SYSTEMIC REGIONAL DEVELOPMENT
- A SYSTEMS THINKING APPROACH

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ABSTRACT

Rapid change is occurring in regional (non-metropolitan) areas in relation to a wide range of natural and human-mediated forces and is taking place at various temporal and spatial scales. Attempts by governments of different persuasions to confront the challenges have partially succeeded or failed altogether. A novel and integrative approach is required to analyse, plan and manage the sustainable use of ecosystems, resources and biodiversity in regional systems. Based on systems thinking concepts, especially from cybernetics and complexity science, the approach, termed systemic regional development, is put forward in this article.

Key words: systems thinking, sustainable development, regional system, systemic intervention, boundary critique, methodological pluralism, essential variables

Introduction

Regional (non-metropolitan) systems are important as areas for homes, work, and recreation, as well as the main providers of ecosystem services. They are, however, undergoing rapid change through a wide variety of natural and human-mediated driving forces. Among them are the ever-increasing trends towards urbanisation, encroachment by expanding cities, community-change in the form of demographics and family structures, and also mechanisation of the natural resource sector (Brandt et al., 1999; Ramsey and Bryant, 2004; Bürgi et al., 2004). Concomitantly, the organisations that have been responsible for managing regional systems are also changing.

Regional change has direct impacts on the environmental components of the system, such as biodiversity, soils, water and the atmosphere; regional change is thus directly related to many environmental issues of global importance (Meyer and Turner, 1994; Lambin et al., 2003; Millennium Ecosystem Assessment, 2005; Koomen et al., 2007). Climate change is a newly perceived environmental stressor with potential major consequences for the survival of humanity and the Earth's ecosystems (IPCC, 2007a,b,c,d), and is integrally linked to regional systems.

Attempts by governments of different persuasions to confront the challenges posed by regional change and its impacts have either partially succeeded or failed altogether (Light et al., 1995; Diamond, 2005; Capistrano et al., 2005). Analyses of the failures show that conventional regional development approaches are based on false or partial theories and assumptions, which has led to the formulation and implementation of flawed development policies. In particular, conventional approaches have not kept pace with the speed of changes that alter and control development processes in large-scale, coupled natural-human systems (Lee 1993; Daly, 1997; Gunderson and

Pritchard, 2002). Poor understanding of their systemic behaviour has diminished our ability to formulate effective policy responses (Gunderson et al., 1995, State of the Environment Advisory Council, 1996, 2001; Gunderson and Holling, 2002).

A consensus on the nature of the problematic situation is however emerging. Regions are extremely complex and dynamic systems, and many of the regional issues involve the additional complexity of synergistic interactions between them (Norgaard, 1994; Levin 1999; Holling, 2001; Berkes et al., 2003). This complexity creates an insurmountable barrier for traditional disciplinary approaches. Phenomena whose causes are multiple, spatially diffused and involve human activities cannot be comprehended, let alone planned, through scientific research organised along narrow disciplinary lines (Churchman, 1968; Checkland, 1981; Meadows and Randers, 1992; Holling and Meffe, 1995).

A novel and integrative approach is thus required to analyse, plan and manage the sustainable use of resources and ecosystems in regional systems in the 21st Century – this approach is termed in this article *systemic regional development.* Several key concepts require a succinct discussion prior to introducing the approach.

Sustainable development

The modern conception of sustainable development grew up from the debates of the 1960s and 70s, when eminent scientists drew attention to the impact of chemicals on humans and the environment (e.g. Carson's *Silent Spring*, 1962). It had also its roots in the idea of a sustainable society (Brown, 1981) and in the sustainable use of renewable and non-renewable resources (International Union for the Conservation of Nature, 1980). The World Commission on Environment and Development (WCED) adopted the concept and launched it into political and academic discourses. It was defined as "development that meets the needs of the present without compromising the ability of future generations to meet their own needs" (WCED, 1987). Since its introduction, the concept has given rise to considerable debate and concerns (Robinson, 2004; Norton 2005; Thompson, 2007). It has been contended, in particular, that ecological and social thinking must be incorporated into decision making processes (Daly, 1992; State of the Environment Advisory Council, 1996, 2001). Several authors have also emphasised ecological, human/social and economic factors as the *pillars*, or viewpoints, of sustainable development (Yencken and Wilkinson, 2000; Dresner, 2002; Munasinghe and Swart, 2005; Kates et al., 2005).

The 2002 World Summit on Sustainable Development marked a further expansion of the conventional definition with reference to those three pillars. The Johannesburg Declaration on Sustainable Development (4 September 2002) set up "a collective responsibility to advance and strengthen the interdependent and mutually reinforcing pillars of sustainable development – economic development, social development and environmental protection – at local, regional, national and global levels" (http://www.housing.gov.za/content/legislation_policies/Johannesburg.htm).

A sensible basis for long-term decision making on sustainable development is therefore the approach depicted in Figure 1. This, at a broad level of aggregation, gives explicit recognition to four sub-processes of development taking place within a set of corresponding *fields* (or domains) or *spaces*. The sub-processes are conceived of as tied together in a system of relations of interdependencies and they affect several spatial and temporal scales. Accordingly, sustainable development must be analysed concurrently in *ecological (or biophysical), socio-cultural, economic, and politico-administrative (or organisational) fields, or spaces*. This approach is based on the consideration of *topological spaces* as advanced by the economist Perroux (1964a, 1964b) and extended by the economist Lasuen (1972, 1973).

Driving forces (Bürgi et al., 2004; Nelson et al., 2005) operate in each of the fields and each field has specific strategic objectives. The ecological field focuses on protecting the integrity and resilience of ecosystems, biodiversity and the physical characteristics of the environment. The economic field is mainly geared towards improving human welfare, primarily through increases in the production and consumption of goods and services. The social field is concerned with enriching human development and relationships, as well as addressing concerns related to social justice and the promotion of greater societal awareness on environmental issues (O'Riordan, 2004). The politico-administrative field is, by its nature, different to the others. The view that sustainable organisations/institutions are crucial for the realisation of sustainable development is supported by initial evidence from development studies in developing countries (Brinkerhoff and Goldsmith, 1990), and more recently by studies in developed countries (Dunphy et al., 2000; Dimitriou and Thompson, 2001; OECD, 2002; see also Gunderson et al., 2002b).

Changes in one of the fields have an effect on the others and cause changes in them. Transformations in the various fields can thus be produced either directly, by changes that are taking place (or by making changes) in a given field itself, or, also indirectly, by changes occurring in (some of) the other fields and causing repercussions in the first one (Lasuen, 1973).

Regional system

A country (e.g. Australia) or a state (e.g. the State of Victoria) can be considered as a system of interacting sub-systems; each sub-system being a region which is more or less integrated into the larger system. In other words: (i) the elements of the country, or the state, can be looked at in such a way that they form clusters of sub-systems which interact through a number of relationships; and (ii) each of these clusters refers to a region. The national/state system of regions is, in turn, a sub-system of the international system (i.e. the supra-system) and is thus subject to driving forces in the global setting as well as those that actuate within (Hilhorst, 1971).

Consistent with the interpretation of sustainable development, diagrammatically depicted in Figure 1, the regional system is thought of as composed of four (sub-)systems existing within a set of corresponding (topological) spaces – ecological (or biophysical), socio-cultural, economic, and politico-administrative (or organisational) (Figure 2).

The very concept of a regional (supra-)system makes it clear that any sub-system (and its corresponding space) is a selective simplification (and abstraction), implying *boundary judgements* (see the next section) about the inclusion of some elements and the exclusion of others. When the purpose is a cognitive one, the sub-system of interest will include those elements necessary to explain or describe the phenomena that interest us. When the purpose is normative, the sub-system must be described with a view to the effectiveness of policy and action upon it. Thus, the very definition of a 'region' will vary with both the type of interrelations being considered and the purpose of analysis and systemic intervention. For instance, a region defined for catchment management will be different from one defined for the measurement of the economic multiplier effects of an investment. Implicit in this discussion has been the level of abstraction. That is to say, the concepts of socio-cultural, economic or organisational spaces are at higher level of generality than the concept of geographic space.

Systemic intervention

Systemic intervention is defined as *planned action by an agent to create change in relation to reflection on system boundaries* (Midgley, 2000). An agent is considered either a single human being or an identifiable group of human beings in communication and interaction (e.g. a project team or an organisation) that have purposes ascribed to them. Three activities embody the core concern of the generic methodology of systemic intervention; these are: reflecting critically upon, and making choices between, boundaries; making choices concerning theory and method – methodological pluralism; and taking action for sustainable improvement (Midgley, 2000, 2007).

Boundary judgements – Boundary critique

Since any attempt to comprehensively study a system is unrealistic (Bunge, 1977; von Bulow, 1989), reflection on its boundaries enables the analyst to investigate options for inclusion or exclusion. The concept of boundary analysis draws together the ideas of Churchman (1970, 1979), Ulrich (1983, 1987) and Midgley (2000). Setting out the boundaries defines both the knowledge to be considered as relevant and the people who generate the knowledge and also have a stake on any attempt to improve the system of interest. Boundary judgments and value judgements are intimately linked; i.e. the values adopted will guide the drawing of boundaries that define the knowledge accepted as pertinent. Similarly, the process of drawing boundaries constraints the ethical stance taken and the values pursued.

Making choices on theory and method – Methodological Pluralism

The second activity is the need for agents to make choices between theories and methods to guide action; this requires a focus on *methodological pluralism* (Mingers and Gill, 1997; Jackson 1997, 2003). If understandings can be bounded in many different ways, then, each of the boundaries may suggest the use of a different theory and, conversely, each theory implies particular boundary judgments. A great variety of methodologies and methods are available for analysis, policy formulation and intervention (Sposito et al., 2008). However, most methodologies and methods developed for scientific research or practice are 'isolationist' in nature since they prescribe 'a one way of doing things' (Jackson, 1987).

Problem solvers normally use a small number of methods with restricted systemic capabilities. They often do not know either the philosophies underpinning the method they are using or its limitations. Each method is limited by the types of issues that it is best deployed to tackle and several methods may be required to tackle the complexity of systems issues. Choice of a suitable method can be achieved through critical reflection of the strengths and weaknesses of each method. The value of being aware of, and learning from, a variety of methodologies and methods comes from the knowledge that no theory or set of theories – whether or not they have been codified into a methodology and its methods – can ever be holistic (Flood, 1995; Mingers, 1997). Methodological pluralism therefore implies that we can draw upon methods originally formulated within other methodologies (and paradigms) and reinterpret them though our own methodology. "This means that, if we are using a systems methodology, even methods outside systems paradigms can be used as part of systemic intervention" (Midgley, 2000, p. 215). Consequently, the essence of methodological pluralism is linking together parts of methodologies possibly from different paradigms.

Taking action for sustainable improvement

The methodology for systemic intervention has to be explicit about taking action for improvement (Checkland, 1981; Checkland and Scholes, 1990). This requires consideration of the two key words: 'action' and 'improvement'. As argued by Midgley (2000), it is not possible to formulate a general definition of action since its meaning has to be determined in local contexts. This does not necessarily imply a geographical locality because the context may be broad in scope; for example, when dealing with international relations, or global environmental problems such as climate change. Indeed, the use of different systems boundaries, theories and methods will give rise to different understandings of what it means for an agent to take action. Similarly, the term 'improvement' has to be defined temporarily and locally as different agents may use different boundary judgments and, hence, what it looks like an improvement to one agent may look like the very opposite to other agent (Churchman, 1968, 1970). Moreover, what constitutes and improvement today may not be considered as such by future generations. The temporary nature of most improvements makes the concept of *sustainable* improvement particularly important. We can say then that an improvement has been realised when (i) a desired consequence has been achieved through intervention and (ii) the sustainable improvement looks like it will last into the indefinite future without unintended negative consequences. The notion of improvement is important because agents are restricted in the number of interventions they can undertake and, consequently, they must make decisions about what they should do and should not do. In other words, agents must prioritise about the possible interventions that are available (Midgley, 2000).

Complementary of the key activities

The three key activities of systemic intervention are complementary. Undertaking one implies doing the other two as well, although the focus may shift from one to the others. The separation is analytical rather than factual, but it ensures the consideration of a minimum set of three perspectives on possible paths for intervention. Making all of them a specific focus of a methodology for systemic intervention guides the reflections of the agent(s) thus ensuring that boundaries, values, theories, methods and action for sustainable improvement all receive explicit consideration (Figure 3).

Intervention through the essential variables of a system

Control in complex systems

As argued above, a regional system can be thought of as comprising four sub-systems in interaction (ecological, socio-cultural, economic, and organisational). Any regional system is therefore exceedingly complex. Now, the notions of great complexity, interaction between systems which are in themselves very complex, and of decision, control and purposive behaviour in systems are the domain (though not exclusively) of *cybernetics* - its key concepts formulated in the 1940s–70s (Wiener, 1948; Beer, 1956; Ashby, 1956; Bateson, 1972). A new understanding of complex systems is emerging to augment cybernetics with advancements in *complexity science*, especially through developments in biological evolution (Prigonine and Stengers, 1984; Kauffman, 1993; Holland, 1995; Levin, 1999). This section therefore first introduces key cybernetics concepts which are later on complemented by novel interpretations from complexity science.

According to cybernetics, there are general laws which govern control processes (whatever the system under governance), and to guide a system is to *control* the changes that the system is undergoing so as it follows an intended trajectory (Ashby, 1956, p. 25). Control is a deeply entrenched feature of contemporary societies. For instance, we control traffic flows through several devices including regulations and traffic signals; we control the effects of climatic variations by constructing suitable dwellings and through the use of heating and cooling devices. This 'command-and-control' approach implicitly assumes that the problem is well-bounded, clearly defined, relatively simple and generally linear with respect to cause and effect. When this approach is uncritically extended to complex and poorly understood systems (e.g. ecosystems), it often results in unforseen and undesirable consequences (Holling and Meffe, 1996).

However, as advanced by Beer: "control is not a mandatory exercise in which people are bullied or things are coerced to operate in a desire way. Rather is it a question of coaxing a system towards optimal performance; or, even better, of arranging for the system to regulate itself" (1966, p. 255). [Despite this clarification, we prefer to use the word *guide* instead of 'control' and *guidance* or *management* instead of 'controlling' to avoid focusing on an unproductive debate regarding such an important biological and cybernetic concept]. According to cybernetics, this is the basic control device used by natural systems. "[Biological] homeostasis is that feature of an organism which holds some *critical variables* steady within physiological limits" (Beer, 1966, p. 289). The most quoted example is the homeostasis of blood temperature – within the human body there are several (positive and negative) feedback loops that operate to keep the body temperature very close to 36.9ºC although the body passes from refrigerator to furnace-room.

V*iability* is defined in cybernetics as the ability of a system to persist under conditions of internal and external changes. Fundamental characteristics of a viable system are: (i) its innate complexity, including complexity of interaction with the environment and complexity of internal connectivity; (ii) its ability to continuously adapt to the changes in their environment, and by this means survive – quite possible in conditions which had not been entirely foreseen; and (iii) its capability of discriminating and anticipating such change - i.e., the ability to forecast (Beer, 1966, pp. 256-257).

The role of 'essential' system variables

Drawing from the biological sciences, Ashby asserted that certain system variables are logically necessarily for guiding complex systems. Each system has a set of states (M) in which the system is viable. "The states M are often defined in terms of variables. The states M1, . . Mk that correspond to the living organism are then those states in which certain **essential variables** are kept within assigned limits" (1956, p. 197, bold text in the original).

Based also on biological concepts, the ecologists Gunderson et al. (2002a) argued that the future state (evolution) of a regional system is determined by the relationships between the capacity for change in the social system and the resilience of its ecological systems. Extending the concept of viability, (ecological) resilience is defined as the ability of a system to persist despite disturbances and reorganise while undergoing change so as to retain basically the same function, structure, identity and feedbacks (i.e. the ability to re-generate). Gunderson et al. also advanced the notion that it is crucial to identify a few *controlling variables* that characterise the system dynamics. "*The organisation of regional resource systems emerges from the interaction of a few [controlling] variables*. The essential structure and dynamics of complex systems are produced by the interaction of at least three, but no more than six, variables that operate at spatial and temporal scales that differ by approximately an order of magnitude" (Gunderson et al, 2002a, p. 17, italics in the original). See also Berkes et al., 2003.

Therefore, Ashby's *essential variables* are notionally similar to Beer's *critical variables* and Gunderson's *controlling variables* [in what follows we will refer only to 'essential variables']. This implies that the guidance of change in a complex system should be attempted by affecting its essential variables and these variables should be kept within certain bounds (limits or thresholds) so that the system viability is maintained. Note that this does not imply 'within prescribed limits'. The point is that there is no satisfactory way of specifying acceptable limits of variation for the essential variables without an analysis of the system dynamics (see also the next section).

An example from climate science will illustrate this and further expand on related concepts. Natural and human systems have been forced by past natural climate variability to evolve or adapt so that most of the time they function within a comfortable range in which they operate well. Sometimes systems exist outside that range in climatic conditions in which they survive, but not well. This is usually termed 'coping range'. Occasionally, natural and human systems experience extreme climatic events that are damaging, sometimes fatally. These events, called natural disasters, can be defined as those falling outside the previous coping range; they include droughts, floods, storm surges and wildfires. Climate change moves the average climate so that comfortable conditions become less common and extreme events become more common or of greater severity. An important concern in climate change studies is therefore to assess the risk associated with changes that will take the systems into more extreme conditions that are damaging or disastrous. From a planning viewpoint, we are thus concerned with the risk of the climate changes that will take the system of interest outside the thresholds of its key climatic variables (e.g. temperature, rainfall, solar radiation) (Willows and Connell, 2003; Pittock, 2005). See Figure 4.

Systemic guidance of regional systems

The above discussion suggests that, in practice, this very important systems concept has been ignored or misinterpreted: only the essential variables of the regional system of interest should be attempted to be systemically managed. It is however necessary to understand the dynamics of the system as a whole (though not necessarily in complete detail throughout) to guide it effectively (see also the next section).

In addition, the role of governments in systemic intervention is not only to see that appropriate policy instruments are formulated and implemented but also to look continuously at the ethical questions of: what ought to be done, what should we doing, and where lies gubernatorial right or wrong? It is then clear that in many cases it may be impossible to guide a system through a few of its variables, especially when ecological, socio-cultural, economic or political factors inhibit exercising guidance. Still, identifying the essential variables of a system, even if they cannot be managed, may reveal the reasons why systemic intervention cannot take place, and this is often valuable knowledge in its own right. It may lead, for instance, to a changed attitude regarding the system that, for certain reasons, cannot be subjected to guidance. In such circumstances, management may be possible by re-defining what is to be regarded as acceptable by the agents pursuing systemic intervention.

Furthermore, as pointed out by both Ashby (1956) and Beer (1966, 1972), the essential variables must be maintained within certain value ranges. In a simple, mechanistic system its essential variables are within their assigned bounds as determined from outside the system, usually by a human controller (e.g. when a navigator calculates the course for an aeroplane and then sets the automatic pilot to follow the course). Extremely complex systems, such as regional systems, have typically internalised these processes, i.e. the controls are intrinsic to the system. As previously discussed, the regional system is composed of four sub-systems, one of which, the organisational system, is wherein the policy instruments (or control devices in cybernetics terms) are formulated. The systemic guidance process in complex system is hence fundamentally different from that in mechanistic systems (Kauffman, 1993; Holland, 1995).

These considerations also provide insight into the reasons why conventional technological approaches to resource and ecosystem management are not succeeding and in some cases making problems worse. This is partially related to the ideology of a positivist resource management science with its emphasis on centralised institutions and command-and-control policy instruments. Such management is based on a mechanistic view of nature and the use of linear models without feedback loops. It aims to reduce natural variation to make an ecosystem more productive, economically efficient and controllable. The reduction of the range of natural variation is however the very process that may lead to a loss of resilience in a system leaving it more prone to resource and environmental crises (Holling and Meffe, 1996; Berkes et al., 2003, Introduction)

It follows that systemic guidance should include two major features: the selection of the relevant system variables and deciding on the desired value ranges for them.

Characterisation of the regional system (through its essential variables)

To recap, systemic guidance implies that the regional system of interest should follow a trajectory within desirable bounds (or ranges or thresholds) and this should be reflected in the policy instruments formulated to guide the system.

Moreover, as argued by Gunderson et al (2002a), a complex system may have multiple stable states and alternative stable organisations. This means that the system, in its evolution, can move to various possible stable states and, hence, future options along the system trajectory should be left relatively open. To explain this, those authors refer to fisheries where some managers are exploring the use of 'reference directions' (e.g. increasing the number of sexually mature year-classes in the fish population (Christianson et al., 2003), instead of the conventional target reference points (e.g. a catch of 1000 tons of a particular species). This kind of approach shifts the concern of management actions from the exacting question 'where do we want to be' to the more manageable 'how do we move from here in the desired direction' (Berkes et al., 2001). Therefore, planners and managers attempting systemic intervention in a regional system must constantly review (and re-define) the desirable value ranges of the essential system variables, and closely monitor the system trajectory as well as changes in the system environment (e.g. through monitoring changes in the driving forces of the system).

More importantly, it is possible that the system in its trajectory has irreversible changed and, hence, the only possible strategy is to adapt to the new (transformed) system. This implies that (some or all of) the essential system variables may have changed and a new set may need to be defined. This is a further indication of the continuous, iterative approach, based on feedback learning, required in systemic intervention.

Furthermore, depending on the context and the purpose of the particular systemic intervention, as a result of *boundary critique*, different resolution levels of the system of interest (i.e. of its elements, attributes and relationships) should be selected as relevant. The intention of an agent pursuing systemic intervention thus constitutes a perspective in its own right (this is known as the 'cybernetic viewpoint'). Because the multiplicity of perspectives which are possible in comprehending a complex systems, there is not one 'correct' all-encompassing viewpoint of a system. One can choose to analyse, for instance, a particular level of biodiversity conservation, but that perspective will be different from another.

The selection of the essential variables of a system is hence the result of the agent's choice of how he/she perceives, or understands, the system of interest and the situation in which it is immersed. In other words, it is a consequence of the perspective from which the system is viewed by the agent. Therefore, the selection of the essential variables of a system is meaningful in relation to the system defined (through a boundary judgement) at a particular resolution level. It is always possible to increase (or reduce) the resolution level of a system and, consequently, alter the information and analyses required to respond better to changing circumstances.

An example will help to clarify this important point. Planners working a strategic level in a particular region may consider as an essential variable of the defined regional system the economic state of the agricultural sector, whereas planners working in a local area in the same region may consider as an essential variable of their system of interest the local schools. For the former, the location of a school has no relevance (unless he/she has a personal interest, for instance, if he/she sends his/her children to that particular school). On the other hand, for the local planner, the economic state of the agricultural sector may have only a relative interest (for example, whether it would affect the cash flows of the children' families attending the local schools so that they can buy computers for their studies).

It also follows that the system variables selected for the dynamic characterisation of the system of interest should not differ from the variables upon which systemic guidance will be effected; i.e., the essential variables of the system. An example of this approach is the analysis of the resilience and adaptive capacity of the Western Australian (WA) Agricultural Region (Allison and Hobbs, 2004). In this study, consistent with the "Rule of Hand" (Holling et al., 2000), only five variables were selected. The variables from the ecological, social and economic (sub-) systems are: (1) the area of productive land, (2) the number of agricultural establishments, (3) farmer age, (4) agricultural terms of trade, and (5) the wheat yield (economic production target). Based on them, they also developed a conceptual model of the dynamics of land use change patterns – a predominant progression in the WA Agricultural Region from primary native vegetation to a productive broad acre agricultural system.

Systemic regional development methodology

Framework and process

Coupled human-natural systems are such that nothing ever happens twice, not in exactly the same way. This means that the approach to deal with the complexity of real-world situations has to be a methodology. A methodology, as the word indicates, is a *logos* of methods; i.e. it is a structured set of principles which can be adapted for use in a way that suits the specific nature of each situation in which it is used (Mingers 1997, Checkland, 1981).

Figure 5 shows the key components of the *Systemic Regional Development Methodology* advanced in this article. It is based on the analysis of the previous sections and on the holistic model of decision making formulated by one of the authors of this article (Sposito, 2008). The methodology includes seven major phases shown in the central part of the diagram in yellow. The three key activities of systemic intervention are depicted in the right of the figure informing the various phases of the process – boundary critique, judgment concerning choices on theories and methods, and taking local actions for improvement. To avoid further complicating the figure, feed-back loops linking the various phases have been omitted (central part of the diagram). Each component of the process is briefly described below.

- **Phase 1 - Problem Formulation / Purpose of the project and the systemic intervention.** This includes an initial appraisal of the complexity of the problem faced by the regional system of interest and the design of a project plan to guide the overall systemic process. Since most regional problems are 'wicked' (Rittell, 1972) or 'messy' (Ackoff, 1974), the notion of building a rich picture of the *problematic situation*, or *problematique*, is also a good description of this initial phase (Checkland, 1981; Checkland and Scholes, 1990; Warfield and Perino, 1999). In this phase: (i) the existing, relevant information on the system and its context (e.g. from previous studies, expert opinions) is reviewed and synthesised; (ii) the agents in the process, including systems analysts and decision makers, are identified; and (iii) the goals and specific objectives of the project and the systemic intervention are formulated. Guided by *boundary critique*, significant outcomes of this phase are the definitions of the **Regional system of interest and its context**.

- **Phase 2 - System Description and Analysis.** A regional system is composed of four main sub-systems: ecological, socio-cultural, economic, and organisational. Each of the sub-systems must be described as well as its driving forces. The agent must select the theories and methods to underpin the analysis in each of these sub-systems. It is difficult, for instance, to understand a social system without considering its history - the interacting flux of events and ideas unfolding through time (or Vickers' 'two stranded rope', see Checkland and Casar, 1986) - as well as its social and political contexts.

- **Phase 3 - Selection of the Essential System Variables.** The selection of the essential variables of the regional system of interest (in principle, in each of its four sub-systems) is steered by the purpose of the systemic intervention being pursed. Transformations in the various spaces can be caused either directly, by changes that are taking place (or by making changes) in a given space itself, or, indirectly, by changes occurring in the other spaces and causing repercussions on the former space. This means that a goal in one sub-system (space) may be realised by actions taken in the other sub-systems (spaces). Since the intention is to select a few essential variables, it is possible that, depending on the project purpose, some sub-systems may not contain anyone of them (unless we want to monitor the evolution of the system only through its essential variables).

- **Phase 4. Solution(s) / Action(s) for sustainable improvement.** This includes the generation of options for the sustainable development of the regional system and their holistic appraisal (i.e., in the ecological, socio-cultural, economic, and organisational fields or spaces). An important consideration here is to ensure that sustainable improvements will occur in the regional system of interest once the various actions are implemented.

- **Phase 5 - Decision-Taking.** There are three clear distinct groups of activities in the process shown in the figure: those encompassed in Phases 1 – 4 are the province of what traditionally has been called *decision making*, whereas those included in Phase 6 can take place only after the decision to implement a particular course of action has been taken. Therefore, *decision taking* is located precisely at the articulation point between decision making and implementation. It is important to consider it as a separate stage to be able to distinguish, at least conceptually, the role of decision makers, including policy analysts and scientists, from the role of politicians. That is, to distinguish between those who provide the knowledge upon which decisions are based and those who take the decisions and give the commitment, including funding, required for their implementation. In this Phase 5, the various policy instruments are also prioritised by reference to the local context, which not necessarily indicate geographical locality.

- **Phase 6 - Implementation / Monitoring and review. T**his continuing phase involves actions and the evaluation of their results, as well as sustaining the initiatives initiated by the project.

- **Stakeholder Engagement / Assessing and enhancing systemic intervention.** This is crucial for the successful formulation and implementation of the approach (Renn, 2004). It is a cross-cutting methodological component that involves creating and sustaining an active dialogue with the agents/stakeholders. It is hence represented in the figure (on the left of the diagram) with arrows to/from each of the phases of the systemic process. Stakeholder participation gives credibility to the overall process, especially at the regional/local level, and through participation stakeholders are more likely to 'own' the results thus increasing the likelihood of successful systemic guidance.

Conclusion

Based on the study of past societies, Diamond (2005) argues that two types of choices have been crucial in tipping their outcomes towards success or failure: (i) long-term planning and (ii) willingness to reconsider societal core values. The first of those choices has depended on the courage to practice long-term thinking, as well as to take bold, courageous and anticipatory decisions at a time when problems have become perceptible but before they have reached crisis proportions. This type of decision making is the opposite of the short-term, reactive decision-making which too often characterises how decisions are made in government and private organisations (Yencken and Wilkinson 2000, Lorey 2003).

The other crucial choice informed by the past involves the courage to make, sometimes painful, decisions about core values. For instance, which of the values that formerly served a society well can continue into the future under new circumstances? Which of those 'sacred' values must instead be jettisoned and replaced with a different set? (Wilson, 2002; Brown, 2003; Ehrlich and Ehrlich, 2004).

The systemic regional development methodology advanced in this article is based on a systems thinking approach to long-term planning and action that is underpinned by a strong sustainability ethic. It thus offers a framework for strategic thinking and planning and the consideration of the ethical consequences of possible courses of action. The scale and inter-connectedness of the problematic situations confronting regional systems, its human communities and natural ecosystems are such that only well-thought systemic intervention would offer hope of successfully tackling them.

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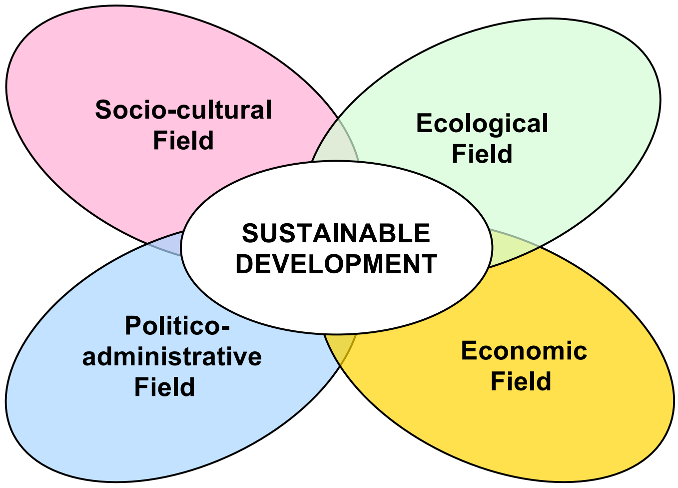


Figure 1 Decision-making fields (spaces) for sustainable development

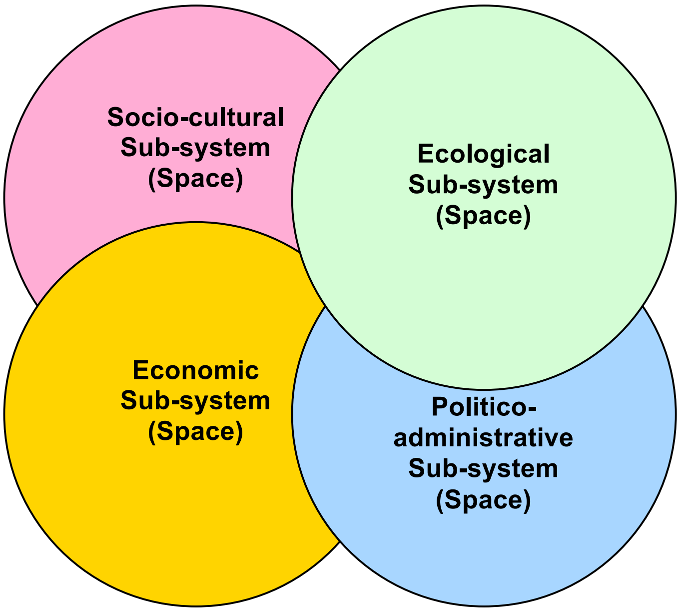


Figure 2 The regional system comprises four sub-systems each existing in a different space

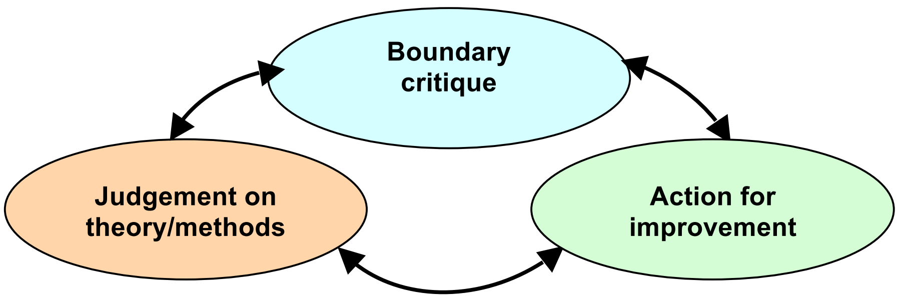
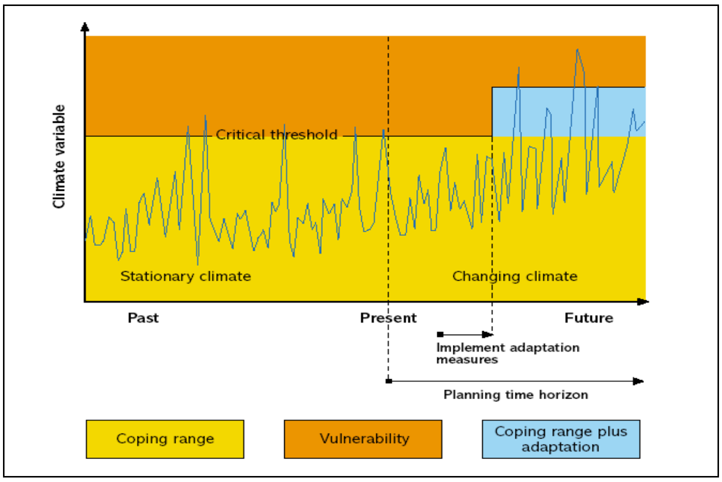


Figure 3 Key aspects of a generic methodology for systemic intervention
Source: Mingley, 2000 p. 132.



In this schematic representation, the *coping range* represents the tolerable climate; and the coping range boundaries may lie above and/or below the average value of the climate variable of concern. An upper boundary, or critical threshold, above which unacceptable impacts may be suffered by the system of interest, represents vulnerability. *Adaptation* would reduce vulnerability by increasing the critical threshold (i.e.; expand the coping range), whilst *mitigation* may limit the likelihood of that range being exceeded under climate change. The diagram also shows the time taken to implement adaptation measures within the planning time horizon.

Figure 4 Relationship between coping range, critical thresholds, vulnerability and a climate-dependent variable
Source: Willows and Connell 2003, Part 2, p. 73.

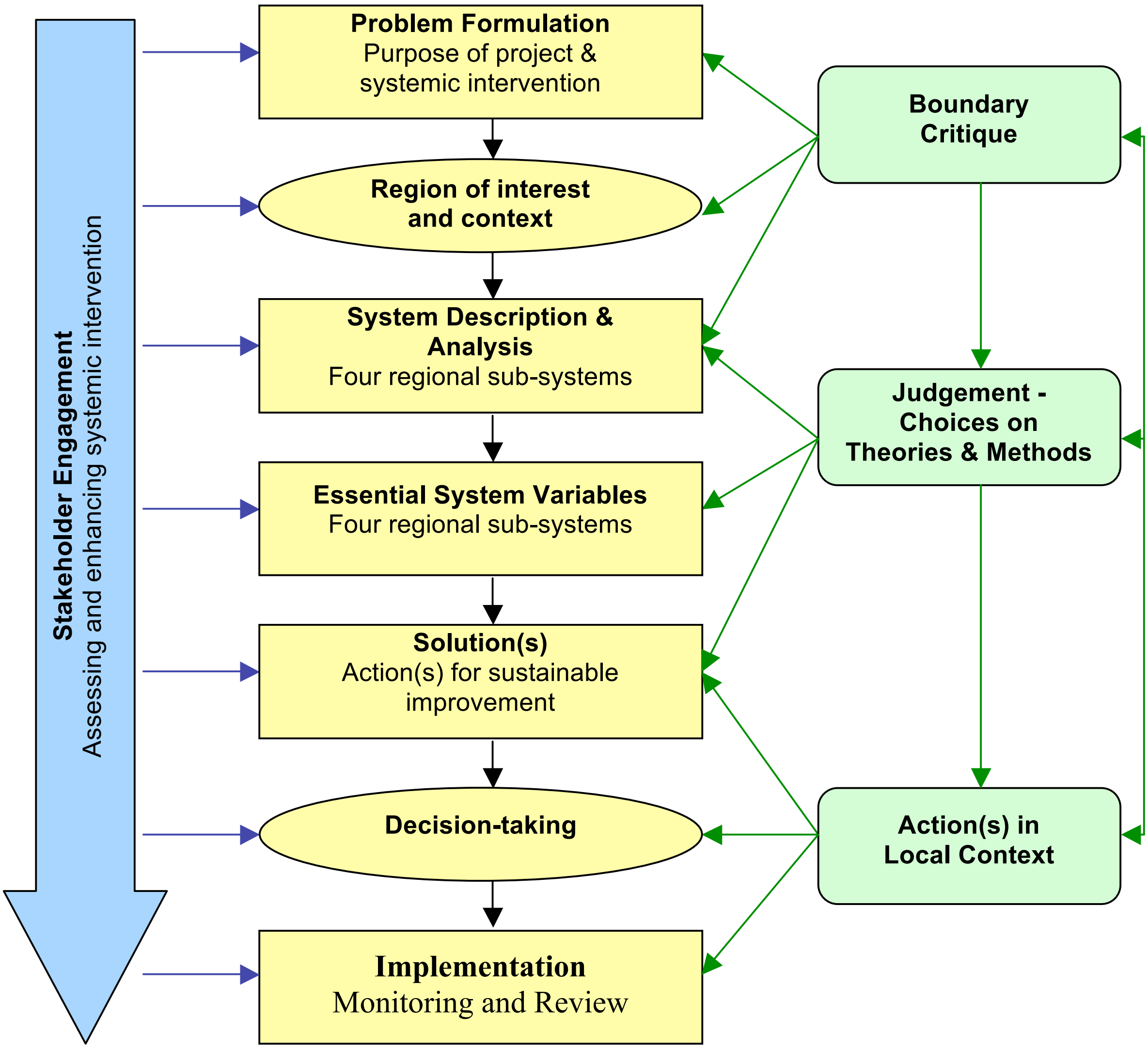


Figure 5 Systemic Regional Development methodology