DELIBERATIVE SUSTAINABILITY ASSESSMENT WITH THE ON LINE KERDST DELIBERATION SUPPORT TOOL

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ABSTRACT

This article presents the design principles and application of the on-line deliberation support tool **KERDST** (developed by the KerBabel™ team at the C3ED) for sustainability assessment, in the context of the European *SRDTOOLS* project concerned with assessing regional development projects and policies relative to sustainability criteria. After a succinct exposition of the 'problem of social choice', we introduce the 'Deliberation Matrix' as a framework for multi-criteria multi-stakeholder assessment and then present the **KERDST** system for managing and mobilising indicators. To conclude, we highlight the design principle of a "representative diversity of indicators" relative to the (impossible) ideal of monetary cost-benefit analysis of an inventory of project costs and benefits.

KEY WORDS

Assessment, Deliberation, Environment, Evaluation, Indicators, KerDST, Multi-criteria, Regional development, Social capital, Social choice, SRDTOOLS, Stakeholders, Sustainability

SA VIA MULTI-CRITERIA MULTI-STAKEHOLDER DELIBERATION

Sustainability is *par excellence* a problem of social choice. As in all public policy, territorial planning, or collective risk management policy contexts, there is a need to identify, appraise and choose amongst the various different options or courses of action that present themselves (O'Connor 2002a, 2002b). Following the fundamental convention of economics analysis, we may propose to develop evaluation methods in terms of the comparison of one thing or action with another. If an action A is contemplated, the questions may be asked: What is obtained (or gained) by action A? What is lost or excluded by choosing A rather than B (or 'not-A').

Economists speak of the 'opportunity costs' of an action, this being defined as the value of the most attractive alternative foregone. Up to this point, the economists' conventions are robust; where things diverge is in the way that the 'values' and the 'trade-offs' will be represented and (perhaps) quantified.

We exploit, in this regard, the distinction made by O'Connor (2006d) between 'mono-metrical' and 'poly-phonic' valuation perspectives (see also O'Connor (2000) on valuation 'from the point of view of complexity'). The 'mono-metrical' approach to decision support, favoured by many (but not all) economists, is to seek to establish a 'rational' justification for a choice between A, B, C, etc., on the basis of relations of preference along a single scale. If C is preferred over B, and B is preferred over A (etc.), then C is the highest-valued action. However, this simple principle of establishing preferences, or a ranking of options, is not always easy to apply and does not necessarily resolve a problem of choice. The primary reason, which is relevant for almost all policy problems of any significance, is that whenever choices (A or B or C, etc.) involve or will have consequences for more than one person, judgements may differ as to what is preferable. Typically, the different options (A, B, C) will produce differing distributions of benefits, risks and costs for the individuals or sectors of society concerned. We can illustrate this with the notion of a 'conflict matrix'. Suppose that each of three stakeholder groups of a society, *Alpha, Beta* and *Gamma*, put forward their preferred policy, A, B and C respectively. We obtain a 'poly-phonic' profile of judgements such as in the table (above), where, as a general rule, no overall ranking emerges.[1]

	A	*B*	*C*
Alpha	**GOOD**	**VERY BAD**	**MEDIOCRE**
Beta	**MEDIOCRE**	**GOOD**	**VERY BAD**
Gamma	**VERY BAD**	**MEDIOCRE**	**GOOD**

Selecting between options therefore requires some sort of 'arbitrage' or ruling over the appropriate distribution of (perceived) benefits, risks and costs — in other words a problem of fairness, justice, equity. In this regard, the different protagonists may not only have divergent interests, they may also propose quite different principles for resolving this "problem of social choice". In our specific context of SA, the difficulties of this formal "problem of social choice" (Arrow 1963; O'Connor 2002a) are given compelling practical cogency a variety of considerations that include:

- Resource management choices usually relate to complex entities, processes or outcomes, each option (A, B, C, etc.) being characterised by a range of attributes. Comparison of options means comparing a vector of attributes with a variety of concepts, units of measure and criteria. It is not always easy to pass from a multiple criteria appraisal to a ranking of alternatives along a single scale.
- Consequences of choices are distributed in time and, often, different aspects of outcomes (good and bad, as perceived by different constituencies) will have distinctive time profiles, e.g., climate change, radioactive waste decay, fish population dynamics, dilution of chemical pollution by natural processes, coastal erosion.
- For all actions whose consequences will be revealed through time, there are various degrees of uncertainty due partly to natural system complexity and partly to 'social' indeterminacies such as other decisions not yet made or whose consequences are not yet known. There is also indeterminacy in values due to the sensitivity of any 'preference based' valuation to the principles and parametric assumptions about distribution that will or might be adopted.

[1] This is the typical situation of multi-criteria analysis; see Munda (1995).

- A great variety of different reasons or principles can be put forward as justifications for the acceptability, or not, of different outcomes (including perceived uncertainties and risks, distribution of benefits and costs across different constituencies within society, or across generations through time, etc.). It may not be possible to respect all these quality-performance principles simultaneously; this may be the case for the judgements offered by a single person, or for the judgements offered by a range of sectors. Because the principles may be 'irreducible' (that is, incomparable, in the sense of being grounded in qualitatively different considerations), assessment (ex post or ex ante) can be characterised by dilemmas and — in the case of communication and decisions — the need to yield ground or make concessions of principle, not merely trade-offs on quantitative terms.[2]

The significance for evaluation of a plurality of justification principles, considered as irreducible, can be illustrated by a second conflict matrix. This also portrays the 'classic' multi-criteria situation where no one option 'dominates' all the others on all criteria.

	Option A	*Option B*	*Option C*
Principle 1	**Not Applicable**	**SATISFACTORY**	**INACCEPTABLE**
Principle 2	**SATISFACTORY**	**INACCEPTABLE**	**Not Applicable**
Principle 3	**INACCEPTABLE**	**Not Applicable**	**SATISFACTORY**

It can easily be admitted that, most often, distinct stakeholder groups will have their distinctive attachments to some principles relative to others, and also they will project their own distinctive 'content' for each of the principles (e.g., justice, equity, nature conservation, profitability). This leads us to frame the generic problem of 'social choice' as a *multi-criteria multi-stakeholder deliberation* about the merits and demerits of the options for action that present themselves to the society.

By bringing together the two 'conflict matrices' introduced just above, we obtain a three–dimensional array (*see diagram on next page)* which has been made the basis of the **KerBabel™ Deliberation Matrix** (or "Cube", see O'Connor 2006c).[3] The logic of this 3-dimensional **Deliberation Matrix** is to permit a highly didactic presentation of the process and outcomes of judgements offered by *each* category of stakeholders, for *each* of the options or scenarios under evaluation, with reference to a *spectrum* of governance or quality-performance issues.

In the context of sustainability assessments (SA) which is the focus of the present paper, we adopt the terminology of 'multiple bottom lines' or, as a neologism, the notion of '*sustainability quality-performance multiple bottom lines*' (**SQPMBLs**, see O'Connor 2006d). In a stakeholder-based approach to SA, the spectrum of **SQPMBLs** (and also the range of stakeholder categories itself) must be established on the basis of prior discussions and analyses or by real-time deliberation amongst those participating in the SA. The scale of analysis and the range of sites, strategies, options or scenarios (etc.) to be assessed must also be decided. Then, by focussing on each cell of the "Cube", the prospect is that that each stakeholder class should offer a judgement (*satisfactory, poor, intolerable*, etc.) of each scenario in relation to each of the key governance or decision issues. One obtains in this way, for each stakeholder (or actor class), a rectangular array of cells, being a layer of the Matrix, within which each row represents the evaluations (issue by issue) furnished by a given

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[2] For introductions to the myriad debates around economic analysis, sustainability and societal choice, see — among others — Holland (1997) O'Connor (2000, 2002a, 2002b), O'Neill (1997); and references indicated there. Both theoretically and empirically, it is inevitable that, whether or not a monetary cost benefit analysis is engaged, a social-political process will intervene to navigate (with or without consensus of the concerned stakeholders) and 'chart a course'. On the scientific uncertainties that feed, interface with and are in turn fuelled by societal indeterminacies, see Funtowicz, O'Connor & Ravetz (1997); Gallopin et alia (2001).

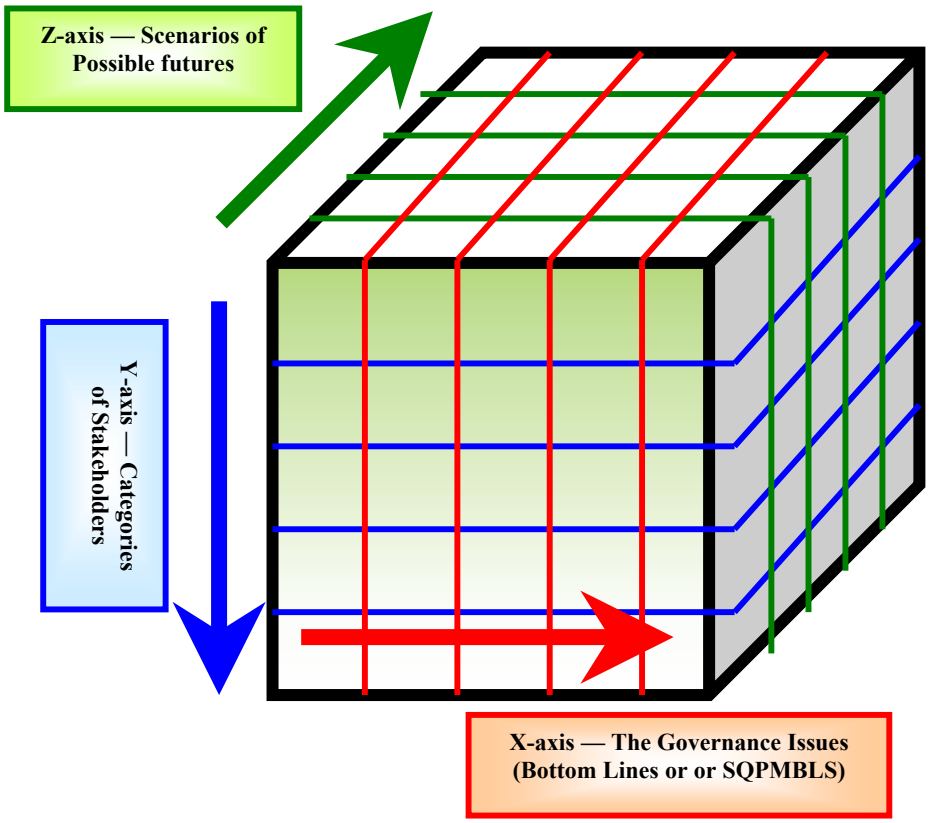
[3] We note that, from a mathematics standpoint, strictly speaking the three-dimensional array is more a 'tensor' than a matrix... The **Deliberation Matrix** concept was crystallized, and given a prototype multi-media implementation, in the context of the EC-funded multi-partner **GOUVERNe** project on interactive tools for integrated management of ground water resources (*Guidelines for the Organisation, Use and Validation of information systems for Evaluating aquifer Resources and Needs*: Contract No. EVK1-CT-1999-00043, European Commission 5th Framework Programme, within the Thematic Programme: Environment and Sustainable Development, March 2000 to February 2003, coordinated by Martin O'Connor, C3ED, Université de Versailles St-Quentin-en-Yvelines, France).

class of stakeholders for successive scenarios. Or, looked at from another angle, one obtains the evaluations by each stakeholder, of a given scenario. And so on.

As a general rule, this process of cell-by-cell piecewise judgement will not produce a clear conclusion about the 'best' option. It might, at best, permit a partial ranking (with reference to any one of the bottom lines, or from any single stakeholder's point of view, etc.). The principle role of the 3-D array is not to signal the 'best' decision; rather to act as a *deliberation support tool* (DST) providing participants in the SA process a common framework and an opportunity of "collaborative learning".

In this way, we motivate a *multi-stakeholder deliberation* framework as a generically appropriate underpinning for Sustainability Assessment.[4] We also establish, from starting points within or, at least, familiar to economic analysis, the requirements for a *dialogue model of knowledge* as an underpinning for Sustainability Assessment characterised by *conditions of complexity*.

However, this does not yet exhaust the methodological debates. A central question to sustainability analysts engaged in "deliberation support" will henceforth be: *what emphasis is to put on analytical conventions and research procedures that aid the representation of this agonistic situation, and what emphasis is to put on analytical or procedural conventions that may help structure the process of arbitrating over or 'resolving' the conflicting claims*? Various SA tools and, more particularly, the users of these tools, propose responses to this question of strongly contrasting character. One can observe, empirically, methods that strongly privilege one or the other side of this question. Some analysts prefer to put their emphasis on the social process as irreducible to analysis; others prefer to seek formally to 'represent' the outcome of what Hegel once called the 'tribunal of history' as an ex post emergent ranking or weighting. Which preference for SA is right? Our sentiment is that *explicit constructed deliberation* has considerable pertinence, justified not merely as a honourable *moral, ethical and political choice* (which it is), but also as a *scientific stance* that is in line with and gives deliberate weight to, certain strongly observed 'social facts'.



[4] Without attempting any review of the literature, we mention Simos (1990) and De Marchi et alia (2000) as good illustrations of this methodological point of view.

THE KERBABEL DELIBERATION MATRIX

In this section we will show how the above ideas for the structuring of multi-stakeholder dialogue and deliberative approaches to Sustainability Assessments can be implemented with the aid of interactive on-line ICT "deliberation support tools". Our focus here is on the use of the **KerBabel™ Deliberation Matrix** (henceforth **DM**) with its associated **KerBabel™ Indicator Kiosk** (henceforth **KIK**) developed at the C3ED as an on-line deliberation support tool (henceforth DST).[5] We propose that Sustainability Assessments, can in general be organised as a multi-stakeholder multi-criteria deliberation process, structured in terms of:

- A defined spectrum of performance "bottom lines" to be addressed; and
- A synthetic representation of the full spectrum of the 'stakeholders in sustainability' relevant to the assessment situation.

Starting with this basic structure, as a function of the class of situation — e.g., company performance appraisal, evaluation of territorial planning options or investment programmes (etc.) — we may introduce further comparative dimensions as a function of evaluation need. For example:

- In the case of *ex ante* evaluations of policy or investment alternatives (at whatever scale of system being considered) one might propose a number of alternative scenarios (that is, envisaging various 'possible futures').
- In the case of *ex post* evaluations, one might wish to consider, in a comparative appraisal, a spectrum of industrial sites/plants, or a number of distinct territories (cities, regions, catchments, etc.), or different countries; and so on.

The 'crossing' of these three dimensions leads to the three-dimensional structure of the **KerBabel™ Deliberation Matrix** already introduced. The role of the **DM** is to permit a transparent presentation of the process and outcomes of judgements offered by *each* category of stakeholders, for *each* of the scenarios, across a *spectrum* of governance or performance issues.[6] According to this schematic model, the evaluation activity proceeds through the step-by-step phase — which can be undertaken on an individual or a collective basis within a group — that consists of *colouring the cells of the 3-D Deliberation Matrix*. The idea is that, once the DM structure is in place (or, as it is being developed),[7] the actors in the SA process focus on each cell of the 'Cube'.

- One obtains in this way, *for each stakeholder* (or class of actors), a rectangular array of cells, being a layer of the Matrix, within which the successive rows represent the evaluations (issue by issue) furnished by the selected class of stakeholders for successive scenarios.
- Or, looked at from another angle, one obtains, *for each scenario*, a rectangular array of cells, being a layer of the Matrix, within which the successive rows represent the evaluations (issue by issue) by each class of stakeholder, of a given scenario.
- Or, in the third way of "cutting the cake", one obtains *for each issue* (or SQPMBL), a rectangular array of cells, being a layer of the Matrix, within which the successive rows represent the evaluations (stakeholder by stakeholder) of each scenario, with reference to the selected issue.

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[5] Background to the ambition of exploiting interactive ICT as deliberation support and social learning tools in the sustainability field can be found in Guimarães Pereira & O'Connor (1999) and O'Connor (2006a). The methodological underpinnings of the kerDST system as a framework for participatory integrated environmental analysis are laid out in O'Connor (2006c).

[6] In a methodological sense, the term "scenarios" (as the third axis) can be given a very broad range of interpretations. For example in an *ex ante* study it might be a range of sites for a power station siting or, in a 'sensitivity study' it might be different 'scenarios' for assumptions made about key parameters subject to uncertainty or about distributional variables in project evaluation. Because *SRDTOOLS* is mainly concerned with *ex ante* evaluation of regional/territorial planning or investment options, we retain the term "scenarios" as for the third axis of the DM structure. In *ex post* comparative studies, the term "scenarios" is not so appropriate, and the third axis could more typically be a spectrum of districts, or industrial sites, or countries (etc.) chosen for performance evaluation.

[7] The spectra of options, of governance issues and of stakeholder categories must evidently be established. In principle, this can be done either on the basis of prior discussions and analyses or by real-time deliberation amongst those participating in the SA. The on-line **KERDST** system permits both procedures.

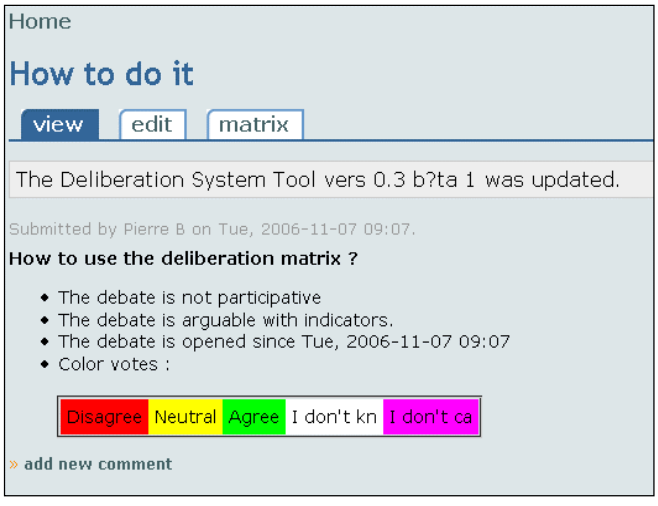
As of late 2006, several variations of the **KERDST** on-line system are available, with increasing structure, as signalled in the Table below.

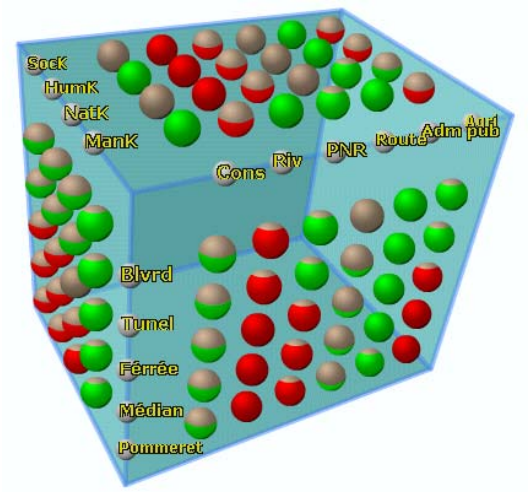
KERDST **Typology of Deliberation Processes with the "KERDST" Deliberation Support Tool** **© KerBabel™ C3ED (2006)**		**ROLE OF INDICATORS IN THE EVALUATION**	
		NO INDICATORS **"Colouring in the Cells" (with or without commentary** *For each Cell, a single judgement (by colour) is registered for each stakeholder category (via discussion or expertise)*	**WITH INDICATORS** **The judgement for each Cell of the Matrix is informed by a "Basket of Indicators".** *The colour of the Cell depends on the signification and relative weighting attributed to each indicator in the 'basket'*
USER COMMUNITY	**CLOSED** **The deliberation is not open to an extended community.** *A single (synthetic) judgement is registered for each actor/stakeholder category*	**QUALITATIVE MULTI-STAKEHOLDER MULTI-CRITERIA ASSESSMENT**	**NON-PARTICIPATORY INDICATOR-BASED ASSESSMENT**
	OPEN **An extended user community.** *Multiple participants within each stakeholder category may contribute to the evaluation.*	**QUALITATIVE MULTI-ACTOR PARTICIPATORY ASSESSMENT (WITHOUT INDICATORS)**	**MULTI-ACTOR PARTICIPATORY INDICATOR-BASED ASSESSMENT**

THE KERDST ON-LINE DELIBERATION SUPPORT TOOL

Two websites currently provide access to two distinct prototypes of the kerDST on-line deliberation support tool.

- Since early 2006, the KerBabel™ Deliberation Matrix has been made available for use at the website: **kerdst.c3ed.uvsq.fr**. This version provides the framework for a qualitative multi-stakeholder multi-criteria comparison of scenarios (or sites, or options, etc.) by a single person or a community of users.
- Since late 2006, the integrated **KERDST** system of Deliberation Matrix with associated Indicator Kiosk (KIK), available on **http://iacaprod.c3ed.uvsq.fr/kerdst2**, allows multi-criteria evaluation to be supported by indicators and, in the 'participatory' option, allows judgements by each category of stakeholder to be produced as a composite outcome of multiple participants.





INDICATORS AND DELIBERATION WITH THE ON-LINE SYSTEM "KERDST"

The current phase of multimedia development of the **KERDST** system integrates two major features within the basic multi-stakeholder multi-criteria comparative evaluation framework. The first is the **mobilisation of indicators** as a basis for the cell-by-cell judgements; these indicators are catalogued in a "KerBabel™ Indicator Kiosk" (**KIK**),[8] which can be accessed through on-line interfaces with the Deliberation Matrix. The second is the accommodation of **multiple participants as members of the deliberation community**, each participant being associated with one (or, exceptionally, several) of the stakeholder categories and contributing to the building up of composite judgements for the cells of the **DM** corresponding to that particular stakeholder category. By combination (as shown in the preceding table) we obtain the four types of exploitation of the **KERDST** system's possibilities, as follows.

- **CLOSED/NO INDICATORS — The first and simplest exploitation of KERDST is to define an array of (1) actors, (2) performance issues and (3) options or situations to be evaluated, and then colour the cells of the resulting 3-D Matrix using a code such as *[red = bad], [yellow = not so bad], [green = good], [white = no idea], [blue = don't care or not applicable]*.**
  Notes: The **KERDST** system proposes these judgement categories and colours as default options, but the user can modify both the categories and the colours if desired. It is possible to proceed with 'colouring the cells' and, at the same time, make use of a text box for adding an explanation or commentary of the judgement (colour) made for each cell of the Matrix.

- **CLOSED/WITH INDICATORS — The second type of exploitation of KERDST is to incorporate a descriptive basis as a motivation for the judgement (colour) proposed in each cell, through the selection of a 'basket' of indicators taken to characterise relevant attributes of the scenario/choice or activity/site/territory under scrutiny. In this case, the indicators themselves must be managed in some sort of catalogue.**
  Notes: As a function of the process adopted and the functionalities of **KERDST** that are exploited, the person or group undertaking the SA can either choose indicators from a pre-existing catalogue or contribute their indicator suggestions into an evolving catalogue. The judgement at the "cell" level in the Matrix is obtained as a "weighted amalgam" of the judgements assigned to each indicator within the "basket" (using a colour code analogous to that employed for the cells). Therefore the colour (or composite) of each Matrix cell is a function of the relative weight and significance attributed to each indicator in the corresponding basket.[9]

- **OPEN/NO INDICATORS — The third type of exploitation of kerDST is the introduction of a community of participants in the SA process. In this case, after the spectrum of stakeholder categories has been defined (or, in real time, as these categories are decided), each of the individual participants (who are 'registered' on-line as members of the deliberation community for the SA that is taking place) declares themselves as a member of one of the stakeholder categories. Then, each participant may contribute to the building up of composite judgements for the cells of the Matrix corresponding to that particular stakeholder category.**
  Note: The composite judgements are expressed as colours (or colour composites) in the Matrix cells. The

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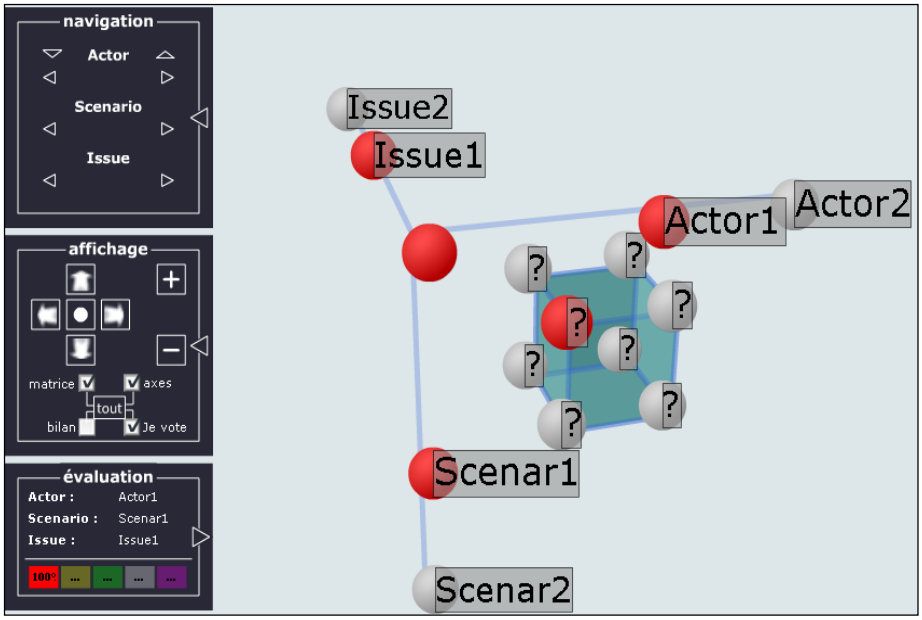
[8] We use the term "kiosk" (and, in French, "Foire" as in open marketplace or fairground) to highlight the notion of "going shopping for indicators". The **KIK** is, in itself, a generic deliberation support tool whose meta-information structure addresses the contexts of indicator use and pertinence as well as the more traditional domains of information sources (see O'Connor 2004, 2006). In the overall programme of C3ED tool development work, the **DM** and the **KIK** are seen as naturally coupled, and the **KERDST** system establishes this coupling for use on-line. However, just as the **DM** can be used without indicators (other than the colours and text commentaries associated with the cells), so also it is also possible to develop an "Indicator Kiosk" as an indicator catalogue permitting documentation of and deliberation about the indicators themselves, prior to eventually engaging the 'higher level' deliberation process represented by the **DM** itself. In *SRDTOOLS* our emphasis is on evaluation relative to multiple bottom lines by a stakeholder community, hence we focus primarily on the **DM** and refer secondarily to the **KIK**.

[9] It follows that there must be some sort of rule for the 'aggregation' or 'amalgamation' of the judgements of individual participants within the stakeholder class, and also some choice of convention for visualising the 'amalgam'. The choices on these points are important both methodologically and for the user-friendliness and effectiveness of the DST.

"composition" of each cell is therefore a function of the judgements expressed individually by the participants as "voters".[10] As in the simple (non-participatory) use of the **DM** without indicators, it is possible to proceed with 'colouring the cells' while, at the same time, using a text box for adding an explanation by each participant of the judgement (colour) proposed for each cell of the Matrix. So, the accumulation of individual explanations constitutes a discursive database of this stakeholder category's views for each option/issue.

- **OPEN/WITH INDICATORS — The fourth type of exploitation of KERDST is to combine the participatory process with the use of indicators. The participation of a real community of participants is proposed in terms of the selection, by each participant within a stakeholder class, of a 'basket' of indicators that characterise relevant attributes of the scenario/choice or activity/site/territory under scrutiny.**
  Note: The doubly composite judgements are expressed as colours (or colour composites) of the Matrix cells, and the "composition" of each cell is therefore a complex function of the judgements expressed individually through the selection of indicator baskets by each participant within the stakeholder class.[11]

In all variations of **KERDST** there are the synthetic deliberative tasks of (1) forming an overall impression and (2) composing a piecewise or overall comparison, via the array of coloured cells in the Deliberation Matrix, between sites or scenarios (etc.), based on the multi-stakeholder multi-criteria profile of each one. In the following paragraphs, we present some of the key steps for an on-line user of the **KERDST** system. Our purpose is not to give a complete guide to the user, rather to provide a glimpse of how things look in practice, the evaluation process and outcomes being built up progressively and deliberatively, through several layers of declarations, choices and judgements.



The screen-copy on the left gives a simple illustration of the structure of the Deliberation Matrix on-line. This is a 2x2x2 array: there are two scenarios; there are two actors (or stakeholder categories; and there are two performance issues.

The 3 axes with their values are visible, as well as the individual cells, each of which must be attributed a judgement. When a cell is grey, it means that no judgement has yet been attributed for that scenario on that issue by the actor concerned.

Within this general framework, as a function of the conventions of deliberation adopted, there are "lower" layers of deliberation may include the following:

- In the case of an indicator-based assessment: (1) there is the selection, from amongst the range of "candidate indicators" available or invented, of a small number (not more than 5) indicators for each basket; associated with (2) the interpretation (significance) to be attributed to each indicator in a basket;

[10] It follows that there must be some sort of rules or conventions for the 'aggregation' or 'amalgamation' of the judgements attributed to individual indicators within the basket, and also some choice of convention for visualising the 'amalgam'. We give a brief discussion below; for full documentation see Bureau, Legrand, O'Connor & Reichel (2007).

[11] Once again, there must be rules for the 'aggregation' or 'amalgamation' of the judgements of individual participants within the stakeholder class, and also some choice of convention for visualising the 'amalgam'.

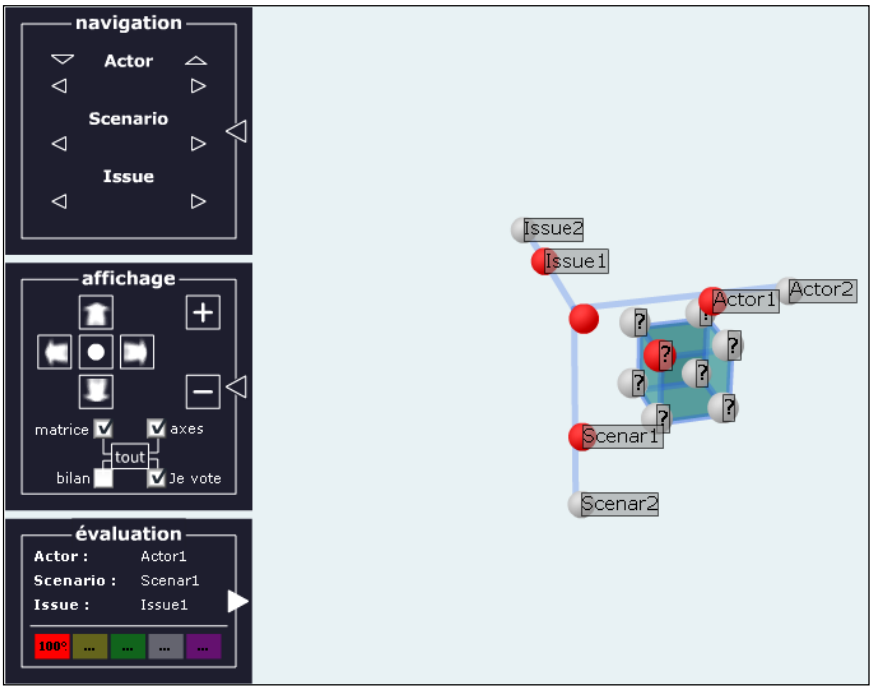
and decisions about (3) the relative or absolute importance (weight) of each indicator in relation to the others in the basket, for arriving at a synthetic judgement for the cell as a whole.

- In the case of a multi-actor participative assessment: (1) there arises logically the question "who participates" as "representative(s)" of each stakeholder category; and then (2) there is the question of the relative importance of participants within each stakeholder group in the building up of the "composite" judgement (with or without indicators) of the stakeholder class for each cell.

Although **KERDST** offers four main variants, for simplicity we will present here the version of a non-participatory evaluation supported by indicators (viz., the variation labelled **CLOSED/WITH INDICATORS**).[12]

The key feature of this variation **[CLOSED/WITH INDICATORS]** of **KERDST** is to incorporate a descriptive basis as a motivation for the judgement (colour) proposed in each cell, through the selection of a 'basket' of indicators taken to characterise relevant attributes of the scenario/choice or activity/site/territory under scrutiny. We show, with the screen-copy images below, the on-line interface for selecting indicators deemed relevant for the scenario-issue in question, and attributing a sense and relative importance to them. In order to adopt the convention that the Deliberation will exploit indicators, the user must click the option « **MATRIX WITH SMALL INDICATORS DIALOGUE BOX** » in the menu for setting up the deliberation.

Once the deliberation process is activated, question marks appear on all the cells. Clicking on any cell then allows that the user (or the respective "actor") can express their view of a scenario as a function of each performance issue. In our example below, **ACTOR** 1 is engaged in making a judgement on **SCENARIO** 1 with reference to performance **ISSUE** 1. But, the judgement at the "cell" level in the Matrix is obtained not by a simple choice of colour for the cell, but as a "weighted amalgam" of the qualitative judgements assigned to each indicator within the "basket" (using a colour code analogous to that employed for the cells).



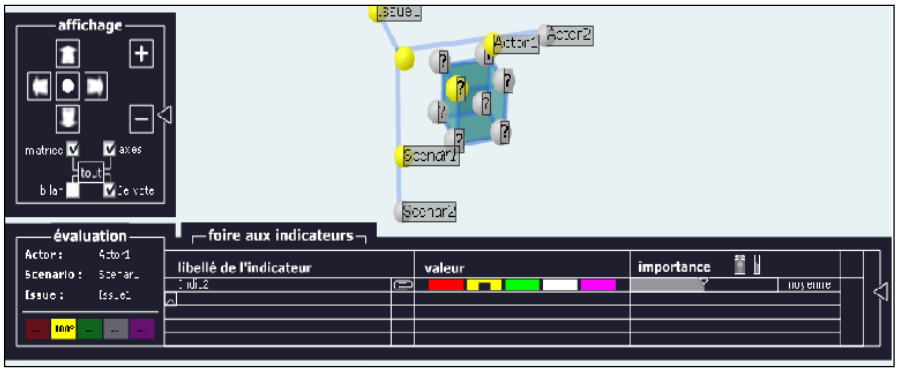
Therefore the colour (or composite) of each Matrix cell is a function of the relative weight and significance attributed to each indicator in the corresponding basket.

With the option of an Indicator Kiosk linked to the Deliberation Matrix, the user has the possibility to select a "basket" of indicators relating to any one cell (viz., the judgement that an actor gives about one scenario regarding one issue). The indicators themselves must be managed in some sort of catalogue. In the **KERDST** system, as a function of the sustainability assessment (SA) process adopted and the functionalities of the on-line tools that are exploited, the person or group undertaking the SA can either choose indicators from a pre-existing catalogue or contribute their indicator suggestions into an evolving **KIK** catalogue. Within the catalogue as it appears to the user on line, there appear columns for the name of the indicator, its significance (expressed in form of the predefined colour code), and its relative weight in the final result of the cell.

[12] This is the variation of **KERDST** that provides most straightforwardly for expressing the *SRDTOOLS* Project's principles of an evaluation of regional development projects in terms of changes to the four capitals.

Working on-screen, there are two ways to specify the ***weights*** (that is, relative importance) of the different indicators in the "basket" that contribute to the overall cell judgement. One way is to propose a weight expressed in absolute figures for each of the indicators; the alternative way is to specify a weight expressed in relative (percentual) figures. As an example, with the specification of absolute weights, one might choose figures between 0 and 100. Suppose that the figure of *50* is specified for two indicators, and *100* for a third one. Then, expressed as relative (percentage) weights, these figures are normalised into 25%, 25% and 50% respectively, summing to 100%.

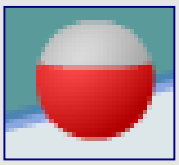
The result of the process of indicator mobilisation for one cell is visible on-screen in an array that shows the percentages for every colour "summed up" across the indicators in the "basket". Given that each indicator is individually attributed a qualitative significance (via its colour code), it follows that there must be some sort of rule for the 'aggregation' or 'amalgamation' of the indicator 'signals', and also some choice of convention for visualising the 'amalgam'.



Numerous conventions could be adopted, and here we mention one of the current 'default' conventions offered within the existing **KERDST.**[13] This default convention is that the cell itself takes the colour that has the highest percentage in the "basket of indicators".

Consider, for example, a basket composed of four indicators as follows:

- **Green [*GOOD*] for an indicator that is attributed 50% importance**
- **Yellow [*FAIR*] for an indicator that is attributed 10% importance**
- **Red [*BAD*] for an indicator that is attributed 30% importance**
- **Red [*BAD*] for an indicator that is attributed 25% importance**



The weight given to "red" is 55%, which is the highest single colour, and so this is the "predominant" judgement. The cell will be displayed in the Matrix with a colour pattern of 55% red, as shown.

Cell by cell, as the deliberation process is pursued, the Deliberation Matrix becomes more and more colourful, each cell's colour profile being generated by the indicator basket composed for it. An overall impression of the choice problem is then obtained by appraising the patterns of colour differences — from scenario to scenario, from actor to actor, from issue to issue. There are many facets to the impressionistic "reading" of the Deliberation Matrix" once filled in. One angle of appraisal that is specifically provided for by the on-screen visualisation, is by regarding the arrays of ***"EXTERIOR" CELLS*** that "aggregate" the results (in the format of colour composites) of the respective Matrix rows, or of entire Matrix slices. For example, by regarding the "aggregate" cells associated with successive scenarios, a "fuzzy" signal is obtained as to the degree of acceptability for the actors across the spectrum of issues.

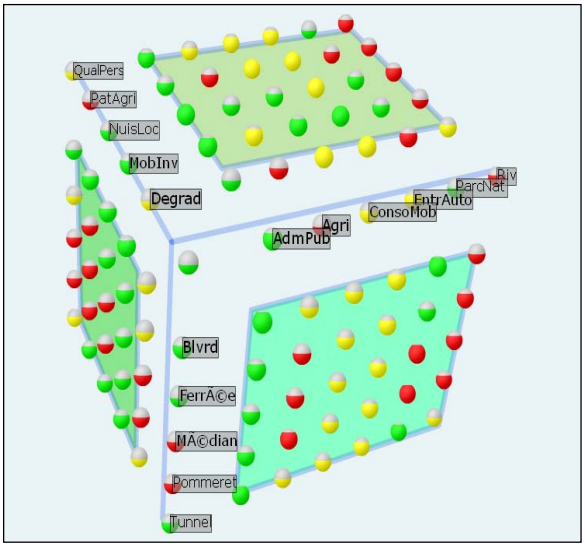
In the figure below we show a screen-copy of these "*EXTERNAL CELLS*" (with the inner Matrix suppressed, for clarity). Of course, these "external cell" colour composites are obtained through application of composition conventions (analogous to those mentioned above for the passage from an indicator basket to a Matrix cell). As "composite" signals in this sense, they do not and cannot convey every aspect of the underlying information. (For example, a "half-red" cell, at whatever level of composition, does not necessarily convey a judgement that is definitively worse than a "half-green" cell.) For a meticulous interpretation it is always necessary to look back into the individual's or individuals' statements at the lower levels.

[13] The documentation of these aspects of the **KERDST** system can be found in a series of internal C3ED documents (e.g., Bureau et al. (2006) and Reichel et al. (2007[A/B]).

The constructive role of the **Deliberation Matrix** is thus to make emerge and accessible **in a stylised way**, a full range of stakeholder perspectives with regard to the effects that an existing activity, or a proposed technological, economic or governance policy (etc.), may have. It provides a framework allowing us to make the transformation from a plethora of "weak signals" to a structured array of strongly focussed judgements.

In this way, the **KERDST** system as an interactive ICT framework or interface, is concerned not just with the management of data for evaluation, but also with the development of collective intelligence and collaborative learning opportunities.

The late-2006 prototype of **KERDST** [on **http://iacaprod.c3ed.uvsq.fr/kerdst2**] thus presents the fundamental features needed for integrating scientific system analysis with multi-stakeholder dialogue as a basis for project or policy evaluations. In particular, the variant described as **OPEN/WITH INDICATORS** for a participatory evaluation process with supporting indicators available to the entire deliberation community, is the definitive structure envisaged for the **KERDST** system as an on-line deliberation support tool. [14]



THE DEVELOPMENT & VALIDATION OF KERDST IN SRDTOOLS

Experience to date with **KERDST** shows that potential users can grasp the basic concepts and features of use of the Deliberation Matrix quite quickly, without requiring of them specialised knowledge or evaluation skills.[15] This is an important feature of a tool and process intended to aid transparency to the evaluation process.

However, it would be misleading and unhelpful to underplay the complexity of rigorous and robust SA. The fully participatory **KERDST** evaluation process with supporting indicators, although designed to be highly didactic and intuitively accessible, is nonetheless quite a complex multi-layered activity. Engagement of the **KERDST** process described as **OPEN/WITH INDICATORS** is, indeed, tantamount to undertaking a stakeholder based "integrated analysis" with an assortment of stakeholder consultation processes, working groups, preparation of scenario profiles, and so on. Two main features of this 'complexity' should be noted.

- First, within the Deliberation Matrix itself, accommodation of a multiplicity of participants means that there must be some sort of rules for the 'aggregation' or 'amalgamation' of the judgements of individual participants within the stakeholder class. This amalgamation process is multi-layered, because there is

[14] The currently available on-line versions of **KERDST** are *Beta-prototypes*, meaning that while they have the functional features intended of the final product, various secondary features are still patchy or undeveloped. In the ongoing 'tuning' process, the KerBabel™ team at the C3ED is still making refinements to the on-screen visualisation and to the navigation around the system on the basis of experience with the existing prototypes. There are also developments envisaged in the availability to the user(s) of different options for the steps of 'composite' judgements (e.g., from baskets of indicators to DM cell level, and from multiple participants to composite stakeholder judgements) inherent in the multi-criteria multi-stakeholder evaluation framework.

[15] Numerous experiments have been conducted, in quite contrasting situations (e.g., post-graduate students from several different European countries; leaders of artisan fishing communities in West Africa and South America; our *SRDTOOLS* partners) with the process of "colouring in the cells of the Deliberation Matrix" — or, more formally, the variation **CLOSED/NO INDICATORS** of the kerDST system. These experiments have shown that the system can successfully be used by individuals and small groups to build a problem and obtain a preliminary picture of the spectrum of stakeholders' judgements, *within a few hours*. Of course, refining the 'picture' can take much longer, and the tasks of preparing the stakeholder deliberation and then documenting the use of the DM in any empirical situation are non-negligible (the order of magnitude being a few person-days for each task).

(1) the movement from basket of indicators to proposition of cell colour (or composite of colours) *for an individual participant*, and then (2) the amalgam of individuals' propositions for a cell to produce the result that will be visualised as the "composite" judgement of the stakeholder class as a whole for the issue/option in question (see Bureau, Legrand, O'Connor & Reichel, 2007). It takes some time for a user or community of users to develop a good intuition for the layers of this 'composition' process and for the interpretation of the results visualised on-screen.

- Second, and as already explained, the on-line **KERDST** system generates or exploits a "KerBabel Indicator Kiosk" for the management of indicators. In a territorial development situation, these indicators will, to a greater or lesser extent, be the products of prior analysis and consultation processes and will include — as a function of circumstance — various forms of process and system modelling, maps and data sets of all kinds). The transparency ideals of a stakeholder dialogue require that the sources and status of these 'candidate indicators' must be made available to the participants. This requires a quite rigorous meta-information system and, more than that, a quite carefully designed process for making the meta-information accessible to the members of the deliberation community. Within the current on-line **KERDST** system, the catalogue of indicators that is generated alongside the DM is actually only a "mini-Kiosk" with a minimum number of meta-information fields (see **Section §4.3** below). This "mini-Kiosk" is the visible tip-of-the-iceberg of a much more comprehensive structure — the fully fledged "KerBabel Indicator Kiosk" (KIK) — whose design and development as an on-line tool has been carried out by the C3ED since 2003 in parallel with the Deliberation Matrix itself (see O'Connor 2004). The full exploitation of a comprehensive KIK is, in fact, a much more arduous activity of data management, judgement and documentation than the mere use of the DM itself; but, in any real project evaluation or territorial development process this documentation is a fundamental part of the multi-criteria evaluation.

In view of these complexities of the full participatory KERDST process, users are advised to experiment with the simpler options for KERDST exploitation before engaging a fully participative SA with indicators. This progressive initiation of users has been a feature of the *SRDTOOLS* project, partly by design and partly by necessity (see text box, next page).

Experimentation with the KERDST system in SRDTOOLS

The basic concepts of the Deliberation Matrix framework were presented to project partners in the early months of the *SRDTOOLS* Project, and then the successive variants of **KERDST** have become available to *SRDTOOLS* partners progressively during 2006.

- The on-line Deliberation Matrix at [**kerdst.c3ed.uvsq.fr**], which is a version of **KERDST (CLOSED/NO INDICATORS)**, was made available to *SRDTOOLS* partners in early 2006. All case study partners have carried out a profiling of their SRD options within this tool.
- The integrated **KERDST** system of Deliberation Matrix with associated Indicator Kiosk [**http://iacaprod.c3ed.uvsq.fr/kerdst2**] has been offered to *SRDTOOLS* partners towards the end of the project. Within the tight time-frame and budget, it has been tested with some, but not all, of the project's case studies. The variant of **KERDST (CLOSED/WITH INDICATORS)** has been demonstrated for two of the project's case studies. On the other hand, the timeframe, language diversity and budget constraints together mean that, although most of the case study partners have developed consultative processes with territorial authorities and other stakeholders in their regions, it has not been feasible to demonstrate the fully participatory variant for a real territorial development.

The main features of these case study applications are summarised in the technical documents compiled for *SRDTOOLS* by Bureau et al. (2006) and Reichel et al. (2007[A,B]). Finally, although the *SRDTOOLS* project itself has come to a close in December 2006, a number of experiments with the indicators-based and participatory versions of **KERDST** are underway in several other domains. These ongoing applications can be regarded as 'proofs of concept' for the *SRDTOOLS* project accomplishments.

THE PRINCIPLE OF A REPRESENTATIVE DIVERSITY OF INDICATORS

By design, although the **KIK** can accommodate an unlimited number of indicators, the **Deliberation Matrix** framework proposed by the **KERDST** software restricts the number of indicators in a « basket » to a maximum of five. This limit could easily be relaxed (at the price of some modifications to on-screen visualisations). But, for the time being at least, we have 'hard-wired' the limit of five. It is in this way made clear that what is sought is not a full descriptive inventory of all

system features or system changes, but rather a *reflective appraisal of the most significant considerations from a plurality of points of view*.

In effect, following O'Connor & Spangenberg (2007), we adopt here a principle of *representative diversity of indicators,* setting this in a dialectical opposition (along both methodological and epistemological planes) to the notion of a complete *"inventory" of costs and benefits* (or of direct and indirect impacts of a project, etc.) that is necessary for the construction of any single-bottom line or "aggregate" SA indicator (such as 'net benefits' for an investment programme, or 'genuine savings' as a national performance indicator, etc.).

The approach in terms of *representative diversity* accepts pragmatically that, under the sorts of conditions of complexity and stakeholder diversity that prevail for major SA situations, (1) many significant SA concerns cannot be made the object of reliable quantification and (2) even when this quantification is available, the process of aggregation would tend to mask over key issues about *what is to be sustained, why and for whom?* Although useful systems measurements and model-based quantifications can be obtained for a great variety of features, there is a need to work synthetically with an amalgam of qualitative as well as quantitative elements of description and judgment.

Our conviction is that, the overall procedure of SA indicator selection and reporting, if built as a multi-stakeholder dialogue or "reconciliation" procedure, can be effective for the building and communication of shared meaning and purpose with a relatively small number of indicators and therefore low implementation costs. This is why, with the **KERDST** system, the emphasis is placed on *building the problem* — that is, arriving at an agreed set of performance-quality considerations (the **SQPMBLs**) in terms of which the multiple stakeholders will conduct their comparative evaluations of policy or project options. This strategy of *building common ground* at the level of problem-framing is, in our view, critical for operational SA capacity and penetration of evaluation work into real decisionmaking, because it is effectiveness in problem-framing that will determine the clarity of the "signals" conveyed by the indicators to be deployed.

As regards the use of **KERDST** in *SRDTOOLS* with its four capitals approach to SA, this preoccupation with problem-framing and parsimony in the selection of indicators is clearly manifest in the conventions that we propose for the juxtapositioning of qualitative and quantitative performance considerations in relation to natural and social capital.

Critical Natural Capital and Critical Thresholds

Formally, the role of the Deliberation Matrix is to permit, in a qualitative and sometimes also quantitative way, the articulation of the many facets of the social choice. SA is presented as the evaluation of options relative to multiple bottom lines (the SQPMBLs) and from multiple stakeholder points of view. In *SRDTOOLS*, our convention is to consider regional development options in terms of the four capitals. This means that, in the first "cut at the problem", indicators must be sought that allow to declare whether or not a policy (or project, or investment programme, etc.) satisfies sustainability criteria expressed in terms of the four capitals.

For example, the profile of each scenario in the Matrix should show, at a glance, whether a given scenario is broadly aligned towards, or incompatible with, the "strong" sustainability" criterion of *maintenance of all four capitals* considered as complementary pillars of development.

In this context, the *net change in natural capital* is an appealing idea in its simplicity, whether from a 'weak' or 'strong' sustainability point of view. However, there is no meaningful way of aggregating the grand diversity of natural resources, environmental services and ecosystems (etc.) so as to give to this concept a content that is both scientifically credible and socially robust for SA purposes. Faced with this difficulty, environmental and ecological economists have introduced the equally appealing concept of *critical natural capital*, referring by this term to environmental resources or system capacities that perform important welfare support (or other) services/functions and for which no substitute in terms of manufactured, human and social capital exist. Strong sustainability is then framed not in terms of maintenance of the aggregate 'stock' or fund of natural capital, but rather in terms of the requirement for maintenance of these specific environmental capacities or functions,

thereby assuring a qualitative performance goal: the maintenance of the overall integrity of the environment. [16]

In what sense is a natural system or function critical? When and how can it be determined if environmental change is impairing natural system functions in a 'critical' way? Answers to such questions are rarely free from scientific and wider social controversy. Policy applications of this concept tend to proceed in a pragmatic way, by specifying (or asserting) environmental standards or thresholds below which — it is asserted, or feared — the environmental function is not maintained (or there is a risk of it being lost, etc.). These "critical considerations" are then *performance standards that ought to be respected*.

Within the framework of **KERDST** we can propose, with a view to signalling violations of 'critical thresholds' (if and when these are affirmed to exist and the violation occurs), the following colour conventions for registering judgements within indicator baskets and cells of the Matrix.

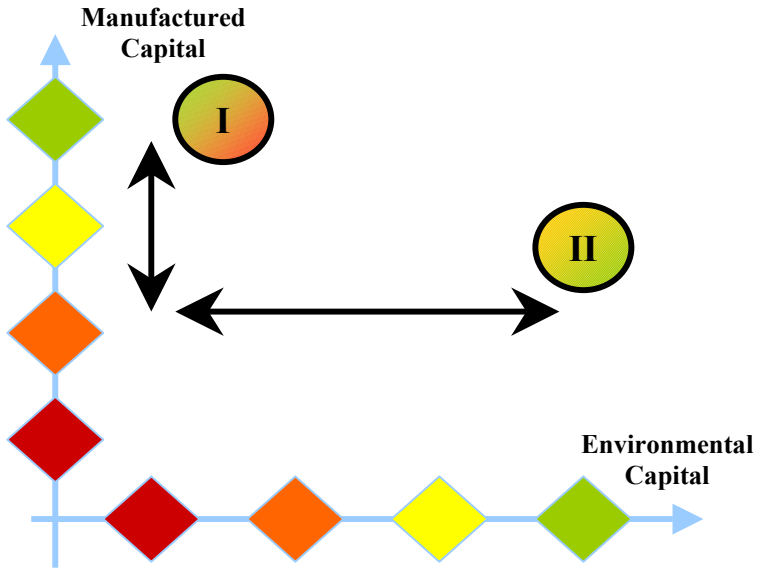
GOOD	HO-HUM	BAD	CRITICAL!	NO IDEA	N/A

With the **SQPMBL** framework of the four capitals, we build up the composite picture of the respective scenario profile to obtain — either for the "slice" of the Matrix corresponding to a specific stakeholder category or for the higher-level plane of composite judgements obtained as the "amalgamation" of stakeholders' judgements for each scenario — a basis for piecewise comparison of scenarios along the lines of the tabular array below.

Category of Capital	MANUFACTURED	HUMAN	SOCIAL	ENVIRONMENTAL
Scenario I	GOOD			CRITICAL!
Scenario II	HO-HUM			GOOD
Scenario III				

In a multi-criteria perspective, it is possible to interpret at a glance that **SCENARIO I** favours economic (manufactured) capital at the expense of human capital and the environment; whereas **SCENARIO II** favours environmental quality as the expense of social capital.

It is possible also to make a piecewise comparison *between* scenarios. For example, if the focus is placed on manufactured *versus* natural capital, the decision between scenarios (**I**) and (**II**) must be negotiated with reference to, among other things, the "trade-off" or "opportunity cost" between the two capitals, as portrayed graphically.



Social Capital and the 'Social Choice' Problem

Although the concept of "social capital" is not completely stabilised, there is nonetheless a consensus that it relates to collective capacities linked to collective identities (see O'Connor 2006b). It is hardly meaningful to seek to quantify an absolute value for the "fund" of social capital, nor to quantify

[16] In this paper we do not discuss the pros and cons of the "strong sustainability" criterion; for some extensive discussions see Victor et al. (1997); Ekins & Simon (1999); Faucheux & O'Connor (1998, 2001).

changes in social capital on a single scale. The key consideration for a pragmatic approach to evaluation is to identify significant changes in the *capacities* of distinct stakeholder groups, communities and societies, and to explore the costs or constraints on economic activity associated with assuring their integrity through time.

In effect, the social capital question can be addressed via indicators of individual and collective capacities and, correspondingly, of poverties. This is where the question of the "stakeholders in sustainability" (and in SA) takes on its paramount importance. The *social choice* question of fairness in the distribution of opportunities, benefits, costs and risks (etc.) must be addressed for the full spectrum of sustainability's stakeholders for the policy, project or programme under scrutiny. This leads to a two-tiered framework for the articulation of performance goals or criteria with reference to diverse *stakeholder communities*.

- The primary level of analysis should specify obligations of respect for the stakeholder classes or communities given standing — in other words, identification of the classes of community meriting respect and of the forms or norms for expression of that respect. (Given the 'monopoly' presence of the present generation, it is up to today's policymakers and citizens to affirm duties towards — or, by proxy, the 'entitlements' of — future generations, endangered species and ecosystems, vulnerable peoples and so on.)
- The second level of analysis should address fairness or unfairness in access to services, distribution of opportunities, vulnerability, stresses and risks (etc.) within each class.

Indicators at the first level are essentially qualitative. In the **KERDST** system, this first level is established by the specification of the **ACTOR** classes, along one of the three axes constitutive of the Deliberation Matrix. Indicators at the second level can sometimes be quantitative, as a function of the various notions of capacity, vulnerability and poverty (etc.) involved. Nonetheless the significance attached to the various 'ups' and 'downs' that might thusly be indicated, must be solicited qualitatively from stakeholders.

Given the relational character of social capital, the key to identifying consequences of a policy for social capital is to appraise — relative to each of the "stakeholders" (or communities or classes, etc.) — whether, and in what ways the policy is felt to reinforce, or impair, the capabilities and viability of the group. As an evaluation criteria for social capital we may then adopt, as an adaptation of the "strong sustainability" criterion for the social dimension, the convention that an unambiguous improvement or maintenance of social capital would be identified if, and only if, there is the simultaneous satisfaction (hence reconciliation or coexistence) of the needs of all communities.

From this point of view, the "social bottom line" policy criterion would be to reduce (or eliminate) life-threatening stress due to violence or to poverty of available means of subsistence or to other loss of capacities (including communication, status in political processes, etc.). Indicators should be sought to highlight or draw attention to threats to or reinforcements of collective capacities for each of the specific stakeholder groups or communities identified. Equally, indicators can point in directions of increased capacities. But, in order to appraise a community's viability and vulnerability, it is not sufficient to look at the community alone, it is also necessary to put the spotlight on relations between stakeholder categories (e.g., relative domination, subordination, antagonism, forms of cultural and commercial exchange). We have therefore proposed for *SRDTOOLS* partners that, within the **KERDST** system, the stakeholder's appraisal of the impact of a policy (or scenario, or territorial development option, etc.) on social capital should be characterised — by commentaries or with indicators, depending on the version of kerDST being employed, in two complementary ways

1. Stakeholders signal or assess the significance of a project/scenario for *their own capacities and vulnerabilities* ;
2. Stakeholders make judgements about others' capacities/vulnerabilities with a view to significance for *relations between the stakeholder groups*.

Examples of this relational focus could be, e.g., income levels or education and employment prospects as a relative thing, relative or absolute influence in political processes. Through this procedure, we build up, in effect, a sort of collage/composite picture of the distribution of poverties (and of privileges).

In this way, based on the indicator(s) selected, a judgement can be formed about the consequences of the project for each stakeholder group and for the pattern of relations between stakeholders (including

future generations) that might arise or emerge as a consequence of the project. This leads directly, in the Deliberation Matrix framework, to the prospect of a didactic portrayal of tensions between and "trade-offs" between different stakeholder groups.

For the social dimension, as in the other facets of the evaluation, we use colours to signal judgements attributed to indicators or, by composition, to scenarios. For the social dimension, therefore, one might propose that **DEEP RED** (critically bad or alarming) = life threatening impoverishment, violence or loss of status; and **ORANGE** = non-critical reduction to group capacities, status, political influence and integrity; and so on.

With such conventions, the Deliberation Matrix provides for a direct comparison of options in terms of the relative "standing" of stakeholders. The diagram below shows a simple synthesis of two pair-wise comparisons, the judgements by stakeholders Alpha and Beta, of the 'social capital' consequences of two scenarios (engaging 2x2 = 4 "cells" in the Deliberation Matrix).

It shows a situation where **SCENARIO I** reinforces social capital from Alpha's point of view but worsens social capital from Beta's point of view; whereas **SCENARIO II** reinforces social capital from Beta's point of view but seriously worsens social capital from Alpha's point of view.

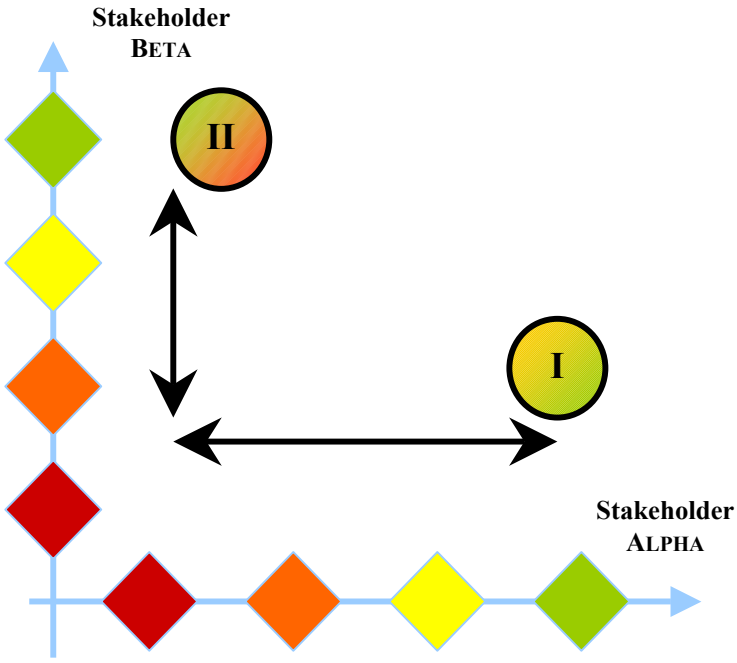
Here, the focus is placed on the *distribution of status or opportunity* for Alpha and Beta, as represented by the respective 'social capital' evaluations. The decision between scenarios (**I**) and (**II**) must be negotiated with reference to, among other things, the "trade-off" or "opportunity cost" of improving the status/capacities of one group at the expense of the other. This is the classic "social choice" problem.

Social Capital Indicators in KerDST

The standard DM framework proposed by the **KERDST** software, restricts the number of indicators in a « basket » to a maximum of five. This means, among other things, that in the DM second-level process, for each actor, *no more than 5* indicators should be selected relating to the "social dimension" for each community or stakeholder class. This leads us to suggest that, when drawing up lists of candidate indicators,

- no more than 5 indicators should be shortlisted by a stakeholder class for self-assessment, and
- no more than 5 indicators per stakeholder group should be short-listed for the characterisation of the distributional/relational aspects of stakeholder coexistence.

From within this shortlist, a "representative diversity" should then be included in the "basket". Using the same set of « social dimension » indicators for all stakeholder categories would, on the face of it, enhance comparability. But it might also obscure the question of the specificities or incommensurability of one stakeholder value system or « identity » (that is, the specificity of their « way of being ») relative to others. Here, as in all other facets of indicator selection, there is a tension to be managed between variety and « specificity » on the one hand, and standardisation and « generality » on the other hand. However, this tension takes on a particular significance for the social dimension, due to the consideration of the (relative or absolute) moral status of the « stakeholders in sustainability »



SUMMING UP: SOCIAL CHOICE AND DELIBERATION

These simple graphical expositions of piecewise "trade-offs" do not exhaust the possibilities of exploitation of the Deliberation Matrix as a synthetic register of multi-stakeholder multi-criteria judgements. However, the two examples given — trade-off between two categories of capital on the one hand; trade-off between two categories of stakeholders on the other hand — are intended to highlight the point that sustainability assessments need to make reference to two complementary sets

of principles — "systems integrity" and "ethical integrity". The systems integrity concern is expressed, in the conventions of *SRDTOOLS*, as the principle of maintenance of the "four capitals". However, in order to give this general precept a societal and political meaning, the necessary complement to be added, by considerations along ethical plane, is the principle of a fair distribution of status/opportunities, viz., *a principle of respect for multiple classes of community*.

The generic "social choice" problem or, as rephrased in our context, the problem of "sustaining what, why and for whom?" is impossible to resolve by the mechanical application of abstract rules. This is why the process of sustainability assessment with the **KERDST** system is not purely analytical. The evaluation of scenarios — of *options for action or of options for assessment* — takes place from many different points of view. As the multiple perspectives are brought to bear on a common ground (the scenario set, the agreed bottom lines, the catalogue of indicators visible to all, the list of stakeholders…) then the tensions, conflicts of interests, uncertainties and dissent (amongst scientists as well as decision makers, administrators and stakeholders from different walks of commercial activity and civil society) can be expressed and explored in a structured way. The formal outcome of this exploration is an array of qualitative indicators (the coloured cells of the Deliberation Matrix, as illustrated above) that, very often, will not permit the system user or user community to make a simple aggregate judgement or comparison. This places the users explicitly in their political status as actors in a collective process of social choice.

ACKNOWLEDGEMENTS

This paper is based on parts of an unpublished report: O'Connor, M. (2006d), *Deliberative Sustainability Assessment: Multiple Scales, Multiple Stakeholders, Multidisciplinarity and Multiple Bottom Lines*, for Work Package WP6 of the *SRDTOOLS* Project (**Methods and tools for evaluating the impact of cohesion policies on sustainable regional development**, funded by the European Commission, EC 6th Framework Programme, Contract No.502485, 2005-2006), available as *Rapport de Recherche du C3ED*, Université de Versailles St-Quentin-en-Yvelines, France. Thanks to all *SRDTOOLS* colleagues and particularly also to Pierre Bureau, Aurélie Chamaret, Christelle Hue, Franck Legrand, Vicky Reichel, Joachim Spangenberg and Charlotte Sunde.

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