31st October 2009 | Draft

Recognizing the Psychosocial Boundaries of Remedial Action

constraints on ensuring a safe operating space for humanity

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Introduction

A team of 26 scientists, led by Johan Rockstrom and Will Steffen, and centered on the Stockholm Resilience Centre and the Stockholm Environment Institute, have produced a report entitled *Planetary Boundaries: exploring the safe operating space for humanity* (2009), also available under the same title in *Ecology and Society*. This was presented at the Club of Rome General Assembly (Amsterdam, 2009). It has been separately summarized as *The Nine Planetary Boundaries*. These boundaries are necessarily environmental constraints and boundary conditions, and the focus was on the degree to which they are already exceeded or in process of being exceeded. A summary of the study has been provided by Fred Pearce (*From Ocean to Ozone: Earth's nine life-support systems*, *New Scientist*).

In discussion of action to constrain the marked tendency to exceed these boundaries, and the initiatives which might be collectively undertaken, the point was made that a complementary analysis was necessary. This would explore indications of remedial capacity in the light of the track record of collective action, namely the probability that any advocated collective action could be effectively undertaken -- even if agreement was reached on what needed to be done.

The argument developed here is that the focus of analysis on what appears to need to be done, however urgently, needs a higher order of realism and constraint recognition -- in the light of demonstrated capacity for collective action on a global scale. The approach follow from a much earlier exploration of *Remedial Capacity Indicators Versus Performance Indicators* (1981) for a meeting on social indicators of the Goals, Processes and Indicators of Development (GPID) project of the United Nations University (Warsaw, 1981) -- later incorporated into *Insights into Maldevelopment: reconsidering the idea of progress* (Edited by Jan Danecki).

The method here is to use the exemplary analysis and representation of "planetary boundaries" of the more tangible environmental systems as a form of template -- if only as a suggestive metaphor -- to provide a means of focusing on the essentially intangible "psychosocial boundaries" which undermine collective global initiatives.

Planetary boundaries of the environmental system

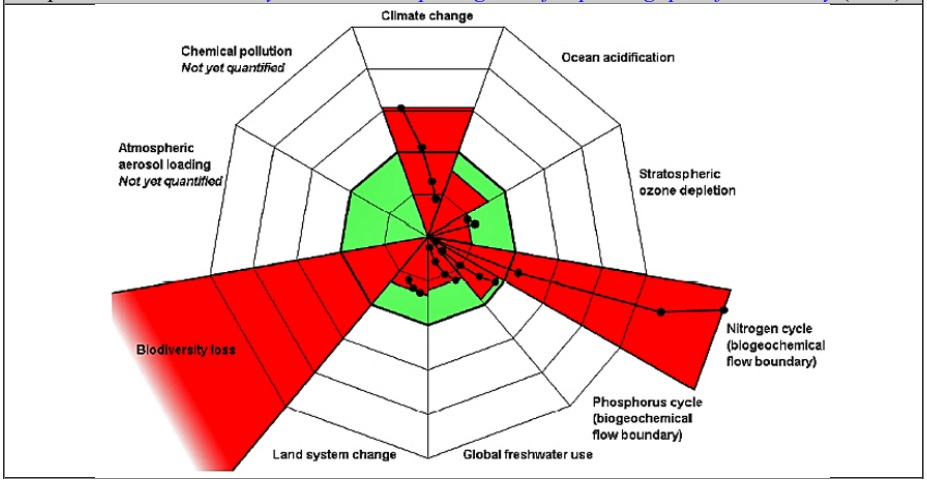
The boundaries that have been identified are:

- **Stratospheric ozone layer**: decrease allows increasing amounts of ultraviolet radiation to reach ground level, damaging biological systems
- **Biodiversity**: increase in species extinction potentially threatens the viability of ecosystems with unforeseeable problematic consequences
- **Chemicals dispersion**: irreversible additive and synergic effects of emission of persistent toxic compounds, notably leading to increased infertility and permanent genetic damage.
- **Climate change**: potentially driving the Earth system into a much warmer state with rising sea levels
- **Ocean acidification**: reducing the amount of available carbonate ions essential for shell and skeleton formation in organisms dramatically affecting ocean ecology and potentially resulting in drastic reductions in fish stocks.
- **Freshwater consumption and the global hydrological cycle**: increasing scarcity of freshwater and disruption of river flow and

associated ecosystems, notably downstream.

- **Land system change: conversion of land-use for purposes of agriculture, thereby reducing biodiversity** and affecting water flows
- **Nitrogen and phosphorus inputs to the biosphere and oceans:** conversion of nitrogen into reactive forms polluting waterways and coastal zones and disrupting ecosystems
- **Atmospheric aerosol loading**: promoting climate change and adversely affecting human health

Nine Planetary Boundaries
Reproduced from *Planetary Boundaries: exploring the safe operating space for humanity* (2009)



Necessity for urgent action, globally, regionally and locally

The evidence for those boundaries and the rate at which they are increasingly infringed -- and expected to be dangerously infringed in the near future -- leads to increasingly strident calls for collective action. But, as Margaret Mead is reported to have declared on a memorable occasion in the 1960s: "We know all we need to know".

The First Global Conference on the Future (Toronto, 1980) had as its theme: *Thinking Globally/Acting Locally*. However the problem noted on that occasion is that "we" do not know how to fit together what "we" know into a meaningfully communicable pattern which could catalyze appropriate action (*The Future of Comprehension: conceptual birdcages and functional basket-weaving*, 1980). In fact, as indicated then, there is no "we" with a shared awareness permitting coherent action. But as is noted on the cover of *The (Updated) Last Whole Earth Catalog* (1974): "We can't put it together; it is together".

In that period it was already clear that there were learnings to be derived from the many global calls for action, such as those formulated at the Club of Rome gathering of 2009 in relation to "planetary boundaries" (*Cooperation and its Failures: 12 Metaphors towards understanding the dilemma for the 1990s*, 1988; *Collective Learning from Calls for Global Action*, 1981). The latter document concluded its analysis with the comment:

> It would be a serious mistake to perceive the above considerations as a "negative" or "pessimistic" damper on any initiative. The international community has experimented with a variety of initiatives over the past two decades. We should not fool ourselves by the content of the "success stories" which those involved feel obliged to circulate afterwards for public relations reasons. Achievements have varied from modest to insignificant when measured against the dimensions of the problem. The first step towards more significant initiatives is to recognize how the previous ones have tended to fail. The purpose of this document is simply to point out that possibly we are not taking into account important constraints. To avoid acknowledging constraints is the most stupid form of "positive" thinking. Constraints are essential to good design as any architect, artist or inventor knows. The question is how can we learn to use them creatively.
>
> - If we do not know how we are part of the problem, we cannot understand the nature of the solution required.
> - If we do not know how we are part of the solution, we cannot understand the nature of the problem we face.

As indicated in the Club of Rome gathering, **we have a "we" problem with regard to articulating and addressing calls for action** -- especially if these are primarily informed by the expectation that there is the capacity to recognize urgency collectively and to act collectively in response to it, on the global scale which the challenges are held to require.

It is typically assumed that appropriate calls for action will engender appropriate action. The track record of calls and responses is far from encouraging. **There is very little indication that collective action of the scope required has every been engendered, agreed, or implemented with any degree of effectiveness, whatever the public relations claims to the contrary.**.

Most emphasis is placed on the optimistic expectation that such action is possible in the light of past practice -- and without requiring any new insight into past inadequacies. These are typically simply ignored, or denied -- with a high level of dependence on "positive thinking" and an emphasis on "bright-siding". In the case of mega projects, this is especially evident in planning and coordination disasters, project cost overruns, and highly problematic side effects.

Global calls for action cannot therefore be effectively made and acted upon globally in the 21st century by assuming a *tabula rasa*,

"green field" opportunity for fruitful outcomes. In planning terms the challenge is more appropriately described as one of constructing new initiatives on a " brown field" site -- littered with the unprocessed "toxic" debris of the institutional past. Within this metaphor, it might even be suggested that this toxic heritage is frequently creatively repackaged by those responsible -- and sold on to credulous investors in the inappropriate mindset from which it derived (*Credibility Crunch engendered by Hope-mongering: "credit crunch" focus as symptom of a dangerous mindset*, 2008).

Global remedial action boundaries

To clarify the strategic situation it is therefore appropriate to distinguish between:

- planetary environmental system boundaries, as identified
- remedial capacity boundaries in the light of collective capacity to respond to calls for action
- actions to be enabled by remedial strategies for which calls are made

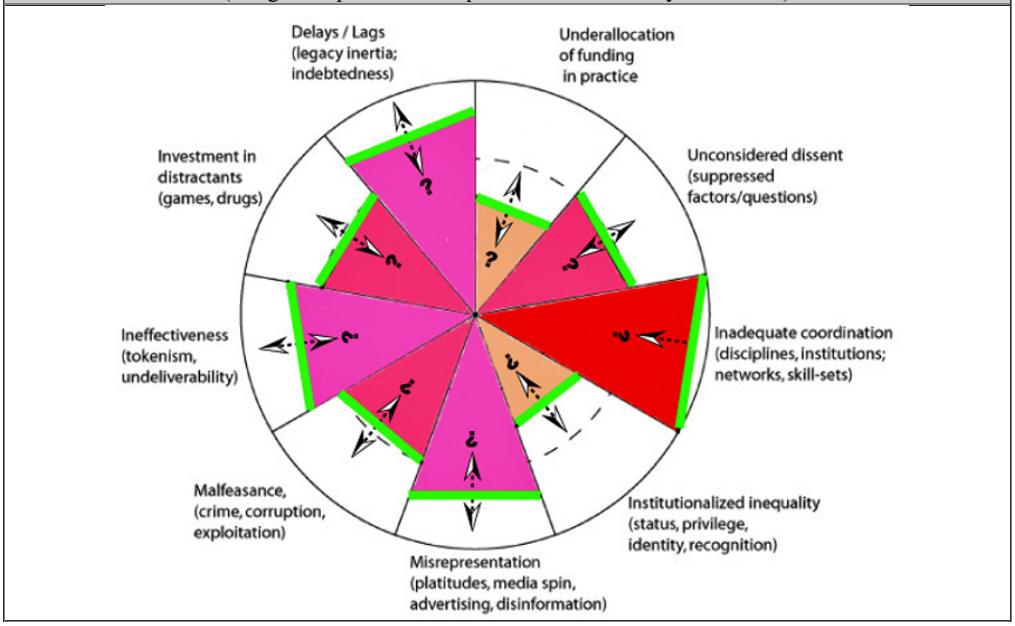
Whilst the first and the last appear clear, it is the intermediary challenge of remedial capacity that requires clarification -- as previously argued (*Remedial Capacity Indicators Versus Performance Indicators*, 1981). As noted above, the valuable presentation of the 9 "planetary boundaries" suggests a means of looking at the remedial capacity boundaries.

The existence of such "boundaries" is highlighted by the acclaimed "most important problem facing humanity", namely the focus of the United Nations Climate Change Conference (Copenhagen, 2009). At the time of writing:

- the "proof" of climate change, on which there is claimed to be a global consensus of serious scientists, is contested by other scientists whose qualifications and motivations may then be variously questioned
- the credibility of climate change campaigners is contested to the point that increasing proportions of any population question the urgency -- a process exacerbated by the missionary/religious fervour of the campaigners
- it is clear that various vested interests are exerting pressures to being about the about erosion of credibility or to "save face" in their failure to reach a viable agreement
- it was officially indicated in November 2009 that there is little chance of a "legally binding agreement" emerging from Copenhagen; emphasis has been switched to the possibility of a "politically binding agreement". Commenting upon this, Lumumba D-Aping, chair of the G77 group of developing countries, noted: *Tell me of any politician who delivers a politically binding agreement*. The chief negotiator for the EU indicated: *It is a Catch-22 situation. People are waiting for each other so it is difficult to blame anyone*. Such an agreement might be said to be only of value for public relations purposes -- as with any electoral promise. The reframing of the extremely urgent agreement emerged at the same time as:
    - the announcement by the expected future prime minister of the UK reneging on his "cast iron guarantee" to hold a referendum on any EU treaty.
    - the promise of Barack Obama to put an end to the US government's 200-year history of neglect and broken promises (many enshrined in treaties) towards the Indian tribes of the USA

The following figure is therefore an effort to represent a **possible** set of 9 "remedial capacity boundaries". As with the "planetary boundaries", those extending closer to the circumference would then be the most problematic, and the most likely to undermine any remedial strategy. However the main function of the figure is to raise questions about the degree to which each does effectively extend towards the circumference -- the **information presented being merely indicative** of a possibility (in the absence of substantiating indications). Attributions are therefore only arbitrary.

Nine Remedial Capacity Boundaries
(using the representational pattern of the Planetary Boundaries)



Such an array must necessarily be challenged, at least in terms of:

- the clusters indicated, namely whether other significant factors have been removed -- remembering however that some of the planetary boundaries are based on what amounts to indicator factors representative of other factors not specifically mentioned
- distribution of factors between clusters, namely whether the set is well-formed and whether more generic terms could be used to name them
- the significance of any given cluster as being indicative of a critical remedial capacity
- a measure of the current weighting of a given cluster, namely its relative potential for undermining any remedial strategy
- whether "nine" boundaries is significant or arbitrary, namely whether there is a systemic case for reducing or increasing the number or whether there are cognitive reasons for considering the nine to be appropriate (issues discussed in *Representation, Comprehension and Communication of Sets: the role of number*, 1978)

As with the "planetary boundaries", these "remedial capacity boundaries" are presented in the figure as though they were independent of one another. It is of course a fact that there are important systemic links between the boundaries within each set. Of great concern in the case of the "planetary boundaries" is whether such interactions are of a synergistic nature, namely pushing the system as a whole past tipping points. The same may be the case with the "remedial capacity boundaries".

In the case of the above figure, the **green lines** are indicative of a kind of **credibility boundary**. Each of the clusters may be understood as indicative of the degree of erosion of the credibility of any initiative dependent on ability to constrain the influence of that cluster. The **arrows** raise the issue as to whether the credibility is:

- decreasing further -- as the boundary is pushed outwards to the circumference and any "capping" efforts fail
- increasing -- to the extent it is possible to constrain the influence of the factor (in reality, rather by claiming to do so or denying its significance)

This last point highlights the extent to which elaborating such a figure is itself subject to the factors represented within the figure -- whether "massaging" in support of some undeclared agenda (or vested interest) or downplaying certain factors (arguing the need to be "positive", "hopeful" and presenting a "bright side"). Of particular interest are boundary issues which are effectively "too hot" to handle and the consequent need for appropriate procedures (*Overpopulation Debate as a Psychosocial Hazard: development of safety guidelines from handling other hazardous materials*, 2009).

Substantiating the remedial capacity boundaries

Having clarified the clusters named, or in order to do clarify them further, one procedure might be to identify a set of 20 to 50 global strategies of the past decades and to provide a ranking of the extent which they were undermined by each of the 9 clusters. This might be presented in a table of the following form.

Possible framework for assessing remedial capacity boundaries										
Notable global strategies	**Body**	**Launch**	***Remedial capacity boundaries*** (from the above figure)								
			Funds	Dissent	Coord.	Inequ.	Misrep.	Crime	Ineff.	Distr.	Delay
Agenda 21	UN	1992	?	?	?	?	?	?	?	?	?
Food for All	FAO	1996	?	?	?	?	?	?	?	?	?
Education for All	UNESCO	1990	?	?	?	?	?	?	?	?	?
Health for All	WHO	1998	?	?	?	?	?	?	?	?	?
Decent Work for All	ILO	?	?	?	?	?	?	?	?	?	?
Cybersecurity for All	ITU	2008	?	?	?	?	?	?	?	?	?
Computers for All	UNIDO	2009	?	?	?	?	?	?	?	?	?
Water for All	ADB	2009	?	?	?	?	?	?	?	?	?
Safe Water for All	IFC	2009	?	?	?	?	?	?	?	?	?
World Heritage	UNESCO	1994	?	?	?	?	?	?	?	?	?
Plant conservation	CBD	2009	?	?	?	?	?	?	?	?	?
Millennium Development Goals * eradicate extreme poverty / hunger * universal primary education * gender equality / empower women * reduce child mortality * improve maternal health * combat HIV/AIDS, malaria, etc * ensure environmental sustainability * global partnership for development	UN	2001	?	?	?	?	?	?	?	?	?

Just as there is a challenge to provide quantitative indications of the planetary boundaries and their vulnerability under present trends, so there is a challenge in replacing the question marks in the above table. Tentative estimates on a 1-10 scale would be a first step -- perhaps averaging over a range of such estimates.

A key question is the extent to which the "viability" of such strategies is in reality primarily sustained by upbeat formal reporting requirements and public relations "spin" (*Globallooning -- Strategic Inflation of Expectations and Inconsequential Drift*, 2009). As with the tale of the *Emperor's New Clothes*, it may be a case of "let's pretend" indulgence in "feel good" evaluations (*Entangled Tales of Memetic Disaster: mutual implication of the Emperor and the Little Boy*, 2009). Information to the contrary may simply not be able available however ineffective a strategy may be experienced on the ground.

Another consideration can be explored in terms of the set of cognitive biases. Of interest in this respect is the argument of Eliezer

Yudkowsky (*Cognitive biases potentially affecting judgment of global risks*, In: Nick Bostrom and Milan Cirkovic, eds, *Global Catastrophic Risks*, OUP, 2008). Yudkowsky distinguishes nine such biases: availability; hindsight bias; "black swans"; conjunction fallacy; confirmation bias; anchoring, adjustment, and contamination; affect heuristic; scope neglect; and calibration and overconfidence. Of relevance is his association with the Singularity Institute for Artificial Intelligence, especially given the argument elsewhere for a "memetic singularity" (*Emerging Memetic Singularity in the Global Knowledge Society*, 2009). Is there a sense in which such biases are associated with the cognitive undermining of remedial capacity, namely with the nine remedial capacity boundaries suggested above? The more general question is then how remedial capacity in undermined by uncritical thinking and whether critical thnking fallacies are usefully to be subject to a ninefold clustering (*Web resources: Critical thinking vs. Specious arguments*, 2001).

Frustration with such a track record, and the failure of the Copenhagen negotiations, will however increase the probability of arguments for a "unilateral" geoengineering remedy which minimizes negotiation and any serious concern for side-effects -- possibly rendering the stars invisible (*Geo-engineering Oversight Agency for Thermal Stabilization (GOATS)*, 2008). This will maximize the need for investment in technologies in which certain countries and corporations can claim competence (David Adam, *Can we manipulate the weather? The Guardian*, 4 November 2009; TDG Community, *5 Radical Science Fixes to Global Warming*, *The Daily Green*, 8 January 2010).

The probable organization of any geoengineering initiative suggests a complementary focus, useful in refining any set of boundaries. This could identify the characteristics of global mega-projects that might be considered as inherently "credible" in the light of the track record of such endeavours. These characteristics might include:

- lack of constraint on costs: examples include military interventions (Iraq, Afghanistan), financial bailouts (where institutions are "too big to fail"), Olympic Games (where the unfortunate cost overruns are repeatedly reframed), "big science" projects (typically with military benefits), and those whose effectiveness is ensured by under-the-table "payouts" and "dirty tricks".
- undemocratic chain of command and avoidance of consultation (even absence of oversight): examples as for the previous point (including "national prestige" projects), as well as secret projects (as with intelligence gathering and electronic surveillance)
- effective indifference to feedback or unforeseen consequences: examples most typically include military operations (where collateral damage can be dismissed as a military necessity), large dam construction
- misrepresentation (including hidden agendas): examples would include those projects where effectiveness is defined in terms of criteria other than those by which it might otherwise be evaluated as questionable (as with the securing oil supplies from Iraq, irrespective of questionable achievement with respect to ensuring democracy and freedom) or by scare-mongering in relation to essentially invisible threats
- relative simplicity, especially in terms of technical focus: examples again include major military campaigns where the focus is on development of high-tech destructive capacity and its targeted application (bombs, missiles, etc), in contrast to initiatives which require more complex and subtle patterns of engagement with "whole system"

The "viability" of such mega-projects is of course achieved by effectively setting aside any values in terms of which their necessity may however be vigorously defended. "Misrepresentation" therefore becomes a key to claimed viability, as in the case of terrorism (*Promoting a Singular Global Threat -- Terrorism Strategy of choice for world governance*, 2002). Credibility issues, if any, are only effectively raised when it is too late to constrain the initiative.

Polyocular strategic vision

Single-eyed focus: Individually, as a strategic focus, it might then be considered that there are three distinct "eyes":

- the "planetary boundary" representation of constraints, effectively promoted as such with respect to current strategic priorities
- the "remedial capacity boundary" representation
- any configuration of complementary strategic actions in response to any excesses associated with the "planetary boundaries"

Any single-eyed focus merits reflection in the light of its adaptive response to information as explored by Orrin E Klapp (*Opening and Closing; strategies of information adaptation in society*, 1978). The challenge is how any such "eye" does indeed "open" or "close" -- like an iris -- in response to information detection challenges and to information overload. The widespread use of the vision metaphor in strategic thinking encourages exploration, within that metaphor, of defects of such thinking in the light of well-known dysfunctions of the eye (myopia, presbyopia, astigmatism, etc). "Short-sightedness" is a well-recognized accusation against policy-makers (*Metaphor and the Language of Futures*, 1992; David Adam and Jonathan Watts, *World leaders accused of myopia over climate change deal*, *The Guardian*, 2 November 2009).

The single eye of course has associations and connotations to the strengths and limitations of the archetypes of the Egyptian Eye of Horus and that of the Cyclops of Greek and Roman mythology. In the quest for insight, a case might be made for also exploring the health of any such "eye" in the light of alternative medical approach of iridology (*Remedies to Global Crisis: "Allopathic" or "Homeopathic"? Metaphorical complementarity of "conventional" and "alternative" models*, 2009).

Stereoscopic vision: Using the vision metaphor so widely favoured in strategic thinking, the question is then how any depth of perspective is acquired through that vision -- vital to achieving focus so as to assess distance. Typically the global problematique is then to be understood as one "eye", configured in terms of the "planetary boundaries". The global resolutique is then to be understood as the other "eye", configured in terms of strategic priorities.

Such a configuration then offers access to a form of truth -- consistent with the theological arguments of John A. T. Robinson (*Truth is Two-eyed*, 1979). The technicalities of achieving depth perception are of course of considerable interest in some computer visualization applications enabling stereoscopic vision. Depth perception enables the world to be seen in three dimensions.

However the metaphor also suggests the more problematic possibility of a strategic approach long-highlighted by the tale of Vice-Admiral Horatio Nelson at the Battle of Copenhagen (1801) against the Danes. At a critical moment, when his superior signalled he should retreat. Nelson ordered that the signal be acknowledged. He informed his flag Captain: "*I only have one eye -- I have the right to be blind sometimes*," and then holding his telescope to his blind eye, said "*I really do not see the signal!*". By his continuing the engagement a British victory was achieved.

On the occasion of the new "Battle of Copenhagen", the question is of course to which "eye" the world might hold its strategic "telescope" at the time of the United Nations Climate Change Conference (Copenhagen, 2009). Choices might be to hold the "telescope", even in the form of Joel de Rosnay's *Macroscope* (1979), to a blind-eyed:

- problematique: focusing on strategic action as being inherently "positive", dismissing as "negative" any challenges as to whether it effectively addressed the system of problems
- resolutique: focusing on comprehension of the system of problems as being inherently "positive", dismissing as "negative" any challenges as to whether it gives rise to any effective actions

But whilst a single eye may indeed be most appropriate to the linear thinking characteristic of conventional military engagements, the question is whether its necessary enhancement by "stereoscopic" depth perception is sufficient for an engagement characterized by higher orders of complexity.

Polyocular vision: The argument above indicates the possibility of three "eyes" of potential strategic relevance. The strategic value of polyocular vision at this time has been stressed by Magoroh Maruyama (Polyocular Vision or Subunderstanding? *Organization Studies*, 25, 2004, pp. 467-480). Any "Cyclopean vision" characteristic of either a problematique or a resolutique approach alone may also be challenged with respect to the strategic relevance of senses other than vision (*Cyclopean Vision vs Poly-sensual Engagement*, 2006).

The strategic question is what is to be understood by the value of more than two "eyes". Using different metaphors, Edward de Bono has long-stressed the cognitive value to strategy of six distinct modes of knowledge (*Six Thinking Hats*, 1985; *Six Action Shoes*, 1991; *Six Value Medals*, 2005; *Six Frames For Thinking About Information*, 2008).

Given the set of three "eyes" identified above, it might be suggested that there is an essential complementarity to them. In addition to the "eye" of the problematique and that of the resolutique, the third might indeed be understood as a form of "third eye". Its traditional metaphorical associations in various traditions might be appropriately suggestive of a self-reflexive cognitive approach responding to a complexity of a higher order than might otherwise be assumed.

Systemic isomorphism

It is to be expected that there should be a degree of strategic match between the organization of the "eye" of the problematique and that of the "eye" of the resolutique. The set of strategies within the resolutique should indeed match the set of challenges associated with the "planetary boundaries". The possibility of such a match was a theme of the interlinked databases on world problems and on global strategies within the framework of the *Encyclopedia of World Problems and Human Potential*.

Such a match necessarily needs to go beyond a one-to-one relationship. The processes associated with the individual "planetary boundaries" are highly interlinked. Any attempt to treat them in isolation constitutes a form of silo thinking resulting in negligence of the system as a whole -- and of its synergistic processes.

The interesting question is the extent to which the "remedial capacity boundaries" need to be understood as a system in their own right -- with an isomorphic relationship to the other two "eyes". Greater insight into the items clustered in the figure above might elicit such an equivalent set of systemic processes.

Representation of boundaries of coherence of complex systems

The representation above of the boundaries of remedial capacity, inspired by that of the system of planetary boundaries, follows from an interest in how the viability of complex systems is to be understood and represented. The representations above are valuable for immediate communications of the nature of the challenge. They do however obscure the complexity of the systemic interlinkages portrayed in this way, whether or not those systems are in some way isomorphic -- as might be suspected.

The argument here could be extended in the light of an earlier argument regarding the need for richer metaphors to facilitate comprehension (*In Quest of Mnemonic Catalysts -- for comprehension of complex psychosocial dynamics*, 2007).

Of particular interest is the notion and nature of any "boundary" between systemic order and systemic chaos. An appropriate consideration of this is the possible mapping of the 9 "boundaries" for each "eye" onto a complex plane -- if only as a mnemonic cue on which the elements above can be "hung". A striking visual rendering of the resultant boundary for a given "eye" might be the Mandelbrot set. This is seen to have an elaborate boundary which does not simplify at any given magnification, therefore described as a fractal. The main argument for using such a representation is that offers a degree of comprehension of complexity with a high degree of aesthetic appeal.

Two distinct approaches to mapping the "eyes" onto the Mandelbrot set might be considered:

- representation of each "eye" on a separate Mandelbrot set -- with each of the 9 "boundaries" associated with individual features of the visually rendered set
- representation of all three "eyes" on the same Mandelbrot set:
    - with the 9 "boundaries" of the problematique attributed to the main cardioid and its features (which has an attracting fixed point)

- with the 9 "boundaries" of the resolutique attributed to the secondary cardioid and its features (which has an attracting cycle of period 2)
- with the 9 "boundaries" of the "imaginatique" (as the third "eye") attributed to the tertiary cardioid and its features (which has an attracting cycle of period 3)

The possibility of mapping problematique, resolutique and "imaginatique" onto a complex plane, independently of consideration of the Mandelbrot set, has also considered separately (*Imagining the Real Challenge and Realizing the Imaginal Pathway of Sustainable Transformation*, 2007). In a diagram there, a fourth "eye" was added in the form of game-playing (an "irresolutique"). Such a diagram highlights the possibility that such mappings may help to identify viable strategic pathways that take realistic account of the remedial capacity boundaries.

From the perspective of complex systems -- which they indeed are -- these pathways may even need to be understood in four or more dimensions rather than two or three (*Geometry of Thinking for Sustainable Global Governance*, 2009; *Metaphorical Geometry in Quest of Globality -- in response to global governance challenges*, 2009). The global challenge of navigating the adaptive cycle, as articulated by Thomas Homer-Dixon, may well call for such a representation (*The Upside of Down: Catastrophe, Creativity, and the Renewal of Civilization*, 2006)

In a concluding comment it was argued, regarding the structure of that diagram, that there would also appear to be interesting ways of associating any further exploration with previous endeavours to derive psychosocial significance from the complex plane in terms of the Mandelbrot set (*Sustainability through the Dynamics of Strategic Dilemmas in the light of the coherence and visual form of the Mandelbrot set*, 2005; *Psycho-social Significance of the Mandelbrot Set a sustainable boundary between chaos and order*, 2005). Of particular interest was the effort to relate this to earlier explorations of the coactioin cardioid (*Cardioid Attractor Fundamental to Sustainability: 8 transactional games forming the heart of sustainable relationship*, 2005) -- to which the structure of that diagram might be related.

In quest of systemic functional connectivity

Another approach to the set of 9 "planetary boundaries" and its possible isomorphs might be taken in the light of the work of management cybetnetician Stafford Beer (*Brain of the Firm*, 1972; *Diagnosing the System for Organizations*, 1985). This notably lead to subsequent work on a viable system model. However Beer also developed another process model of relevance to dialogue on complex sets of issues (*Beyond Dispute: the invention of team syntegrity*, 1994). This is based on the figure of the icosahedron -- the regular three-dimensional polyhedron that has 20 triangular faces, 12 vertices and 30 edges.

Of relevance to the above considerations, and valued by Beer for the cognitive bridge that it offered, is that under a certain geometrical projection the icosahedron gave rise to a figure known as an enneagram (Andrew Pickering, *The Science of the Unknowable: Stafford Beer's cybernetic informatics*, University of Aarhus, 2006). It is described as the final stellation of the icosahedron. Typically drawn as a 9-pointed figure, the enneagram has valued associations in a number of cultures. However, for the purpose of this argument this figure may be considered as the complement, or geometric dual, of the 9-sided representation of the bounded systems above.

The merit of such a figure, through its cultural associations, is that it offers a pattern of connections between distinct functions essential to the integrity of such a system. In the widespread use of the enneagram in personality analysis, for example, each distinct point is understood to represent a distinct and habitual pattern of thinking, emotions and behaviour. This suggests a way of considering the system of 9 "remedial capacity boundaries", especially as these relate to both individual and collective behaviour. Whilst its widespread popular use by **individuals** is valuable to uptake, the key question is whether it does indeed (as it might be claimed to do) offer a means to facilitate a more fruitful approach by **collective** intelligence to complex psychosocial systems at the global level.

The relationship of the enneagram to the cybernetics associated with a polyhedral design, as extensively studied by Beer, suggests ways of reframing any system of boundaries in three (or more dimensions) as discussed elsewhere (*Geometry of Thinking for Sustainable Global Governance: cognitive implication of synergetics*, 2009; *Metaphorical Geometry in Quest of Globality -- in response to global governance challenges*, 2009).