Structural Design for Sustainability: Some Insights from Organisational Cybernetics

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Abstract

Sustainability requires a sophisticated understanding of the interconnectedness of nature and the social domain, and willingness by the practitioner to adopt less top-down, hierarchical approaches to tackling the entailed issues. In order to support the networks and programs that are required to foster sustainable development, there is a need for a holistic approach to organisational and programme design, and a holistic insight into the entailed problems. Stafford Beer's Viable System Model (VSM) provides a comprehensive set of guidelines for such an approach, one that offer criteria for designing more adaptive structures, where control is devolved to the operational level and operational levels are co-ordinated through democratic management. The paper refers to the different levels of organisations and social interactions needed for environmental management ranging from government down to individual citizens. It goes on to describe why the VSM is invaluable for structural diagnosis. .It finally outlines structural design criteria the VSM would recommend for organisations dealing with issues of sustainability, in particular regarding the relationship between government, communities and their ecosystems.

Keywords: sustainability, viable systems, autonomy, democracy, social networks, holistic

Structural Problems in Sustainability

Sustainability is an idea whose time has come, and there is a general acceptance among funding bodies and international initiatives - for example, the massive investment on environmental programmes and projects supported by multi-lateral agencies (World Bank, United Nations and others) – that global issues of sustainability are inextricably linked to local ones (e.g. 'glocalisation'). Today, issues concerning sustainability resonate in the public domain far more than even five years ago. There has been an increase in public awareness about the need to evolve towards more sustainable individual, community and industrial practices; and recognition that community, institutional and government interests and structures *together* impact on the management of environmental issues. However, the speed of the change in practice still lags behind the current trend towards environmental devastation. There are few positive signs that we have reached the "turning point" in our practices (Capra, 1982).

This paper argues that a major factor in our inability to change the patterns of unsustainable massive development practices is the lack of the necessary societal structures for the management of the complexity of the relationship between modern societies and their ecosystems. The result is that the current global crisis - involving unsustainable social and commercial practices on a massive scale - is amplified as a result of a fundamental miss-match between hierarchical approaches of organisation structure and the creation and maintenance of a sustainable society. The mismatch happens not only in the relationship between government and societies but also between development agencies and implementing bodies. For example, Potocan & Mulej have argued that even if the UN started promoting sustainable development, neither their education nor mainstream theory teach them to be as holistic as systems theory requires (Potocan and Mulej, 2003). We suggest that their thinking not holistic enough and most of the structures they are operating lack requisite variety to support sustainability.

We first draw the connection between holism and sustainability, before going on to summarise Stafford Beer's model of viability (the VSM) and its potential usefulness to design complex societal interactions, at the structural level. Examples of use of VSM for structural diagnosis at different levels in the environmental sector illustrate the radical differences in observation and focus of analysis that this approach offers compared to more traditional approaches. Finally we reflect on how the criteria for structural arrangements that the VSM offers would contribute to improved management of complexity in the relationship between governments and communities when dealing with sustainability issues

Sustainability and Holistic Thinking

Capra recommends systems thinking as the most appropriate paradigm for rethinking socio-economic development, and argues that it helps us to avoid the shortcomings of present day global capitalism in tackling environmental challenges (Capra 1982, 2003). His view, with which we concur, is that there is a need for deep paradigmatic change in our thinking, and the application of holistic approaches to society and development. He synthesized ideas from systems pioneers in physics, biology, economics, ecology and anthropology in taking account of the natural dynamics of self-regulation, which (he says) we ignore at our peril (Capra, 1982: 285-332). Laszlo took these insights further, suggesting the need to progress

from well-meaning conscious individuals into evolutionary learning communities and evolutionary emergent eco-systems, as part of the emergence of an "evolutionary learning society" (Laszlo, 2003).

In a similar vein, Meadows and Randers recommended a change from the dominant reductionist scientific paradigm to a systemic approach that more readily incorporates distinct insights and methodologies into the richer and integrated toolsets required for investigating and analysing environmental problems that are intrinsically highly complex and interconnected (Meadows & Randers, 1992). Meadows went on to suggest a cybernetic approach to environmental management, one that offers a more precise language as to the metrics employed, the control and feedback loops identified and thus a more sophisticated insight into the performance of the system and the dynamic relatedness of its parts (Meadows, 1998, Meadows et al, 2004). Haimes explained sustainable development as a holistic approach to environmental management well supported by sound theory, methodology and problem solving algorithms (Haimes, 1992).

The value of holistic approaches and methodologies to facilitate sustainable development agendas and programs has been widely reported. Such approaches generally drive down the impact of an intervention to the level of individual and social welfare, and it is this that facilitates deep structural changes and broad-based participation in more formal initiatives. As Dube has pointed out, the voluntary engagement of entailed actors in the instruments of change engenders a greater degree of self-regulation (Dube, 1990, 62-82). Floyd had also explained how a cybernetic perspective to planning and policy making based on ideas of requisite variety would see government as the facilitator of radical change, which emerges at the local level (Floyd, 1984). However, account must also be taken of the complexity and inherent uncertainty of natural and social phenomena - the multiplicity and frequently conflicting values together with the repercussions of political effects (Midgley & Reynolds, 2004). All these indicate the need for a holistic rather than a traditional hierarchical approach.

One of the authors has taken these insights further, arguing that a pre-requisite to any implementation of a holistic approach to sustainable development requires deep structural changes (in the paradigm of development and intervention, the structure of state-society and the paradigm of measurement), rather than simply an acknowledgement of the problem and the application of conventional tools at the identified problem (Espinosa, 2006). Here we suggest some reasons why structural design of organisations and networks working for sustainable development agendas is one that we must not ignore if we are to reach the turning point that society requires for self-conscious evolution, and ultimately, its survival.

Viability and Complexity Management

Stafford Beer developed a theoretical approach known as Management Cybernetics (also known as Organisational Cybernetics) that applies the basic laws of natural viability to social organisations and institutions; in his words, management is the profession of effective organisations so it needs a sound theoretical framework to understand the fundaments of control and communication in social and business affairs (Beer 1979). The VSM summarises a sufficient and necessary set of functions through which identity and autonomy might be recognised by an observer, and that gives due place in social affairs to the voluntary participation at the lowest possible level required for effective and viable governance. For Beer, this was a direct and conscious reaction against what he saw as an older reliance on heavy handed and hierarchical forms of governance from the top down. In times of rapid change and complexity, Beer's experience was that such top-don approaches just didn't work. The functions identified in the model were derived from scientific findings in the physiology of the autonomic and central nervous systems of the human being (McCulloch 1965; Maturana & Varela 1980, 1988; Powers 1973; von Foerster 1981). From these biological findings Beer developed his model and identified several axioms of Management, describing the interaction between complex organisational and social systems in terms of balancing the variety of information (Beer, 1979). These are the equivalent of biological 'metabolic' processes taking place continuously to maintain the relationship (Beer, 1981) in spite of change over time. In developing his insight into viability, he was inspired by Ashby's Law of Requisite Variety (Ashby 1964).

The Viable System Model (VSM) identifies a necessary set of functions for the 'viable' organisation ('viable' as 'sustained identity within a particular context'). Within this paradigm, a viable system is understood by not simply looking at an organisation in terms of the interaction or efficiency of its parts, but looking at it in terms of its functioning *as itself* in the context of an environment – namely, how it remains viable, maintaining its core identity while coupled to a continually changing world. Of particular importance in the present context, is that such viability is co-existent with the viability of the other organisations or systems to which the particular organisation is structurally coupled. Perhaps the key issue pertaining to Beer's model is that viability results from the organisation responding or anticipating environmental changes, through effecting changes in its own dynamics that allow it to maintain an identity over time (Beer 1979, 1981, 1983, 1985).

Beer developed the model of a viable system as composed of a set of operations (who develop the primary organisational

tasks), a meta-system (which provides an identity that braids the distinct operations into one observable whole), and the environment within which it impacts and sustains itself. Without any one of these elements, understanding is skewed and incomplete.

In addition, a viable system is recursive in that it will contain and be contained within other viable systems (in the case of a human being, for instance, within its family, society, Eco-system and nation). In other words, it is simply not the case that you will discover a single 'viable system' in an isolated void or chaotic situation. Any instance of viability will reflect a 'broader' or 'wider' instance of viability, which the observer needs to discover and identify if they are at all to grapple with the actual complexity of the situation.

The basic conditions of viability are that the system exhibits a structure that balances autonomy (to distinguish itself from what is outside) and cohesion (to join its parts and orchestrate a joint enterprise). In this understanding, maximised local autonomy is one of the logical requirements to ensure effective organisation. But autonomy must be balanced (limited) to ensure cohesion between operational units. This cohesion is provided not by rule of force and authority, but by a 'meta-system' that is accepted by the various operational parts because it is recognised by the actors as providing a *service*, among other things by resolving conflicts and making sure of an equitable allocation of resources across the organisation.

From the perspective of viability, any viable system has to in some way be coupled to the dynamics of its ever-shifting environmental niche, and has to have a structure that allows it to adjust in real time. In terms of social organisations, the challenge is to identify and monitor the 'essential variables' - the most vital aspects of the interaction between organisation and niche. But such a process of emergence requires more than a functional capacity of the parts – it requires a collective involvement in the identification and monitoring which is required to develop a self-regulatory culture and structure, across the organism or social organisation. Once this is done, the structure of the decision-making mechanism can be designed according to complexity management axioms to guarantee wide and democratic participation.

Table 1 presents a comparison between the criteria of structural design of more traditional approaches to management and the Organizational Cybernetic one. As it explains in detail, the main differences between traditional and cybernetic approaches to structural design are that the traditional ones focus in each sub-system and its internal variables, while the systemic ones focus on the dynamic relationship between organisations and their niches, as well as the interactions between the distinct parts that constitutes the particular organisation. Traditional approaches normally adopt hierarchical views of organisation, based on authority-obedience, while the systemic ones appeal to offer insights into how the interaction of autonomous systems can create a cohesive whole, through democratic management. It also requires empowerment, participative financial management and self-regulation at all levels –ability to respond to real time changes in the interaction with their niches and other organisational levels, which are not characteristic of more traditional approaches.

Below we refer to some of the available methods and tools that help a practitioner to use the VSM for organisational design and diagnosis. We go on to revisit some reported examples using the model for structural diagnosis of organisations and networks in the environmental sector. From there we'll assess the availability and reliability of these tools to support design of environmental management structures and in particular, to re-design the relationships between communities (including industries) and governments.

Cybernetic Approaches and Tools for Structural Design and Diagnosis

The Viable Systems Model has been used for around 30 years. Perhaps most ambitiously it was implemented by President Allende in Chile in 1971 (reported in Beer 1981). The Chilean experience resulted in development of the Cybersyn model of public management and the Cyberfilter tool for performance management (Beer, 81: Part II, Espejo et al, 96: App Ch 8). Later Beer developed Team Syntegrity as an additional tool for democratic group decision making in complex social organisations (Beer, 1994; Jackson, 2003**:** 233-251**;** Espinosa & Harnden, 2006).

Although the Viable System Model itself offers criteria to diagnose and understand complexity management, it is worth referring to derivative approaches to organisational diagnosis and design based in the model. The most widely reported are:

- Viplan Method to Study Organisations. Raul Espejo developed this method that offer precise methodological guidance to model the system in focus and to diagnose archetypes of structural problems resulting from inadequate complexity management (see www.syncho.org);
- St Gallen Systemic Approach to Management: This is a comprehensive approach based on the VSM that offer criteria to diagnose different levels of management (strategic, tactical and operational) and to design critical indices for performance management (Espejo, Schuhmann, Schwaninger & Billelo 1996, Ch 8-10) (Malik, 2006);

- Other more intuitive frameworks for organisational diagnosis can be found in (Walker, 1991) and (Jackson, 2003: Ch 6).

The VSM does not explicitly address issues of conflict and power, but what it does do is to offer criteria to design balanced structures and decision-making mechanisms that counter-balance political games. VSM application is not claimed to be all embracing or a universal panacea. What it does is to analyse the *structure* of the organisation by considering that individuals have multiple viewpoints and there is always the need for negotiations to reach agreements and act upon them. Visibility of structural constraints and opportunities is what it claims, the case being that it is dynamics at this level that frequently lead to higher order organisational problems. Complexity management starts from these premises and opens new understanding of desirable relations and roles that necessarily generate (sometimes dramatic) change. Viability requires a good balance of autonomy and cohesion. Thus discussions of centralisation and decentralisation become irrelevant: a viable system is both at once.

The next section presents a short summary on some reported examples using this cybernetic approach in environmental management, in particular in issues of structural design and diagnosis. It illustrates how cybernetic criteria can help to re-design environmental management structures. Using these examples, we may be able to uncover the main differences in criteria when using the VSM, compared to more traditional approaches to structural design. We would then suggest some guidelines for practical application of the VSM to redesign the government vs. community's level of interaction when dealing with issues of sustainability.

Examples of VSM Diagnosis in Environmental Management

Most environmental institutions and programmes in any country still operate with top-down, hierarchical models and methods. However, whatever the quality of the model itself, such models just do not have the requisite variety to deal with complex systems or to adequately engage the participation of varied interests and different actors. Indeed, our hypothesis here is that the current lack of effectiveness exhibited by many environmental agencies and programmes may be closely related to these structural limitations.

In a recent diagnosis of environmental management at the National level in Colombia, we used the VSM to model the national environmental organisation and developed new criteria to design new - more effective - structures for environmental management, at the regional and local levels. What we realised, through participatory workshops with representatives from all environmental agencies and authorities, was that we needed to concentrate our efforts not on centralised governmental agencies but on new approaches based upon the "eco-community" and its related eco-region or sub-eco-region. In other words, the eco-community level includes families, industries and local institutions co-existing in an eco-system (Espinosa, 2004; Jackson, 2003:101-106; Espinosa & Walker, 2005).

The recursive analysis that was undertaken came up with a conclusion both obvious and unexpected. We needed to concentrate scarce resources and strategic actions where the most relevant environmental challenges happen - at the level of the eco-system and eco-region - ; and we then needed to devolve control of resources to this levels to empower them for real time management of environmental targets. The primary step was identification of precisely what constituted that environment. In the particular example, there was a need to design meta-systemic management from the ground up. Traditional institutional boundaries were related to political and administrative borders alone (i.e. county environmental agencies), and were generally irrelevant to the problems emerging from the dynamics of the eco-region itself (many times eco-regions being managed by more than one county agencies each one controlling sub-regions within their administrative and political borders). In other words, rather than their eco-region being the focus of attention, the existing agencies tended to be driven by their internal needs, power structures and political boundaries.

It became clear that co-operative development *between* environmental and social agencies was a critical element in the effective management of environmental projects. What also became clear was that emerging social networks participating in these projects did not have any logically coherent management, but simply operated as temporary structures thrown up and disappearing contingently. What was missing was a meta-system to provide the necessary framework for consistency and guidelines without any of the parties feeling that such a system was being imposed from outside or at the behest of some external interest. The result of such an absence resulted in a missed opportunity to nurture any collective learning, of this level of organisation.

Schwaninger suggested similar criteria when analysing the needs for complexity management in complex development

projects - as those in the environmental sector -. He highlighted the need for strategic and control management at meta-systemic level when implementing this type of project, and explained the use of VSM to support design of meta-systemic levels of management (Schwaninger, 2003). More recently, he explained, first, in a general way the contributions from Organisational Cybernetics to self-evolution of society (Schwaninger, 2004); then, more specifically, how by using the Viable System Model at the level of business and industries, nationally and globally, we can support a multi-level system of self-organizing wholes each of which would assume their ecological responsibility, in a recursive structure of viable systems (Schwaninger, 2006).

Kay et al reported an insightful example where they re-designed the institutional arrangements of Coastal Management in New Zeeland, to evolve from single to multiple dimensional views of institutional arrangements for environmental management; the re-design, that used Managerial Cybernetic based tools, made evident the need for co-operative and democratic management between different stakeholders involved in Coastal Management issues and the need for re-designing the decision making mechanisms, including design of co-ordinating bodies and coastal management plans (Kay et al, 2003). Even if this example illustrate the power of cybernetic tools for complexity management of complex societal problems, it does not show clearly enough the sort of structural arrangements that would be required for improved performance in Coastal Management.

At the level of industry sectors, Stewart and Lewis presented some research results, analysing current environmental business practice in a number of UK industries, using the VSM as diagnostic criteria. They found that the organisations studied required significant changes in structure and management practices to be viable: in particular, they were swamped by details of operational control and were unable to encourage long-term relationships with the environment; also much higher degrees of integration and co-operation were required among different industries in the sector studied (Lewis, 1997). One of the authors of this paper has reported elsewhere a complete application on diagnosis and re-design of a co-operative eco-industry in the UK using the VSM. The co-operative members redesigned the organisation by creating new management and self-regulatory systems. They experienced the new structure as one of enhanced autonomy and participation at all levels (operational, strategic and political) while keeping major cohesion by using performance indicator systems, all together resulting on improved performance (Walker, 1991).

In the studies mentioned, a consistent theme was identification of the inadequacy of structural mechanisms for effective management (whether it was as broad as the relationship government – citizens, government eco-industries or as specific as these relationships when dealing with specific issues as nuclear waste disposal or coastal management). Given the above, not surprisingly there was some overlap in the thrust of the recommendations:

- Organisational re-design needed to allow higher degrees of integration and cooperation and to encourage better self-regulatory practices (Walker, 1991; Lewis, 1997; Espejo & Stewart, 1998; Stewart & Lewis, 1997; Schwaninger, 2006);
- Design of meta-systemic management at appropriate recursion levels (i.e. eco-system, eco-region in (Espinosa & Walker, 2005, Schwaninger, 2003);
- Design or participatory mechanisms for decision making to manage complexity on environmental issues (Kay et al, 2003; see also Hoverstadt and Bowling, 2006);
- Design of monitoring systems for the communities and eco-regions and identification of critical variables (Espinosa & Walker, 2005, see also Grzybowski & Scott Slocomne, 1988).

A common theme in these examples is the need to design more balanced structures and meta-systemic tools and mechanisms to enhance local autonomy while increasing organisational cohesion. In all the cases, this is intimately linked to the importance of both co-operation and autonomy in realising viability for environmental oriented organisations and networks. This type of recommendations would have not emerged from using more traditional approaches to structural diagnosis. The cybernetic approach allows us to identify how self-regulation encourages participation and hence cohesion between the viable sub-systems. Looking at the broader level of the interaction between communities and government, there are wider repercussions and the need for a fundamental re-think of these relationships. In the next section we will summarise some guidelines to support design of more balanced structures at this level of eco-region and eco-communities in their interaction with government - when dealing with issues critical for sustainability. We will comment finally on the implications of this for implementation.

Re-thinking the Relationship between Government and Community in the Context of Sustainability

As we have continually re-iterated through the paper, for sustainability to be effective, a variety of levels and types of

social intervention are required. There needs to be a simultaneous consideration of issues directly under the control of completely different scales of social activity – from the timescale of the government or regional authority to the very immediate timescale of the individual or local community. In creating the VSM, Beer refers to this dynamic clay of different sizes and time scales under the notion of recursion (Beer, 1979). Adopting the notion from R Ashby (Ashby, 1964), his model encourages the practitioner to distinguish and address the complex and very different dynamics that impact on any real world complex situation. Below, we attempt to summarise some of the issues that indicate why this approach has such relevance for sustainable development.

Espejo & Stewart have offered some preliminary reflections on the need to re-design the interaction between communities and governments operating on issues of sustainability, using the VSM as guidance. They concluded that in order to create better conditions for sustainability at this level of interaction, there is a need for improved autonomy, citizenship and performance (Espejo & Stewart, 1998). We wish to more explicitly reflect upon how the VSM enables the practitioner to make sense of the complexity of the interplay between natural and social environments – in particular the interdependences between government agencies, support organisations and the local individuals and communities. At different levels of organisation, we can recollect some guidelines for a practitioner interested in using the VSM to diagnose the interactions of government vs. communities (in the broad sense described above) working in issues of sustainability.

1. Pinpoint the correct level of intervention required for the particular environmental issue. Need to take account of the different dimensions and levels of social processes needed to effectively address environmental complexity. *Tips to practitioner:*
    a. The boundaries of viable systems must be defined by recursive *analysis*, and this must embrace ecological as well as political considerations.
    b. Different recursive levels must have their own clearly defined focus and responsibilities (for dealing with problems appropriate to their particular organisational level (for instance the focus and responsibilities at the national agency level is totally distinct though connected to the focus and responsibility at the local community level).
2. At each different level of organisational complexity (i.e. each level of recursion), it is crucial to identify structural imbalances between the social system (e.g. a community) and its embodying niche (e.g. a river basin). *Tips to practitioner:*
    a. Preliminary VSM diagnosis might well reveal gross imbalances between the existing intervening agencies and the environments with which they are accountable for (e.g. in previous case studies entire meta-systems were found to be missing as a particular level of recursion had not been recognised);
    b. In normal circumstances we must be alert to the fact that excessive centralisation results in variety unbalance because lack of autonomy decreases the self-organisational capacity to 'take up the slack' at the community level (most of the case studies showed this);
    c. This leads to a serious limitation in effective control. In general the above tendency towards excessive centralisation requires that we pay particular attention to encouraging autonomy and self-regulation in eco-communities. This also implies that we play particular attention to sufficient allocation of resources and control at the local level.
3. Provided we are impeccable in identification of the levels of recursion and the actual points of interaction, it is always possible to develop effective performance measures. The key is the relevance of the particular performance measurement rather than quantitative analysis alone. *Tips to practitioner:*
    a. Pay particular attention to the development of systems for defining and monitoring key variables for sustainability which must reflect the interaction of each organisational unit and its niche;
    b. Use local knowledge and participative consultation for the effective design of real time performance indicators;
    c. Ensure continuous and transparent data streams that describing the behaviour of key indicators;
    d. Seek out mechanisms to ensure that everyone at whatever level acknowledges and contributes to the validity of these key variables;
    e. Provided the identification of the variables is sensitive and comprehensive, one should put in place what Beer calls "algedonic filtration" of indices (see Beer, 79); in other words a simple early warning system that allows prevention rather than reaction.
    f. Ensure that these alerting systems are acknowledged by all involved actors in order that signals of instability will be communicated to the relevant parties quickly and effectively.
4. Structural design of networked communities. At the recursive level immediately above the individual community, the most appropriate model is a network of communities corresponding to a particular eco-region, and the appropriate meta-system. The structural design of such a system of networked communities involves the following (*Tips to practitioner*):
    a. Identify the requirement for co-operative working among individuals and social groupings within existing eco-communities.

b. Put in place a meta-system that:
    i. Engenders synergy among the communities by providing networking and information management tools;
    ii. Deals with the resolution of conflict between individual communities.
c. Ensure the same considerations for designing and monitoring (higher recursion level) key performance indicators apply at the networked community level
d. Interactions and feedback between the networked communities should help to develop a culture of peer-pressure.

5. *Relationships with higher levels of recursion.* Communities and networks of communities can only function effectively if they have a healthy relationship with higher levels of recursion such as local and state government. It requires (*tips for practitioner*):
    a. Put in place a good two-way communication channel between communities and higher recursive level governmental systems, thus ensuring rapid response when action is needed.
    b. Linked to a. ensure the necessary supportive structures for individuals to communicate with systems and meta-systems thus allowing the two-way flow and exchange that underlies through ethical and democratic government.
    c. Provide a learning context for embedded systems, offering access to updated knowledge about essential variables and related issues.
6. Design of Participation. Autonomy and participative democracy are necessary for the development of such structures as we are describing. *Tips for practitioner*:
    a. Individuals, communities and networks of communities must be empowered in order to deal with environmental issues existing at their particular recursive level.
    b. Individuals will more likely feel identified with higher levels of recursion, when involved in the decision-making and implementation loops which connect them to these organisational levels.
    c. Key indicators can only be developed and used effectively using local knowledge.

In summary, unprecedented levels of autonomy and participative democracy are crucial in the development of these structures, not simply for ideological reasons but because only would the involvement of all can the complexity of such situations be addressed in the interest of sustainability. The bottom line is that this requires a complete re-think of traditional systems of governance (this is not the place to develop this theme further). In the new structures, individuals, communities and networks of communities must feel empowered and thus able to deal quickly and effectively with environmental issues at the appropriate level. Requisite variety for local communities can only be generated by removing the autocratic domination of centralised power structures and by resources being controlled and allocated at the appropriate level in crucial issues for sustainability.

Conclusion: Towards more Sustainable Social Structures

This paper focused on the value of the Viable System Model for the re-design of environmental management and the underpinning structures. Building up on our own previous experiences in this field, we had suggested some guidelines for the practitioner to analyse and reflect upon the relationship between eco-communities and government, aiming at developing more flexible structures that will contribute to the creation of a sustainable future.

The usefulness of the VSM is because of there is a good fit between a VSM analysis/diagnosis and a consequent effective and sustainable intervention. Perhaps this should not be a surprise as the model is inspired by embracing our current scientific understanding of evolution. The model might well be applied in other less democratic situations. The point is that its effectiveness in practice is far more likely in the context of devolution of participation.

VSM solutions involve rich systems of regular, responsive interaction between autonomous citizens and both their immediate environment and their governments. The practice of participatory governance at all levels progressively changes our attitudes and ultimately our consciousness. In the environmental domain, it is this engagement of actors in the relevant ontology (in other words concrete reality), that leads to participants understanding complexity at the appropriate level and able to contribute to a clearer description of the pertinent problems. The design and operation of clearly identified feedback loops between individuals and their local and national governments contributes to a significant rise in this type of consciousness.

The logic of the VSM for the design of effective organisation requires a balance between centralisation and decentralisation. In the examples referred to this paper, it was generally the case that this balance was badly skewed in favour of centralisation and thus, in practice, fundamental re-design required change towards more “bottom-up” approaches. To succeed, work must start at home - at the level of individual /businesses consciousness and practices. More

democratic societal structures, fostering the self-regulation of communities and businesses, needs redesign and a fundamental re-think of our approach to organisation, management and governance. This entails inclusion at each and every level of social organisation and also genuine - across the board - implementation in order to engage and inspire everyone.

A closing note, then, it is clear that by following this approach, we must re-think the role and function of government, the structure of the State-Society and the role of multi-national global businesses and the United Nations. This is an evolutionary path. Traditional approaches in which the government thinks and acts on behalf of the people without their participation and uses top-down control to impose environmental solutions, simply does not have the required variety. For the implementation of sustainability programmes whose motor for continued effectiveness must be self-regulation at the local level, we need fundamental change at all structural levels of society. The holistic science offer tools and approaches which, at this early stage, appear to offer hope of finding a workable solution. The VSM is one such a tool.

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Table 1.

Traditional .vs. Organisational Cybernetic approaches to structural design

	Traditional approaches	**Cybernetic Approach**
Identification of relevant variables	Focus on relevant variables characteristic of each discrete entity identified (individuals, families, institutions, industries, eco-systems)	Identify both entities and the relevant niche pinpointing the essential variables in the interaction.
Weltanschaung	Interacting systems seen as discrete entities with simple input /output connections	Understanding of the internal dynamics of the system in terms of the niche to which is coupled, in terms of feedback loops.
View of organisation	Focus is on internal relationships –normally hierarchical/ pyramidal structure	Focus on relationship between operation of entailed organisations and relevant niche. Autonomous units cohesive at each level of organisation.
View of Control	Authority/Obedience	Control as responsibility of

Role of authority	People "at the top" have ultimate control Top-down control from boss to worker –no feedback	autonomous yet engaged actors at all levels. Voluntary embrace of shared rules and communication protocols.
Role of participation / empowerment	Empowerment tends to be "bolted on"– Knowledge tends to be a function of the powerful rather than the actors on the ground. Effective action seen as asserted over rather than emerged from.	Empowerment is explicitly required to cope with the variety of complex environmental interactions, including the variety of voices. Increased responsibility and consciousness explicitly nurtured
Financial Control	Tends to be blinkered by arbitrary "12 months Budgets" which often pathologically determine later interpretations of success – assessment of forecast rather than operational effectiveness.	Interactive (participative) Financial planning. Learning cycle based on dynamic performance measurement system. Forecasts seen as guidelines not blinkers.
Relationship with environment	Considered in terms of constraints imposed by management (i.e. Research and Development)	Considered and managed at all recursive levels, With specific focus upon the links of operation to local environment, and feedback to all levels of organisation.
Response to environmental change	Slow. Consequences must reach higher levels before decisions can be taken. Real time - sensitive to environmental change - is mediated by managers at each level.	Immediate: People on operational level have autonomy to operate and respond to real time changes. Closed feedback loops in all interactions