Holarchical Model for Regional Sustainability Assessment[1]

Rodrigo Jiliberto Herrera
Economist, MSc. Director of TAU Environmental Consulting
Santa Matilde 4
28014 Madrid, España
rjiliberto@taugroup.com

Abstract

The epistemology of sustainability sways between two polar opposites that make up a unified system.

On one hand we find what can be described as representationalist, for which sustainability is the result of juxtaposing certain economic, social and environmental aspects of reality.

However, complexity and uncertainty are the most relevant epistemological results of trying to define sustainability as an "objective" entity derived from adding analytical perspectives. These two concepts constitute the foundation on which the transitive epistemology of sustainability is built.

Complexity and uncertainty lead to the conclusion that Sustainable Development (SD) cannot be expressed and, therefore, the problem of what to do does not depend so much on the description of the object we want to act on, but on **how** we decide what to do.

The methodological and epistemological proposal that has guided the development of the Sustainable Development Strategy for the Region of Murcia is equidistant from the two options analysed. It is based on heuristic, enactive, participatory and contingent epistemology for the study of sustainability.

It is based on the belief that it is necessary and possible to constitute sustainability as an analytically coherent (i.e., non-arbitrary) object of knowledge which is at the same time autonomous from the analytical-fragmentary descriptions that comprise standard scientific knowledge. In the middle of this epistemology is a systemic ontology that tries to grasp the holarchical inter-existence of the outer world and focuses primarily on contingent management from an integrated viewpoint rather than on certainty and planning.

Introduction

The theoretical reflections of this paper originated within the framework of the elaboration of the Sustainable Development Strategy (SDS) for the Region of Murcia, Spain. However herewith we will only focus on the conceptual aspect of the methodology applied and not in its actual application for the

transport policy derives from a non-arbitrary diagnosis of the transport system, regardless of the definition employed to describe it.

In this case, it implied that the SDS had to derive from a diagnosis of the present state of regional sustainability.

In this document we present the way in which we have tackled the challenge of defining this object of knowledge known as sustainability, which, as we all know, does not have an analytically operative definition in place to carry out this task. (Ravetz 2000, Holland 2000, Bermejo 2001, Kenneth 2002, UN-SDC 2001)

This challenge demanded a digestion and revision of the short history of the epistemology of sustainability and required us to find a path in order to move through its midst.

The epistemology of sustainability refers to the preconception the analyst has about how he/she has to proceed to know the object of analysis called sustainability. This is clearly linked to the question of what does "sustainability" mean, which is lastly the vision the analyst has about what sustainability is in real, which is his/her sustainability ontology.

The Epistemology of Sustainability

The epistemology of sustainability sways between two polar opposites that make up a unified system.

On one hand we find what can be described as a representationalist, immediate and naïve epistemology of sustainability, while on the other we have what we will call a transitive epistemology of sustainability.

In the eyes of representationalist epistemology, sustainability is the result of juxtaposing certain economic, social and environmental aspects of reality. According to this viewpoint, knowledge, especially scientific knowledge, represents the external world as it is; consequently, the analytical exercise implied by sustainability would only consist in relating the knowledge related to the economic, environmental and social realms as one would be connecting things in the real word.

In fact, this approach to sustainability is so widespread that it is difficult even to find references that attempt to provide it with a theoretical basis: its foundation is taken for granted. A single quotation will serve to illustrate this; the former Deputy Secretary General of the OECD, Mr. Moe Thorvald, stated the following at the opening ceremony of a seminar on sustainable indicators: "Let me conclude by saying that this measurement agenda is important because *´what cannot be measured will not be done´*" (OECD, 2000). But, another example, probably diametrically opposed, is Daly H. and when reducing the problem of sustainability to the determination of a certain stationary state between given things (Daly, 1991). Equally representationalist is the position held by Pearce D. who, in accordance with the tenets of neo-classic environmental economy, defines sustainability in terms of objective restriction to the economic maximisation function, i.e., in terms of quantifiable objective entities placed in their optimum state (Pearce D., 1990).

Sustainable development, like other objects of knowledge, would be a state of things to be attained in the external world, characterised by a balanced achievement of the different aspects of the known external world, such as the economic, social and ecological/environmental spheres. The task consists in representing these worlds and, in view of them, deciding where the balance is to be struck.[2]

However, not all knowledge has the same validity in this epistemological matrix; hence, it will always be better to define SD from different scientific languages that deal with economic, social and ecological aspects, because scientific knowledge, *per se*, "objectively" knows the external world.

Unfortunately, the operative results of this epistemology have been rather disappointing. Even now, sustainability is a difficult operative entity. Regrettably, the juxtaposition of different analytic-fragmentary constructs, such as economic, social or ecological concepts, does not give rise to a new epistemological entity, although a narrative is obtained[3].

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[2] An intermediate path, which does not escape the underlying epistemological issue, is to consider that an SDS merely requires setting balanced economic, social and environmental objectives or principles, without placing overdue emphasis on the need for tackling the analysis of the "real" interrelation among those systems for which objectives are being defined. (UN-SDC, 2001; OECD, 2001a y 2001b)

[3] It is interesting to confirm that one of the final observations of an exhaustive review of the studies on models and scenarios (dealing with, among many other topics, sustainability) carried out over the course

In this sense, to maintain that the knowledge of SD derives from juxtaposing different analytical-fragmentary perspectives does not represent a contribution to the discipline. It is even less useful to maintain that SD is the balance among all these perspectives, because for a balance to exist between objects of a different nature, there has to be a common unit of measurement that determines how much of one compensates for the other, something impossible to achieve when juxtaposing atoms, cells, prices and symptoms of social discontent.

The fruitlessness of the representationalist epistemology of sustainability has rapidly led to the other epistemological pole in which sustainability cannot be represented. Sustainability cannot be expressed if there is no *lingua franca* between the different disciplines (economic, social, ecological) that contribute to it[4].

Complexity and uncertainty are the most relevant epistemological results of trying to define sustainability as an "objective" entity derived from adding analytical perspectives (Funtowicz S., Ravetz J.R.,1994). These two concepts constitute the foundation on which the transitive epistemology of sustainability is built.

Together, complexity and uncertainty lead to the conclusion that SD cannot be expressed and, therefore, the problem of what to do does not depend so much on the description of the object we want to act on, but on **how** we decide what to do (De Marchi B, y Ravetz J.R., 2001; O'neill, and Spash C., 2001).

In this school of thought, the epistemology of SD veers away from the field of the purely rational-objective, which attempts to define SD from a multidisciplinary perspective, towards the study of decision-making processes in an uncertain and complex context, i.e., without objective foundation. In other words, it focuses on decision-making situations where the key challenge becomes how to make public decision-making processes more open to citizens. That is why we describe it as a transitive epistemology of sustainability.

Both extremes of the pendulum between which the study of sustainability sways tend to dismiss non-objective knowledge as a valid description tool in decision-making: the objective- representationalist epistemology does so explicitly and the transitive epistemology does so implicitly.

This is obvious in the objective-representationalist view but less apparent in transitive epistemology. However, transitive epistemology equally considers that complexity and uncertainty (which hinder the "objective" expression of SD) are the obstacles that prohibit the construction of sustainability as an object of analysis and lead to the establishment of an alternative epistemological programme that focuses on the study of **how** to decide and renounces the study of **what** is being decided.

In this way, sustainability, as an epistemological problem, is effectively confined to disciplines that study decision-making. The epistemology of sustainability is simplified as it is centred on a linear and monological object: the decision-making process.

Towards a Heuristic, Enactive, Participatory and Contingent Epistemology for the Study of Sustainability

The methodological and epistemological proposal that has guided the development of the SDS for the Region of Murcia is equidistant from the two options analysed. It is based on the belief that it is necessary and possible to constitute sustainability as an analytically coherent (i.e., non-arbitrary) object of knowledge which is at the same time autonomous from the analytical-fragmentary descriptions that comprise standard scientific knowledge.

In this way, SD becomes an autonomous cognitive reality based on a systemic ontology that tries to grasp the inter-existence of the outer world and focuses primarily on contingent management from an integrated viewpoint rather than on certainty.

This epistemology is heuristic because the descriptions which produce it are not only based on analytical languages or the logical rules that articulate them. It is also participatory because its descriptions do not

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of 30 years and commissioned by the EEA, concludes that the issue of integration has not yet been solved. (ICIS, 2000, pag.91)

[4] One current of thought that exemplifies well this approach is Ecological Economics, particularly the European branch of the International Association on Ecological Economics (De Marchi B. y Ravetz J.R., 2001; Spash C. Y Canter C., 2001; O'neill J, and Spash C., 2001) (Söderbaum P., 2000).

presuppose a subject-object disjunction; rather, the cognitive subject is fully inscribed in the description, giving rise to participated worlds. Thirdly, it is enactive because it understands that the description responds to a cognitive process in which the cognitive system enacts a world not as an objective representation but as a world that emerges from an integrated act of knowledge and action, i.e., from a linguistically-oriented action. Finally, it is contingent because the knowledge outlined is useful for generating contingent feedback here and now, which in this case is a SDS (Jiliberto R., 2001a).

Under this epistemological proposal, SD does not imply the epistemological futility of the descriptions but the futility of the descriptions that aspire towards generating certainty. The certainty-generating descriptions derive from an analytical tradition which has provided excellent artefactual results which the present society values but which are impotent to manage the global balance of the social system (Jiliberto R., 2001b).

Finally, this proposal considers that the transfer of the epistemological axis from the descriptions of the object or SD towards the analysis of public decisions and their rationality implies creating an epistemological emptiness which imprisons us in the analytical-fragmentary description of SD and, what is even worse, keeps us from knowing the object upon which we seek to act. This is a basic epistemological issue because it is only possible to know that which is described.

However, sustainability models based on a he

How can the Integrated whole be described?

The question one needs to solve to go one step further in this epistemological endeavour is how can be the regional realm described as an integrated whole? How can we construct an integrated study object for the sustainability analysis?

The point of departure to construct an integrated study object for sustainability analysis is to understand the region as a single unified system. However, that system is not the algebraic sum of the three systems (economic, environmental and social) and of any others we could imagine, but an entity or system to be identified as the starting point and converted into the analysed object and the object of public action by an SDS.

Representative epistemology fails to describe the regional realm as an integrated whole due to the lack of an analytical foundation which theoretically links the dissimilar aspects to be supposedly considered in the integrated whole (economic, environmental, social, etc.). A merely conventional analytical approximation does not provide a coherent description of that totality which should be the object of sustainability analysis.

This conceptual and methodological lack forces us to base the descriptive effort of the sustainability analysis object on the existing collective experience at the international, European and national levels. In this sense, these communities have made outstanding progress in identifying the aspects of each of the economic, social and environmental spheres that, according to experience, scientific knowledge or common sense, influence sustainability and are therefore part of the system which has to be submitted to a sustainability analysis. In other words, they have started a spontaneous generation process of heuristic models of sustainability which can also be taken as guiding prescriptions (UN-SDC 2001, OECD 2000).

There is no way of describing this system other than starting from concepts of a different epistemological nature, using past experience and common sense, and combining our natural, daily language with our scientific knowledge.

At this point it is useful to introduce the illustrative figure 1.

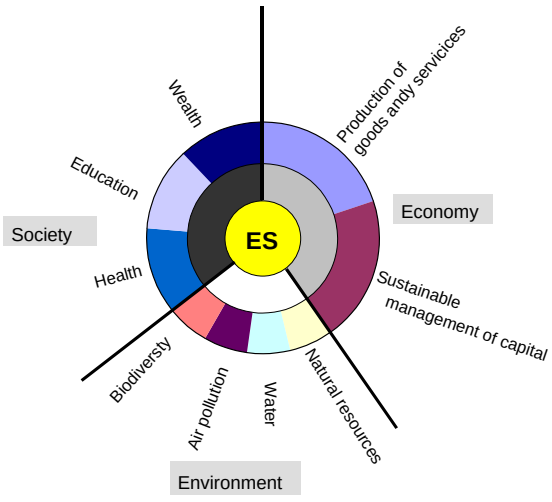

Figure 1: Sectorial Sustainability Aspects

This figure shows, in one of its different versions, what is formally recognised as the magic triangle of sustainability. It can be understood as a proto-description of the system considered as the object of sustainability analysis.

The path chosen in building this dashboard consists in taking a series of issues from each sub-system that affects sustainability, because it is known *a priori*, regardless of whether it is known by formalised knowledge or not, that those sectoral issues affect the balance of other systems and among systems, and ultimately affect the possibility of establishing a lasting pattern of development and improvement of the quality of life.

For example, the consensus accepts that the way in which economic activities employ natural resources affects sustainability. And the way in which they do so determines de degree of efficiency and the degree to which the stock of resources is preserved.

It is clear that this decision does not correspond to standard scientific procedure. It is rather a social process guided by scientific knowledge and by a great number of social, political and economic variables.

This process reveals that implicitly there is a criterion to include one aspect or another in the description, and this criterion is its relational potential within the system. This model reveals that what should be described is the systemic functioning on which social reality is based according to the analytical question sustainability implies.

The model also reveals there is an object of analysis behind that description that distinguishes itself from each of the variables used to describe it.

Hence, the description of this realm, which we will study in order to determine its sustainability level, is an analytically oriented description and not an empirical description derived from an innocent view of reality. This analytically oriented description already has an important legacy of experience in order for that description to be attempted with reasonable levels of consistency in almost any society.

This approach to sustainability, which could be considered systemic, is a starting point and an adequate example of what we call a heuristic, enactive, participatory and contingent epistemology of sustainability.

The radical epistemological difference between these standard analysis exercises of sustainability and the approach set forth here stems from the fact that in our case we consciously assume that the issue described in the figure 1 is an analytical tool designed for describing an analytical object that goes far beyond a pile of fragmentary aspects of the economic, social and environmental reality identified.

We assume that the result of the description is an autonomous entity, whose rules of behaviour can(b)Tj10.02 0 0 10.0215.0 1 5

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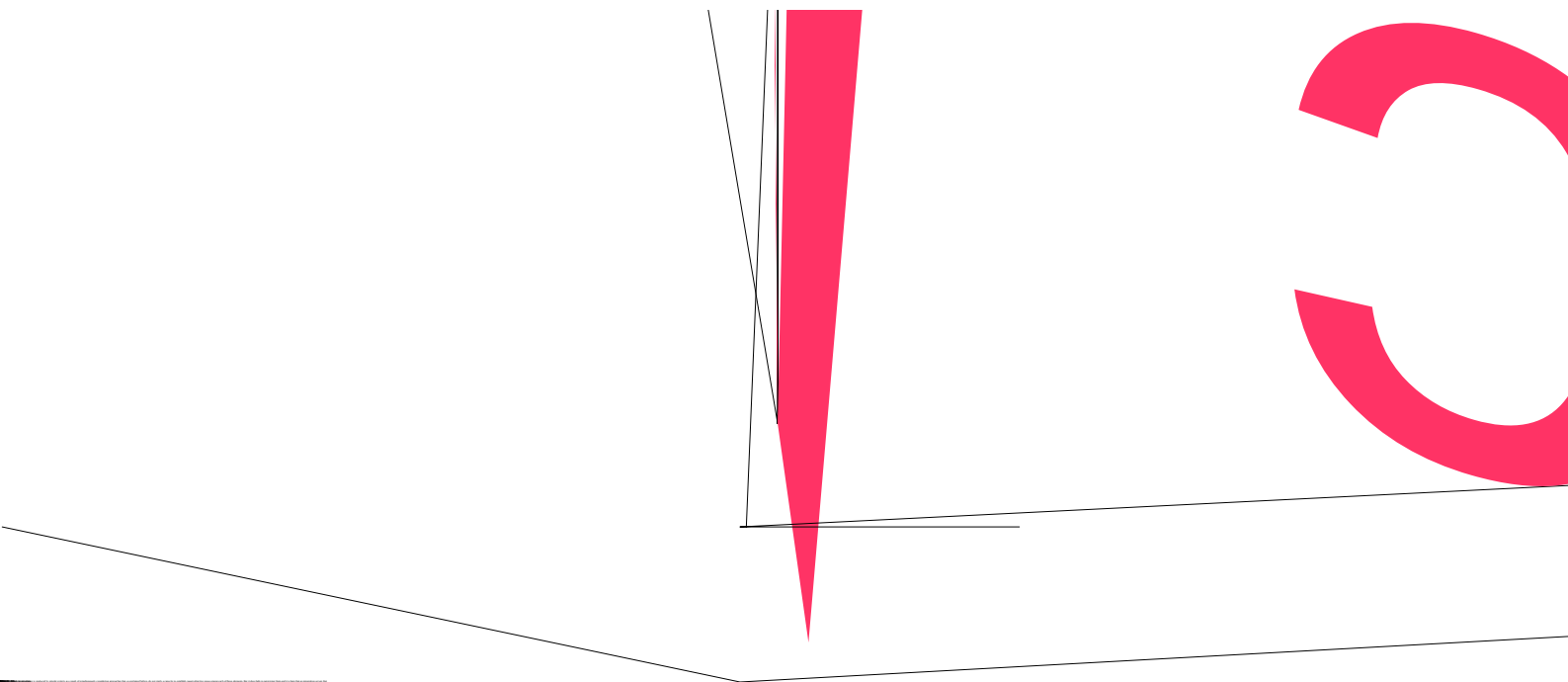

Therefore the next methodological step is to attempt from an proto-description to jump to a actual systemic description of the regional realm. In doing this it is always the cognitive weak integration tool, which play the major role.

This type of exercise is not new. A very well-known exercise is the systemic model utilised by the Club of Rome to elaborate its report "Growth limits" and later improved for another report "Beyond limits" (Medows D. *et al*., 1972; Medows D. *et al*., 1991).

The analysis of systemic models is not the aim of this article; it is only interesting to point out an aspect that has obliged us to go slightly beyond it. Fist of all lets introduce an example, based on the Murcia case of what we called flat systemic description.

The figure 3 shows the interrelations identified among different sustainability aspects valid for the sustainability analysis in the Murcia Region in a shape according to System Dynamics modelling. It is no longer a graphical-analogical description but a logical description of causal relations among sub-aspects where different levels of influence can be identified.

It is important to point out that those arrows in the figure have the same epistemological nature as the rest of the exercise. It is a heuristic identification effort of relations among entities and not a theoretical-objective exercise, which does not imply that these are arbitrary.

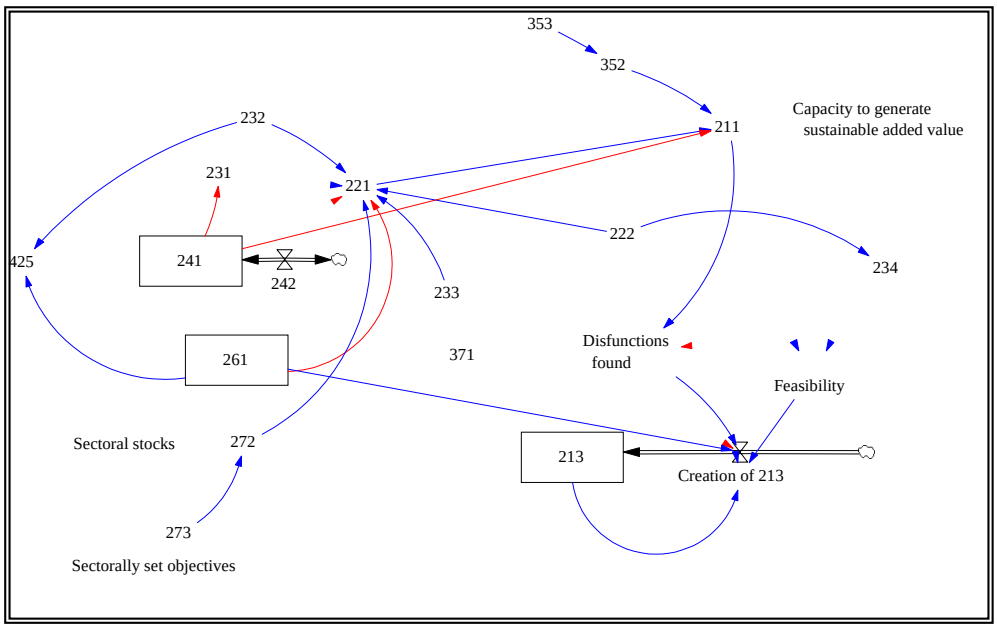

Figure 3: Systemic relationships expressed in System Dynamics Language

What we would like to stress here is that the simple description of functional relations between different parts of the system does not reflect a hierarchical logic of the sub-systems or of the parts under consideration. In other words, the emerging model describes relations among the sub-systems but all of them are equally important for the functionality of the systemic whole they represent. *A priori*, all of them are placed on an equal footing[8].

This implies a problem for sustainability analysis because if all are equally important, there does not emerge a new object of analysis to be submitted to a sustainability analysis. In fact one can say that there is no new system.

A whole, in order to be one, imposes certain order upon all its constituent parts that transcends the order of each individual part. If all the relations we identify lacked a higher functional hierarchical order distinct from the mere interrelation of two parts, we would not have a new totality. If sustainability were limited to the correct operation of all the functional relations among sub-systems, there would be no object of analysis from which to attain sustainability.

[8] Given their feedback potential, some are more relevant than others, but this does not derive from an *a priori* logical hierarchy.

Due to the lack of a greater whole, sustainability would be reduced to simply making each sub-systems function on its own, which could be achieved by an adequate flow of all functional relations among sub-systems.

In other words, the conclusion of the systemic sustainability analysis would be reduced to simply pointing out that the identified relations must continue without catastrophic interruption in order to let each sub-system continue functioning.

The Achilles heel of reducing sustainability to the criterion of "making relations function" is that it does not allow us to deduce a course of action in order to insure sustainability apart from the mere repetition of those courses of action derived from analysing each sub-system separately according to its own logic. This fact transforms sustainability analysis and strategy into a mere aggregation of sectoral analyses and policies. [9]

The model used by the Club of Rome or any other systemic model cannot determine an objective causality behind the interdependences it identifies. Hence, the "non causal-objective" nature of its description impedes the determination of the degree to which the economic sub-system, for example, must function in order to make the natural system work correctly. This limitation makes the cognitive goal "keep the system functioning by identifying its thresholds" in itself unreachable.

In order to go beyond this point, it is necessary to overcome the flat vision of systemic relations. But it is not easy as there is not enough research or evidence. The following section is an attempt to make some progress along these lines.

The Holarchy of Sustainability[10]

The starting point of this reflection is that the relations identified in a sustainability analysis have not all the same relevance and therefore do not have the same meaning for the policy instrument to which the analysis is an input, in this case a SDS.

For regional sustainability**,** the fact that industries discharge wastewater with a larger or smaller pollutant load does not have the same relevance as, for example, the lack of an appropriate environmental information system. At a first glance, the latter is more relevant for regional sustainability because if no aggregated information exists at the regional level, we will not be able, with the help of regional policies, to deal with water pollution from industry.

For an individual living next to the industrial discharge of wastewater, these facts are not at the same level nor do they occupy the same hierarchical niche as in an SDS. For that person, industrial discharge is evidently located at the highest level of priority. And he/she might care very little about regional information regarding the discharge if the industry agrees to improve wastewater quality. In other words, the "facts" of relations among subsystems identified should be relocated in a logical structure based on the intention of the cognitive tool being built.

In order to attain this, we should provide a hierarchical framework with a coherent sustainability logic. We have already seen that integration is the very important issue for sustainability and this is why sustainability analysis uses systems theory as it relates "things" and understands them as an interrelated whole. A step further would be to consider this whole as hierarchically related. A system of hierarchically related systems can be considered a holarchy; it is a hierarchically organised structure made of holons, i.e., totalities which at the same time are parts of greater wholes.

The usefulness of defining the holarchy of sustainability will be explained below. Let us first see how we can imagine this holarchy.

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[9] Conventional sustainability analysis carries out a very similar process, see for example Local Agenda 21. See also the methodological guides available (ICLEI, 1995) with outstanding exceptions (Ajuntament de Calviá, 1997).

[10] The ideas developed in this chapter are specifically based on the ideas on holarchy discussed by Ken Wilber, who evidently inspired himself on the ideas developed by Arthur Koestler (Wilber, 1998, 2000, 2001).

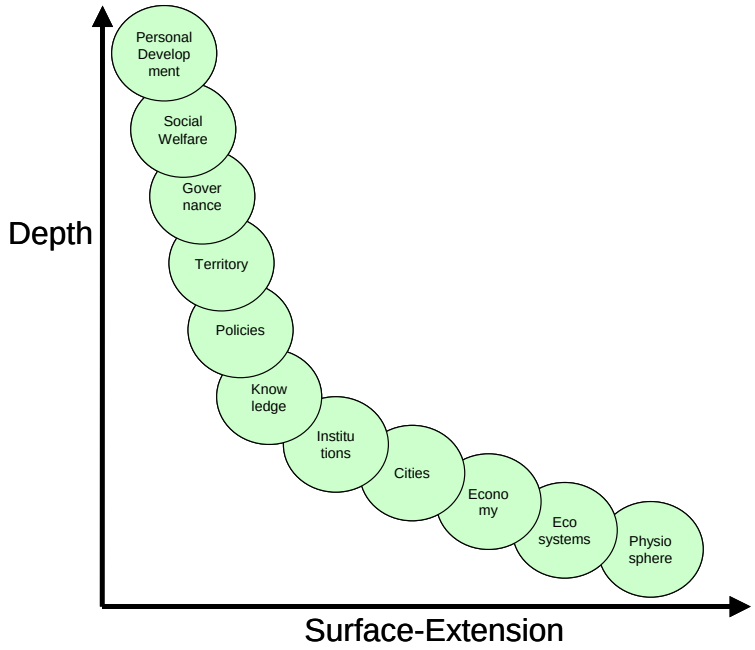


Figure 4: The Holarchy of Sustainability

The illustration of figure 4 displays a hierarchy of sub-systems which would integrate the sustainability holarchy for the Region of Murcia because it closely follows the structure used for the elaboration of the SDS of the region. Its structure is an open proposal.

The holons which comprise the regional sustainability holarchy are as follows:

- The physiosphere, defined as the whole comprised of compounds of materials and energy and its flows
- The biosphere, defined as the whole comprised of living systems and their dynamics
- The economy, defined as the sum total of productive activities in the conventional sense of the term
- Cities, in the conventional sense
- The territory, in both meanings of the term: in the physical sense, composed of its structuring elements, and in the conceptual sense, as the result of grouping together these elements in order to give rise to the idea of a territory
- Institutions, essentially, but not only, public institutions
- Policies, understood basically as the capacity for strategic proactivity
- Knowledge, in the sense of knowledge organised into specialised structures
- Public welfare, understood basically as the sum total of guidelines for social equality
- Governability, understood basically as the emergence of a new form of government that complements representative democracy and is based on the rationality of deliberation.
- Personal development, understood as the sum total of aspects that determine the development of the individuals belonging to a society

This structure corresponds to a contingent, as opposed to universal, logic and is evidently normative in character. It does not contain an objective truth about the way things are, or about how they have been historically, but rather is a heuristic narrative on how things are here and now for a given collective that permits the articulation of a rule-based and hierarchically structured valuation of the relationship between the different regional systems. Its veracity can only be determined according to plausibility and according to its operational usefulness when understanding the hierarchy that exists in identified aspects that matter from a sustainability point of view

The discourse this holarchy wants to transmit is simply as follows. The physiosphere is the basis of the entire system and the biosphere emerges from it as the first new quality. The economy depends upon the biosphere and the physiosphere; in other words, they are preconditions for its existence. Likewise, cities emerge once the economy is implanted in a society. The territory, understood as its physical components, emerges when cities and its interconnecting infrastructures come into being. And once territory comes into being, it is possible for institutions to develop in order to wield power over the territory and to have a spatial jurisdiction. It is only after institutions appear that the possibility emerges of strategic thinking on a social level and this is when policies come into being. Organised knowledge is rooted in strategic thinking, on the idea of organising knowledge in order to act. Social welfare is the result of a deeply profound social and reflexive exercise; it represents a highly elevated expression of social values and is very high on the holarchic scale. Governability is the result of self-reflection on the part of knowledge and of the practice of values of justice and institutional action. It sows the seeds of a new type of reason that gives pride of place to simple and unconditioned deliberation. Finally, personal development is the end product of the holarchic scale, which is a horizon in perpetual evolution.

In the holarchic chain, sub-systems or holons are located on a Cartesian plane whose horizontal axis charts the surface or extension of the holon and whose vertical axis represents the depth or complexity of the holon.

For example, the physiosphere is a highly superficial, i.e., extended, holon because all the holons located above it contain physical aspects. However, the physiosphere reveals a much lower degree of complexity and organisation than ecosystems or the biosphere. In this sense, the biosphere is much smaller in terms of surface (less extended) but ranks higher in terms of depth than the physiosphere.

Thus, for example, the physiosphere is present in the biosphere but not vice versa. It is for this reason that the biosphere occupies a higher hierarchical rank than the physiosphere within the holarchy. The same holds true between the economy and the biosphere, or ecosystems. Ecosystems are in the economy, but not vice versa. Utilitarian productive activity is less extended than ecological productive activity, but is more complex and has new attributes that ecological production does not possess. It imposes new modes of organisation on the ecosystem and thus has a higher level of depth.

Cities, or human settlements, constitute a less extended holon in terms of surface than productive and economic activities, but they are on the other hand more complex than these activities. They would not be possible without economic activities and thus, they incorporate these, but they take them further since they presuppose a higher order of organisation for economic activities.

Institutions are unthinkable in the absence of cities but represent an equally higher level and a factor that shapes and conditions cities. They are less extended but more complex than cities.

The holarchical properties

The systemic health of the holarchic chain is determined by the full functioning of two basic holarchic properties: differentiation and integration. The following illustration in figure 5 is a simplified version of the whole holarchy chain, and helps us to explain in the following chapters the two mentioned holarchical properties.

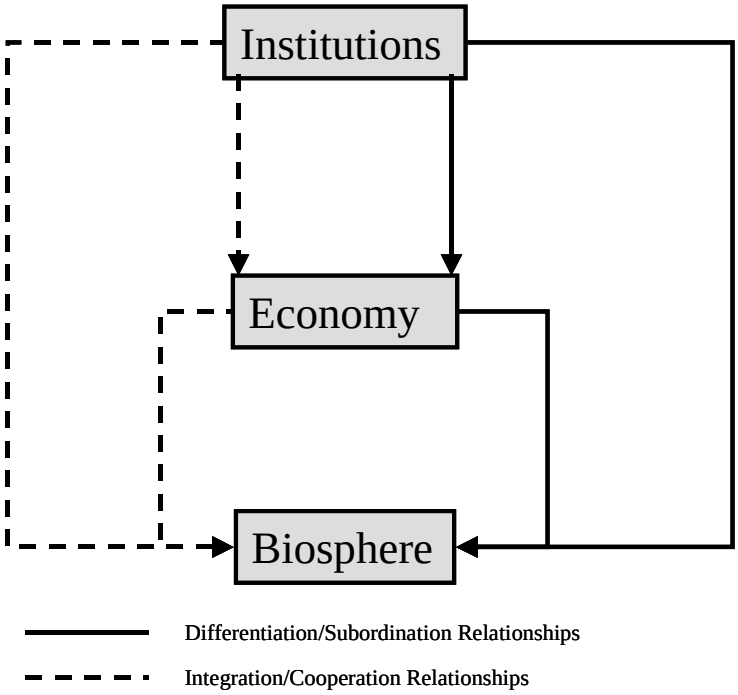


Figure 5: Holarchical relationship

The differentiation holarchical property

The differentiation property has to do with capability of the upper holons to differentiate themselves from the holons located lower down the chain. Thus, for example, in order for the economy to become a successful system it has to differentiate itself from the biosphere and the physiosphere and has to go far beyond what either of them provide.

Human economy transcends the economy of the biosphere, which ar

The integration holarchical property

The integration property has to do with the fact that the holarchic chain would not function if the upper holons, in addition to differentiating itself, did not also integrate the lower holons. Integration means to consider in its own logic the needs of the lower holons.

This is the moment of appearance of the relationship from upper holons, which in addition to subordinating the lower ones must also integrate them. If we look at the illustration of figure 4, just as in the case of relations of differentiation, there are as many relations of integration as there are lower holons.

The lower holons perceives the integration from the upper holons as a relationship of cooperation. A holon will have as many relations of cooperation as the holons located above it on the holarchic chain.

This relation of dependence among the lower and upper holons replicates itself in a systematic way along the holarchic chain. The upper holon is unthinkable without the lower one, and thus integrates it, but simultaneously conditions and accommodates the logic of the upper holon. The lower holon is at once more extended, less complex, and more superficial than the upper holon. It is this greater capacity for organisation and progressive complexity of the upper holon which guarantees that, once transcended, the lower one integrates into the upper holon.

It is thus that the full realisation of the upper holon assures that the lower holon is integrated in a healthy and complete fashion into the upper holon, guaranteeing the stability of the holarchy.

Thanks to this cooperative relationship, the upper holon conserves its equilibrium and recognises the vital needs of the lower holon. The biosphere-economy example can continue to be of use. On one hand, the economy differentiates itself from biospheric production and extends enormously the sphere of utilitarian production far beyond what the ecosystem allows. For that reason, it develops the language of technology. However, since the economy is founded on two systems, it cannot break free from them. If it did, it would axiomatically cease to be a part of this chain. Therefore, it must find a method of integration in order for these systems to continue existing, and the only way the economy has of cooperating with these holons is to internalise the environmental externalities, for instance. This internalisation happens in several ways, but it is necessary in order to prevent differentiation from leading to a pathology.

But, a healthy holon in this holarchic chain is also a holon subordinated from above. When it was stated that the economy needs to cooperate with the biosphere by internalising the costs of exploitation, it is easy to think that this is not frequent. What is now understood is that the economic holon, in order to preserve a healthy relationship with the holons from which it differentiates and subordinates itself (physiosphere-biosphere), must also be subordinated by the upper holons. For that reason, holons above the economic sphere must have distanced themselves sufficiently from the economy. Therefore, a lack of integration/cooperation between the economy and the biosphere reveals, simultaneously, a lack of differentiation between the holons above the economy, which, overimbued with economic language, cannot adequately subordinate it.

Another example: if the urban sphere and the particularity of urban social life do not develop their own interests and languages and ways of seeing things, it is very difficult to condition economic activity in the cities. It is thanks to the differentiation of the urban sphere from the strictly economic point view that cities emerge as a new and distinct entity, capable of subordinating economic activity. The urban must in its turn order economic activity; it must integrate it and determine the place of the economy within its urban order, because the urban sphere needs the urban economy. But at the same time this is taking place, the institutional aspect within cities needs to be enough differentiated and be able to subordinate the pure urban logics.

The holarchical pathologies

A holarchy is susceptible to pathologies. These pathologies arise when holons do not develop their respective properties of differentiation/subordination and integration/cooperation along the holarchic chain.

The crucial point for the proper functioning of a holarchy consists in these properties being carried out in a thorough fashion through the totality of the holarchic chain. As seen previously, the capacity for a holon to transcend and cooperate with the lower holon does not depend exclusively upon itself but on the functioning of the entire holarchic chain.

The economy is not an end in itself but rather functions according to the dictates of an entire series of upper holons that determine its meaning. Thus, personal or individual development sits at the summit of

the holarchic chain of sustainability. Therefore, the capacity for the holon to transcend its lower holons depends also upon the degree of differentiation of the personal development holon from the intrinsic logic of the economic sphere.

In other words, if the average citizen has not transcended the economic-material as a basic means for his or her personal development, the economic sphere can hardly transcend and integrate the biospheric and physiospheric holons in a healthy fashion and, on the contrary, will tend to identify with it. This identification will translate into a motivation to fully colonise and eventually annihilate the lower holons.

Furthermore, the economic holon´s capacity for efficiently transcending and integrating in a healthy fashion its lower holons depends upon the degree of differentiation of the institutional system from the lower holons. For example, it will depend upon the holon´s degree of differentiation and how far it has transcended merely economic criteria, values, and interests. The more developed the logic and language of the institutional-democratic sphere, and consequently the greater its independence from the rules of the economic holon, the greater the possibilities for the economic holon to effectively transcend the biospheric and physiospheric holons.

Therefore, the global development of the capacity for transcending the entire holarchic chain is what insures that each holon, in addition to being completely transcended by the upper one, is also integrated and preserved by it, in order for it to keep fulfilling its functions.

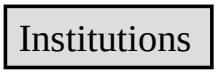
The key tool for complete integration of the holarchic chain lies therefore in the healthy differentiation of each holon from its preceding holons in the complete development of its own languages. In this way, each holon will exert pressure so that the lower holons will also develop more intensely their differentiation and cooperation processes vis-à-vis lower holons.

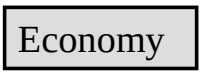
Only if the institutional holon develops its own language, which is the common good and political democracy, the discourse of consensus and strategic vision, will it be capable of subordinating the economic holon by orientating it towards cooperation with the lower holons. The institutional holon in its turn, in order to fully develop this language, must be subordinate to the higher ones and must be compelled to fully develop its own nature.

What happens inversely is that, in the absence of a sufficient development of the holon´s own language, it tends to adopt and mime the language of the lower holon. In this scenario, cities, instead of being perceived as a new emergent form, try to be understood as a mere extension of the economy, understandable in terms of pure economic competitiveness, for example, or the territory is placed at the service of the cities, and so on.

The holarchical functions

Two structures or manifestations become readily visible or comprehensible at a first glance of the holarchic totality: sustenance, on one hand, and realisations, on the other. The following graph illustrates this fact.





Realisation fu

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ena n uncdeio n res n oa ace r idut.oT h si ifer le tn r eisaidl np ord u ord tniin i s h e s ,
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nce/realisation.

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is point t si i eb aunsleryandt ha thtolo n, s hea ysv h e t pe inx eh de ere, utoanom
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h re mus lain e sy, uof im gn nida io uble tuhan tims t b p ra esde ny ic lay hi d eotb ehle a

i

It is important to point out that the description implicit in it does not provide the basis for any predictions. Most of the models that try to represent sustainability in a similar way do not achieve this because it is not in their epistemological nature (Kindley S.J., 2001, ICIS, 2000).

An interesting question would be to enquire whether they should even attempt to be predictive.

Heuristic models such as the one presented here, and any model used to represent sustainability, do not describe a "pure and objective" state of things, even though it is a representation of a state of things.

Therefore, it seems inappropriate to pretend that we are foreshadowing the shape of things to come because, quite simply, we are not dealing with "things", whose behaviour is independent of the way in which see and describe them. We are dealing with things in whose descriptions we are involved.

The holarchical models are partly and truly the shape of an inner state of things. They are the formal description of an inner understanding on our part, who as a members of a society, build these models about a certain state of things.

In this sense, they are in themselves an artefact that reveals a certain state of social consciousness. However, they in no way express things that can be manipulated at a later stage in order to make forecasts. Nor do they express things that can be manipulated in order to answer questions such as "what would happen if?" prior to building scenarios. In this sense, our position differs from those who interpret the capacity for building scenarios as the chief advantage of sustainability models. (McEvoy D., Ravetz J. 2001)[11]

The only manipulation to which these models could be subjected would be something along the lines of: what sort of representation of the regional sustainability holarchy would come about if, instead of elaborating it with a group made up of 80% men and 20% women, we built it with equal percentages of men and women?

Analytical heuristic models for regional sustainability do not represent purely things but rather, and at most, a unit of knowledge composed of an exterior, which are those designations we use to represent it (the economy, the environment, society under its many guises) and an interior, which is the way in which we relate these things starting from the integrated vision hatched in our social consciousness.

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[11] An extensive production of models for generating scenarios is effectively based on an epistemological programme similar to the one defended here, but does not draw the same conclusions about the heuristic nature of this sort of exercise. This is due to the fact that heuristic models for the most part reflect an external reality which is susceptible to manipulation in a certain sense, with a cognitive added value. In actual fact, they do not assume that the epistemological nature of the information that goes into the decision (heuristic, participative) forces us to modify the nature of the decision, which comes to acquire a contingent nature. Under this new decision-making framework, the generation of scenarios of the type "what would happen if?" based upon heuristic participative models is inconsistent.

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