, it can be expected that the sense of engagement of people with the organization will grow as well as the collective mental maps and the holoptic vision will develop in extension and in precision.

5. THE CASE OF BUSINESSES

Businesses are organizations and everything said in the last section applies to them if in quest of the evolution leading to sustainability or "sustained sustainability" (!). But businesses are also special inside organizations as it is possible for those people in the organization having the role of owners to share profit.

As one lives in a prevalent monetary economy, profit has two functions:

1. To measure the viability of an organization;
2. To compensate for the owners' investment of their effort or surplus money in the organization.

The first function results from the requirement that profit *does not become negative*. It is generally assumed that if profit is negative, then the business has become socially inefficient absorbing from society a value of resources greater than the value it supplies. As a consequence if profits are repeatedly negative, either the business will be extinct or will be integrated in another business with a presumable reconfiguration geared towards recovering social efficiency.

The second function is the rationale for the very existence of businesses under the current economic mode of functioning. Profit is sought as the main incentive for people applying their surplus money in them as capital to be remunerated. Or for people initiating businesses as owners in the expectation that they will receive through profits an income greater than it will be possible only through current values for salaries.

The double function of profit hinges on its nature of being the difference of two values:

1. The value society gives to the products and services sold by the business in a year.
2. The value society requires for the products and services paid by the business in a year.

It is the possibility that value 1 may be consistently and repeatedly greater than value 2, together with the fact that the difference may be distributed among the owners, which incentives people to start and operate businesses, and surely

led to their vital role and prevalence in modern economy.

Yet it should be recognized that the profit predicate is a potential source of incoherence for the business as a productive organization, if it is the case that not all the people in the business have the role of owners. Or in other words, if it is the case that some of the people in the business have the role of employees, but not the role of owners. Let P the profit, R the revenue of sales, S the amount of salaries paid, GS the amount of goods and services necessary and purchased to run the business, T the total amount of taxes paid, and OS the total amount paid for other expenses as investment in equipment, financial or banking interests. Then

$$P = R - S - GS - T - OS$$

This equation is visually illustrated as follows.



Now, it is clear that to augment P, either R is augmented or any or some of S, GS, T or OS are diminished. Pressure to diminish GS, T or OS will be exercised towards people *outside* the business or organization. But pressure to diminish salaries (or its fraction in the sales revenue) will be exercised against people *inside* the organization – all the employees of the business. If these have simultaneously the roles of owners and employees such pressure should not result in conflict among people, as the question should be more of bookkeeping than real. But if people with only the role of employees exist, then conflict is most probable to happen, worsening the self-coherence of the business.

It is to be recognized that the conflict spotted above has the potential to undermine mutual trust among people and individual engagement with the collective; to shatter the holo-optical space or to divide the “collective mental map” in two different types: that of owners and that of employees; to create two different (monetary) object-links: profits on one side, salaries on the other; to block the business in becoming a learning organization. Depending on their intensity, all these effects, as by the referred in the previous section, are detrimental to the collective intelligence of the organization. Upon a vision of collective intelligence as founding the discovery of a business roadmap to sustainability, it follows that they are detrimental to business sustainability.

It follows that from a collective intelligence perspective businesses should tend to turn their employees into owners. Of course one is not speaking here of making any employee automatically an owner; or that restrictions on the trade of ownership rights should not be applied; or that the business starters or entrepreneurs should loose control of the business. But one is speaking of finding solutions that by preventing, diminishing or eliminating the potential conflict between owners and employees, will maximize the conditions for the business to develop its collective intelligence.

6. CONCLUSIONS AND PERSPECTIVES

In this paper several ways have been pointed out of how the emerging knowledge in collective intelligence may be applied for a business to discover or set-up its roadmap to sustainability and follow it. One has begun by a preliminary analysis of businesses and sustainability.

Businesses have been considered a special case of productive human organizations, where a) people can take the roles of owners or employees and b) owners have available the sharing of profit.

As any other productive human organization, a business performs a double social function⁸. On one side it produces goods and services for people in general. On the other side it engages its members in socially useful modes of activity and ensures to them monetary income. These two functions are correlate and inseparable.

Sustainability has been framed drawing on autopoietic theory. One has assumed that human organizations, like living beings, are amenable to be understood as a circular pattern of activity that continuously re-produces itself in time. This led to the concept of self-coherence of an organization as a property determining its sustainability. An organization is sustainable (in the inside) while its configuration lies in a space of self-coherence which allows for its continuous self re-production.

Organizations exist in a social environment, exchanging with it goods, services and money. Again a circular pattern of activity leading to its self-reproduction in time can be devised. This led to the concept of coherence of an organization with its environment as another property determining its sustainability. An organization is sustainable (in the outside) while its configuration lies in a space of coherence with the environment which allows for its continuous self re-production.

Because the environment is continuously changing, the space of coherence of an

⁸ Most mission statements refer one function only.

organization is continuously changing. As a result, the organization will find itself moving towards the limits of the space of coherence. If these limits are traversed, the circular pattern of activity and flux will be broken and the organization will be extinct.

So, an organization must continuously change heading towards the centre of the space of coherence, maximizing its sustainability. In a first step, an organization changes in a way that has been termed 'adaption'. This is a type of change that betters coherence in the short term, but has a stressing nature. It may be enough if changes in the environment are fluctuations. But if changes have a definite trend, the organization must evolve, to cope with the depth of changes needed and to relief stress. The concept of evolution presented is synonymous with learning – more exactly with deep learning. While adaption is a change inside the known repertory of behaviors of the organization, evolution implies acquiring a behavior unknown till the moment.

Evolution as learning may best establish the connection with collective intelligence, because learning is the hallmark of an intelligent being in a changing environment. Following this preliminary analysis, one has presented the notion of collective intelligence. This notion is unavoidable when one simply observes that an organization is not a monolithic entity, but an entity made up of other entities. Its intelligence cannot be ascertained to a single locus, or, more exactly, it can be improved by assuming that it depends on all the people inside the organization and the interactions modes among people that are in effect at a given time. This notion also stands as one which application will lead to sustainability, as intelligence has been defined as the capability to attain a goal or solve a problem and being or becoming sustainable, and hence evolutionary, is a goal or problem to solve for every organization.

One has listed some known properties of intelligent collectives with a small number of people – Natural CI. The constraints in human communication which made impossible that these properties be maintained when the number of people in societies grows by hundreds, thousands or millions, can be overcome, in principle, through the use of computer and communications technology leading to Global CI. Basic actions have been indicated to foster collective intelligence in an organization. In particular attention has been given to the social support of decision, indicating results of recent research in the subject.

To end up this excursion one has considered, through the perspective of collective intelligence, the distinctive feature of businesses inside organizations: the simultaneous existence of

owners and employees and access to profit. It has been argued that this is a source of a potential conflict among people in a business, incoherent with the development of its collective intelligence. It has been argued that from the standpoint of collective intelligence it makes complete sense, indeed it becomes of necessity, that businesses will extend the role of owners to all their people.

Perspectives for future research are very wide as the study of collective intelligence is in its infancy and so are the development of techniques and systems following from insights given by the investigation.

Acknowledgements

FCT (the Portuguese Foundation for Science and Technology) has funded the research underlying this paper through its Programa Plurianual.

The author wishes to thank Goran Putnik for incentive to write this paper and Jane Cull for patience in calling his attention to circularity in autopoiesis.

References

- [1] Private Sector. Wikipedia – The Free Encyclopedia. Retrieved 2008-06-03 from: http://en.wikipedia.org/wiki/Private_sector
- [2] Maturana, H. & Varela, F., *Autopoiesis and Cognition: the Realization of the Living*. Boston Studies in the Philosophy of Science 42, R. Cohen and M. Wartofsky, Eds. (1st ed. 1973) 1980, Dordrecht: D. Reidel Publishing Co.
- [3] Maturana, H. & Varela, F., *The Tree of Knowledge: The Biological Roots of Human Understanding*. 1987, Boston: Shambhala Publications.
- [4] Varela, F., *The Creative Circle: Sketches on the Natural History of Circularity*, in *From the Invented Reality*, P. Watzlavick Editor. 1984, New York: Norton Publishing.
Available from : <http://www.lifesnaturalsolutions.com.au/articles.php>
- [5] Mingers, J., *Self-Producing Systems*. 1994, Kluwer Academic/Plenum Publishers.
- [6] Autopoiesis. Wikipedia – The Free Encyclopedia. Retrieved 2008-06-03 from: <http://en.wikipedia.org/wiki/Autopoiesis>
- [7] Heylighen, F., *The Global Superorganism*, in *Principia Cybernetica Web (Principia Cybernetica, Brussels)* F. Heylighen, C. Joslyn & V. Turchin, Eds. 2005. Retrieved 2006-12-02, from: <http://pespmc1.vub.ac.be/papers/PapersFH2.html>
- [8] Ashby, W. R. *An Introduction to Cybernetics*. 1956, London: Chapman & Hall.
- [9] Garrido, P., *Collective Intelligence*, in *Encyclopedia of Virtual and Networked Organizations*, G. Putnik & M. Cunha, Eds. 2008, New York: IGI Global.
- [10] Minsky, M., *The Society of Mind*. 1987, Simon and Schuster.

- [11] Szuba, T. M., Computational Collective Intelligence. 2001, John Wiley & Sons.
- [12] Handbook of Collective Intelligence. 2008, The MIT Center for Collective Intelligence. Retrieved 2008-06-03 from:
http://scripts.mit.edu/~cci/HCI/index.php?title=Main_Page
- [13] Collective Intelligence. Wikipedia – The Free Encyclopedia.
Retrieved from:
http://en.wikipedia.org/wiki/Collective_intelligence
- [14] Noubel, J. F., Collective Intelligence, the Invisible Revolution. 2004, TheTransitioner.org. Retrieved 2006-12-02 from:
http://www.thetransitioner.org/wen/tiki-list_file_gallery.php?galleryId=1
- [15] Zara, O., Managing Collective Intelligence: towards a new corporate governance. 2004, Axiopole Publishing. Retrieved 2006-12-02 from
http://www.axiopole.com/pdf/Managing_collective_intelligence.pdf
- [16] Surowiecki, J., The Wisdom of Crowds. 2004, Doubleday.
- [17] Garrido, P. & Faria, N., Design of a Social Decision Support System for Organizations, accepted for publication in Proceedings of the Controlo 2008 – The Eight Portuguese Conference on Automatic Control, J. Boaventura, Editor.