sue-MoT

Fit for the journey ahead

Levett-Therivel
sustainability consultants

Report to the sue-MoT consortium:

Sustainable Urban Environment – Metrics, Models and Toolkits:

Analysis of sustainability/social tools

9 June 2004

Contact: **Riki Therivel** tel/fax 01865 243488
riki@levett-therivel.fsworld.co.uk
28A North Hinksey Lane, Oxford OX2 0LX

TABLE OF CONTENTS

SUMMARY

Aims and methodology

The aim of our research has been to analyse a wide range of metrics, models and tools (generically described here as "tools") for describing, predicting, evaluating and modifying behaviour towards sustainability. This has involved:

1. Analysing about 100 existing sustainability tools;

2. Clustering them into three broad categories and more specific sub-categories according to their purpose or main function. These are:
   - describing and monitoring the status of sustainability: indicators, conversion to a single unit (money, footprint, eco-calorie etc), matrices, rose diagrams, maps;
   - predicting and evaluating sustainability impacts: impact assessment processes; models, GIS, systems analysis etc. for impact prediction; multi-criteria analysis, benchmarking, equity analysis etc. for impact evaluation;
   - monitoring people's perceptions and actions towards sustainability: participation and stakeholder involvement, cost analysis and accounting, tools for corporate responsibility.

3. Analysing the sub-categories in terms of
   - what situations they are most likely to apply to
   - what they aim to achieve
   - how they work in practice
   - their strengths, limitations and how they link with other approaches

4. Reviewing the full armoury of tools to identify main themes, gaps and research needs.

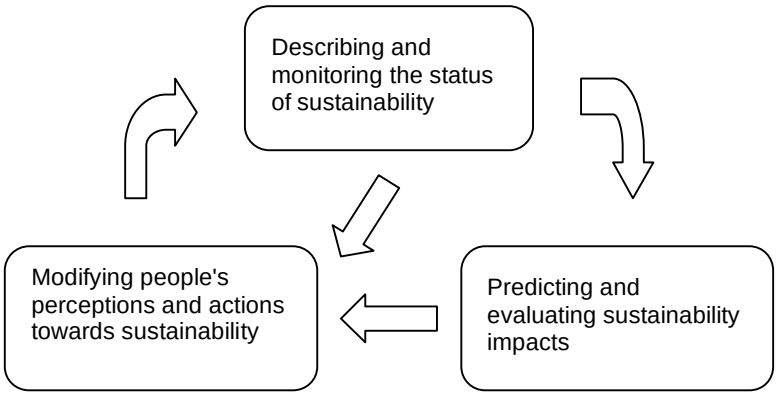


Figure 1. Links between broad categories of sustainability tools/approaches

Summary of findings

General trends

- There are plenty of existing sustainability metrics, models and toolkits.
- There is no such thing as ‘a good tool’ in the abstract, only a good match between a tool and the purpose it is being used for.
- The tools do not seem to be converging on one approach, for instance consistent involvement of the public, or consistent presentation of data in a spatial form.
- They vary in terms of how they deal with uncertainty. Tools that require full sets of detailed data so as to reduce uncertainty do not necessarily lead to more certain results than those that assume a certain amount of uncertainty: the former often merely disguise, rather than reduce, uncertainty.
- The decision determines the tool needed. The purpose of a tool is to connect effectively with decision or planning processes so as to have the greatest possible chance of influencing their sustainability effects for the better. What form the tool takes will vary depending on the scale of the action, the stage of decision-making, the time and skills available, etc.

This suggests that, depending on the context, issues that anyone developing sustainability tools should be aware of are:

- the tool's 'fitness for purpose'. This includes understanding the context within which the decision takes place, time and resources available, level of detail needed etc.
- what sustainability tools already exist, so that new tools do not need to be developed from scratch where existing tools may be adapted to the situation
- how much can be expected from any one tool
- the need for tools to cope with uncertainty and incorporate the precautionary principle

Social issues within sustainability

- Few of the existing tools come close to being "sustainability" tools in terms of being inclusive, holistic, multi-dimensional and capable of simultaneously addressing the social, environmental and economic core issues together with other factors such as political, technical or legal constraints.
- Sustainability involves judgements about integration, win-win solutions, trade-offs. These judgements can be replicated ("faked") by sustainability tools, but are ultimately for politicians and other decision-makers to take. The concept of a true "sustainability tool" may be impossible to achieve in practice.
- Environmental and economic tools predominate in the tools that we analysed, with less emphasis on the social dimension. There is less consensus about what ‘social issues’ are, and more contention surrounding what significant social impacts are, than about environmental and economic ones. Intergenerational (between generations) equity is covered particularly poorly.

This suggests that, depending on the context, issues that anyone developing sustainability tools should be aware of are:

- whether/how to cover the full range of sustainability issues, without necessarily aiming to integrate them into "sustainability solutions";
- coverage of social issues vis-à-vis environmental and economic issues;
- the full range of social issues is taken into account: norms, community interactions etc., as well as basic demographics;
- intergenerational equity (typically as environmental constraints on development today to ensure quality of life in the future);
- the appropriateness (or not) of using natural science techniques to analyse social issues.

Usability of sustainability tools

- Comprehensiveness, rigour, transparency, user-friendliness and low cost are not all compatible. Trade-offs need to be struck between them, and some may need to be sacrificed.
- Several of the tools analysed require so much data and expert input, and their results are so complex that they are essentially unusable in practice. Developers of sustainability tools must be aware of the context in which they are used.
- Some of the most interesting sustainability tools bring together different disciplines and are easy to use, for instance "rural proofing", equity mapping, Quality of Life Capital, Index of Sustainable Economic Welfare, gender analysis matrices and Eco-Cal.

This suggests that, depending on the context, issues that anyone developing sustainability tools should be aware of are:

- the appropriate point of trade-off comprehensiveness, rigour, transparency, user-friendliness and cost. The choice should depend on the decision that the tool is informing;
- the efficiency of the tools: the amount of time and effort they need as input should be proportional to the benefits that they provide as output;
- multi-purpose tools - tools that can be used for several different functions – and tools that bring together different disciplines; and
- two-stage tools or processes, with a "shallow" initial stage which gives a broad-brush analysis of a problem, and a "deep" focus on those issues that were identified in the first stage as being particularly problematic, contentious or important to the decision making process.

Possible next steps

These findings suggest some themes that could be the focus of future research and information-sharing.

- By far the most important is the issue of *what sustainability questions, challenges, and decisions are currently poorly served by tools* – for instance better interpretation and formulation of wellbeing - and therefore what gaps exist in the toolkit.

Other next steps, focused on the development and dissemination of sustainability tools, include the need for:

- Better information about existing tools, and particularly "rules" that help decision-makers to choose what tool is appropriate.
- More understanding of, and consensus on, the social dimension of sustainability.
- More understanding of how the three dimensions of sustainability can be integrated.
- A focus on efficient tools that are "fit for purpose". In many cases, this is likely to mean an emphasis on tools that are fast, not resource-intensive, and transparent.
- A focus on tools that can be used in different ways for different purposes.
- Exploration of tools that bring together different existing technologies and approaches. In particular, as GISs become more ubiquitous and user-friendly, they could be combined with other techniques.

CHAPTER 1
INTRODUCTION

1.1 Aim of research

The aim of our research has been to analyse a wide range of metrics, models and tools (hereafter jointly referred to as "tools") for describing, predicting, evaluating and modifying behaviour towards sustainability, so as to identify gaps in the provision of sustainability tools and aspects of sustainability tools that are particularly good and bad. Our particular focus was on whether and how sustainability tools deal with social issues.

1.2 Research methodology

This has involved four main steps.

1. Identifying and reviewing existing tools. 78 existing discrete tools were identified through discussions with the project Steering Group. Additional tools were added from the researchers' experience. In producing each chapter a broad range of sources were used to build as balanced an assessment as possible. The list of tools is not meant to be comprehensive, but rather to represent the range of sustainability tools currently available. Appendix A briefly analyses the discrete tools.

2. Clustering them into broad categories. The tools identified in stage 1 were divided into three broad categories and more specific sub-categories according to their purpose or main function:

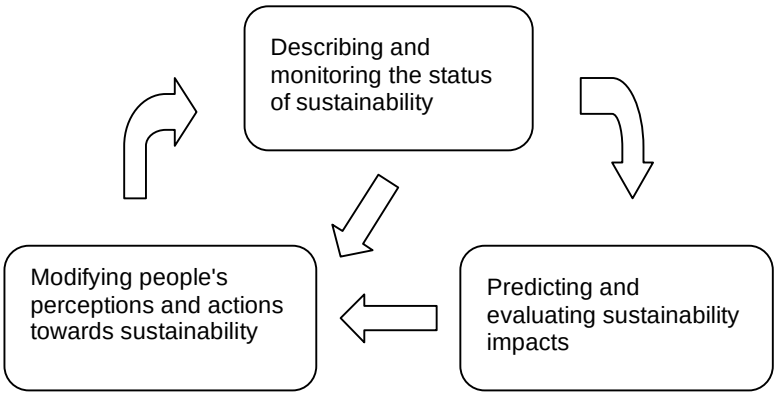
- describing and monitoring the status of sustainability: indicators, conversion to a single unit (money, footprint, eco-calorie etc), matrices, rose diagrams, maps;
- predicting and evaluating sustainability impacts: impact assessment processes; models, GIS, systems analysis etc. for impact prediction; multi-criteria analysis, benchmarking, equity analysis etc. for impact evaluation;
- modifying people's perceptions and actions towards sustainability: participation and stakeholder involvement, cost analysis and accounting, tools for corporate responsibility.

These categories act as different stages in a cyclical process of data collection, impact prediction and modification of actions, where findings from one stage inform the other stages. Box 1.1 shows how the categories interact: data are needed before predictions can be made or behaviour influenced; the results of impact prediction can inform changes in behaviour; changes in behaviour will change the baseline. The process of dividing the tools into the categories was reasonably straightforward, suggesting that categorising sustainability tools by function is appropriate although, given the close links between the categories, inevitably some tools fit into several categories.

3. Analysing the categories and sub-categories. Each sub-category was analysed in terms of:

- what situations they are most likely to apply to (in a matrix format: see Box 1.2)
- what they aim to achieve
- how they work in practice
- their advantages and limitations.

Box 1.1 Links between broad categories of sustainability tools/approaches

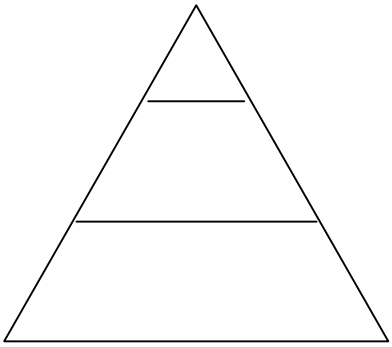


Some qualifiers apply to the matrix. The matrix was meant to assist and stimulate analysis of the tools, and to aid simple comparison with other categories' characteristics. It is broad-brush, and actual situations that tools apply to will vary from tool to tool. For instance, while in general a participatory analysis exercise would be low cost, it would be possible to conduct a very thorough study using a multitude of researchers and interviewers, which would obviously increase the cost. In addition, the matrix is an audit rather than assessment of worth as a tool, i.e. there is no increase in 'value' of the tool by having more shaded cells. A tool which always covered all issues in great detail would be costly, cumbersome and in the end probably difficult to use and a poor aid to decision making, despite perhaps being a beautifully crafted tool.

4. Identifying themes and gaps. Finally the full armoury of tools was analysed to identify main themes, gaps and research needs.

1.3 Structure of this report

The findings of this report can be roughly described as a pyramid, in which the higher levels are based on the findings of the lower levels:



The summary and chapter 5 present the key findings of the research.

Chapters 1-4, the middle level, explain the research methodology and the findings of the detailed analyses of the tools.

Appendix A, the lowest level, briefly describes the 78 discrete sustainability tools analysed for this research.

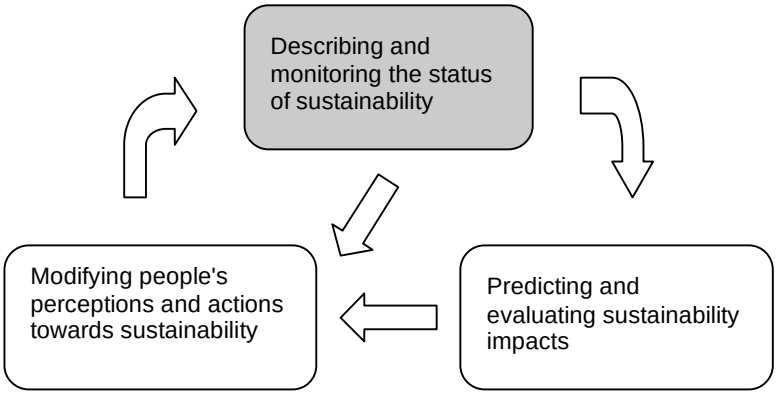
Box 1.2 Situations that tools apply to

The questions in *italics* are those used to analyse the tools. The words in plain and bold font are those used to describe the tools in Chapters 2 to 4. Cells that are shaded in the text are those to which the tools generally apply.

Applies to	*is the* **scale** *at which the tool applies…*	international	national/ regional	local	site
	is the **stage** *at which the tool applies…*	*the* planning *stage of a policy, action, etc?*	*its* implementation/ operation *stage?*	monitoring *of the action's effects?*	
	is the **sector** *at which the tool applies…*	public	private		
Data/ indicators	*what are the sustainability/ social* **issues** *covered by the tool?*	neighbourhood	environment	transport	health
		education	local economy	crime	participation and lifestyle
	what are the **data used** *as input by the tool?*	'hard' quantitative *data, e.g. air pollution levels, monetary costs?*	'soft' quantitative *data, e.g. residents' surveys about quality of life?*	qualitative data, *e.g. landscape descriptions?*	
Analysis	*are the outputs of the tool* **reductionist?**	yes: monetised. *The result is in terms of money*	yes: non-monetised. *The result is in the form of one number or answer, but not money.*	no: multicriteria. *The result is in the form of multiple data, possibly quite different from each other.*	
	the outputs of the tool are **used to:**	describe current status *of sustainability*	predict future status *of sustainability*	aid decision-making *about sustainability, particularly to change people's actions*	
	are the outputs **comparative***?*	comparative re. other sites etc.: *do they compare one alternative against another?*	non-comparative: *do they present data but in a non-comparative form?*		
	what are the **skills needed** *to carry out the analysis?*	expert-based: *needs someone who understands the intricacies of the tool and/or sustainability*	non-expert based: ***can be carried out by e.g. members of the public***		
	what does the tool **output** *"look" like?*	a black box: *there are "invisible" calculations or assumptions behind the result*	explicit, transparent: *the whole analysis is understandable from the result*		
Cost/time		*Money* cost high	*Money* cost low	time input high	time input low

CHAPTER 2
DESCRIBING AND MONITORING THE STATUS OF SUSTAINABILITY

2.1 Introduction



This chapter reviews tools which aim to set a framework for gathering, organising, presenting and drawing conclusions from sustainability data, be it gathered for this specific task or available from other sources. It discusses:

- key findings
- indicators to collect sustainability data
- indices to summarise sustainability data
- conversion of data into a single unit to summarise and interpret sustainability data
- matrices and rose diagrams to present sustainability data
- maps and GIS to present spatial sustainability data.

2.2 Overview and highlights

Describing and monitoring the status of sustainability requires:

1. collection of data covering the full range of sustainability issues;
2. a way of distilling the key information from that data, since otherwise studies are likely to become weighted down by non-critical information; and
3. a way of presenting the data that is appropriate for the audience. The more relevant and transparent this presentation is, the more likely it is to inform and influence the intended audience.

Data collection normally involves the use of indicators. Data can be distilled either into indices that summarise the sustainability status into one unit (money, land, etc.); or into matrices or rose diagrams that pull out key data as colours (normally "traffic light" red/amber/green). Data can be presented in maps, matrices or rose diagrams.

The way that sustainability is measured and represented is due in part to historic precedent and trends. There is still, for instance, much discussion about whether sustainability should be described as three separate "legs of the stool" (social, environmental, economic) or as cross-cutting themes such as equity and access; and whether GDP is an appropriate indicator for quality of life. The tools which in practice are

most popular may not necessarily provide the clearest, or most accurate assessment of the status of sustainability. Some of the "newer" tools explored in this chapter are:

- The Index of Sustainable Economic Welfare (tool 5), which "calculates" quality of life using GDP as a basis. It is an interesting tool because it challenges orthodoxy using very orthodox methods.
- GIS, which has recently become much cheaper and more user-friendly, and now allows even individual members of the public to map sustainability issues.
- Eco-cal (tool 72), which uses a simple questionnaire together with a computer model to educate individuals about the environmental impact of their actions.

2.3 Collecting sustainability data: indicators

Applies to	scale	international	national/ regional	local	site
	stage	planning	implementation/ operation	monitoring	
	sector	public	private		
Data/ indicators	issues covered	neighbourhood	environment	transport	health
		education	local economy	crime	participation and lifestyle
	data used	'hard' quantitative	'soft' quantitative	qualitative	
Analysis	reductionist?	yes: monetised	yes: non-monetised	no: multicriteria	
	used to:	describe current status	predict future status	aid decision-making	analyse complex situations
	comparative	comparative re. other sites etc.	non-comparative		
	skills needed	expert-based	non-expert based		
	output	black box	explicit, transparent		
Cost/time*		cost high	cost low	time input high	time input low

* assumes need to collect new data. Otherwise cost and time input would be low.

Summary of approach

Due to the inherent complexity in understanding and measuring all inter-linked sustainability issues and all economic sectors, the full status of sustainability can only be described at the site level, if at all. For all larger scales, it can only be described by using *indicators*, i.e. measures of some part of sustainability which indicate how the rest of it is doing. Indicators provide a series of markers or pointers based on focussed and specific data which can be used to identify existing or emerging issues.

Indicators can describe:

- the state of sustainability ("state indicators"), e.g. NOx levels, the health of the population
- pressures on sustainability ("pressure indicators"), e.g. NOx emissions from vehicles
- responses to problems ("response indicators" or "input indicators"), e.g. % of vehicles with catalytic converters, average hospital waiting times
- phenomena that underlie policies and that decision-makers have little control over ("context indicators"), e.g. population structure.

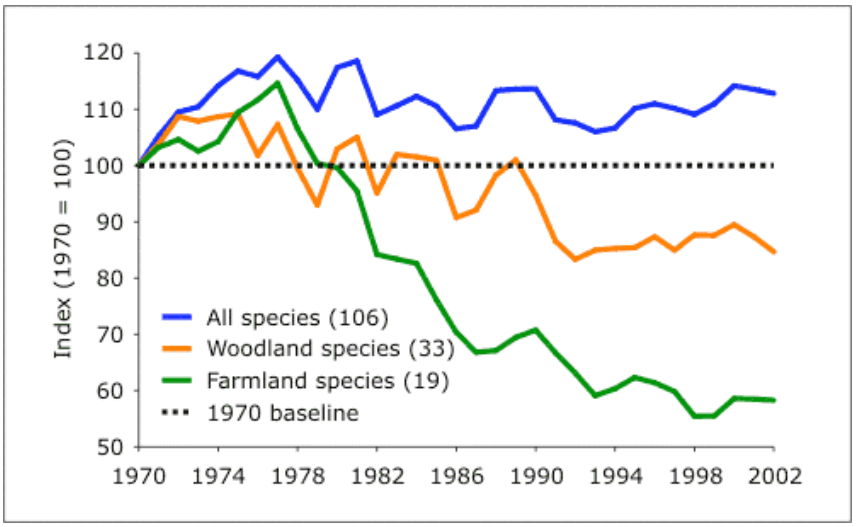
These categories are not necessarily exclusive, nor is the terminology fully agreed. For instance, pressure and state indicators are difficult to distinguish for many social and economic issues, and these state and pressure indicators are often jointly called "outcome indicators"; and response indicators are often called "input indicators". Most indicator lists include a combination of state, pressure, response and context indicators with the aim of producing a full a 'picture' of sustainability as possible.

Where common sets of indicators are used, and where methodology and data gathering / assimilation practices are sufficiently similar, indicator data can be used to compare the sustainability of different regions or alternatives; describe sustainability trends over time; and as a basis for impact prediction and evaluation.

How does it work in practice?
Various sustainability indicator lists have been established at a variety of levels, from international to local. Boxes 2.1 and 2.2 show two examples. In the UK, one of the most widely recognised indicator sets is the national Quality of Life Counts indicators,

Box 2.1 The UK's **Quality of Life Counts reports** (tool 43a) describe the status of 147 sustainability indicators, including 15 "headline indicators". The indicators have been formally monitored since 1999, with the latest report out in 2004, but many are based on indicators with a much longer history. Where possible, the report uses a "traffic light" (red, amber, green) system to describe changes since 1970, 1980, 1990 and 2000. The figure below shows an example of the information presented in the 2004 report.

Indicator: Wildlife	H13
Populations of wild birds: 1970 to 2002	



Note: Figures in brackets give the number of species included in each category

Coverage: United Kingdom
Source: Defra, RSPB, BTO

Farmland birds	
Change since	
1970	
1990	
1998	

Woodland birds	
Change since	
1970	
1990	
1998	

Objective: Reverse long-term decline in populations of farmland and woodland birds

- The overall population of British breeding birds has increased since 1970, but farmland and woodland birds have declined significantly.
- Farmland bird populations fell by 42 per cent between 1970 and 2002, and woodland bird populations by 15 per cent.
- Farmland bird populations increased by 5 per cent between 1998 and 2002. Woodland birds decreased by 3 per cent over the same period.

Box 2.2
The **Calvert Henderson Quality of Life Indicators** (tool 45) compile information about quality of life in the US in a book form. Indicators are "bundled" into themes, and each theme is explained and analysed by an expert.

For instance, the Calvert Henderson indicators for "shelter" include homeownership rate, overcrowding, units lacking complete plumbing facilities, rental cost burdens, population of 100 largest cities living in extreme poverty. This is an example of why it is essentially impossible to distinguish between pressure and state indicators for social issues.

which have been measured since 1999, and are linked with regional scale Regional Quality of Life Counts. These indicators are used as the foundation for reporting on sustainability issues and status, from the national to the local level.

Advantages and limitations

Indicators have the *advantage* of:

- providing a clear and explicit message using a relatively simple set of data.
- being able to use/recycle existing data where appropriate.
- encouraging data to be collected for important sustainability topics.
- potentially covering the full range of sustainability issues.
- providing a base for many other sustainability tools.

They have the *limitations* that:

- Indicator lists can get very long; this has resource implications for compiling data sets and keeping them up to date.
- Some indicators, particularly those that describe the more subtle and complex aspects of sustainability, will almost by definition be difficult to measure: for instance, after five years the UK Quality of Life Counts reporting still does not have indicators for countryside quality, sites affected by water abstraction, or sustainable tourism.
- As the role of indicators is to present a broad picture using the measurement and presentation of only a selection of key issues, the choice of indicators is crucial. The wrong indicator will give the wrong message: for instance GDP has long been used as an indicator of quality of life, even though some activities that increase GDP (e.g. accidents leading to employment of doctors, physiotherapists, undertakers etc.) clearly do not increase quality of life.
- An indicator can only ever be as good as the data used. A commonly stated key requirement of indicators is that they are objectively verifiable, transparent and measurable. With complex lists of indicators this may not always be possible, however where data is incomplete or unreliable, care is necessary in the interpretation of indicators.

Tools assessed in this category:

Number (from App. A)	Name
1	Quality of Life Counts
3	Conjunction of Criminal Opportunity
9	Social/ Human Capital Rapid Appraisal Model
43	Quality of Life indicators
45	Calvert Henderson Quality of Life Indicators
47	Florida Sustainable Community Index
Hertfordshire sustainability appraisal indicator list	
United Nations Millennium Development Goals (MDGs)	
UK Regional Sustainable Development Frameworks (one per region)	

Note: This list is indicative rather than exhaustive.

2.4 Summarising and interpreting sustainability data: conversion into a single unit

Applies to	scale	varies by technique			
	stage	planning	Implementation/ operation	monitoring	
	sector	public	Private		
Data/ indicators	issues covered	varies by technique			
	data used	varies by technique			
Analysis	reductionist?	varies by technique			
	used to:	describe current status	Predict future status	aid decision-making	analyse complex situations
	comparative	comparative re. other sites etc.	Non-comparative		
	skills needed	expert-based	Non-expert based		
	output	black box	Explicit, transparent		
Cost/time		varies by technique and availability of data			

Summary of approach

Due to the complexity of the issues that indicators seek to represent, and the fact that to build a complete picture of sustainability requires information on a number of variables, many indicator lists are very long. This means that it is often difficult to identify and interpret key issues, and compare alternatives or regions, using the full list as a basis. The simplest way of summarising sustainability data is in the form of indices, or groups of indicators.

A more complex way of summarising and interpreting sustainability indicator data is by translating it into one "currency". In theory this allows all impacts to be put on the same footing and thus facilitates much easier and quicker comparison. The currencies used in the examples we have reviewed include money, the amount of land needed to maintain a given activity or lifestyle, "eco-calories", and the benefits that people gain from an activity.

How does it work in practice?

Indices are generated by compiling a number of indicators that have been ranked without being weighted (see Section 3.5 for a discussion of weightings). The final index for each alternative is the sum of its indicator rankings. Boxes 2.3 and 2.4 give examples of indices: other examples include the Index of Multiple Deprivation (tool 13) and the Social/Human Capital Rapid Appraisal Model (tool 9).

Box 2.3

The **UN Human Development Index** (tool 15) describes and compares the "human development" of countries. It is based on three indicators, each with the same weighting: life expectancy at birth, the percentage of children enrolled in school, and GDP. Trends in human development for each country have been calculated every five years since 1975. Norway, Iceland and Sweden topped the list in 2001; Sierra Leone, Niger and Burkina Faso were at the bottom.

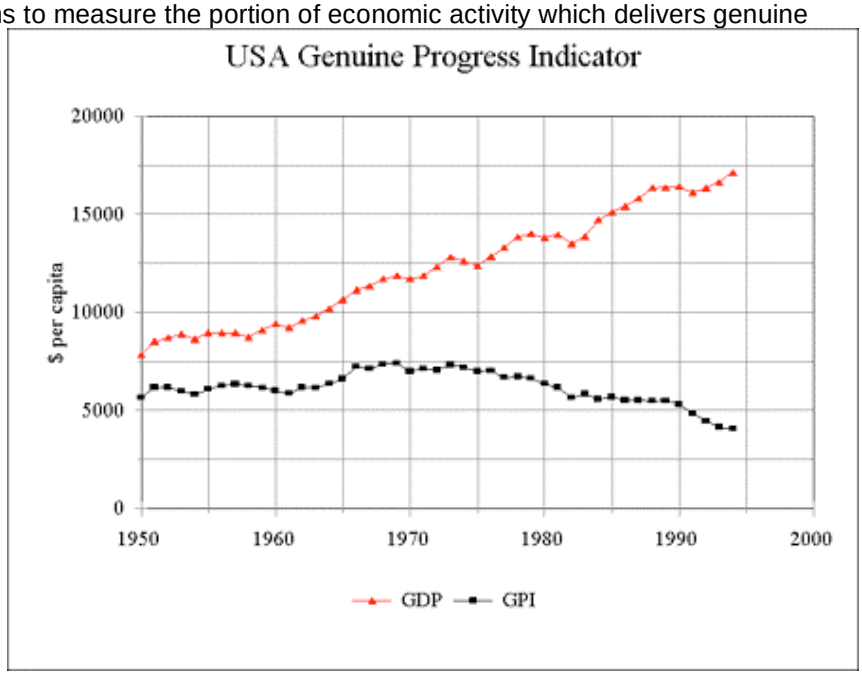
> "*The HDI can be seen as an alternative measure of development, rivalling the GNP. Unfortunately, over the years, people have attributed to HDI things that it does not stand for and this has led to severe criticism of the index. The HDI has a limited scope and it should be seen within that scope*" (Jahan, S. "Measuring Living Standard and Poverty: Human Development Index as an alternate measure").

Box 2.4
The **IUCN Wellbeing Index** (tool 46) compares 180 countries in terms of their "wellbeing" using 28 indicators of human welfare, 49 indicators of ecosystem wellbeing, plus other wellbeing and stress indices. Sweden, Finland and Norway topped the list in 2001; Iraq, the Syrian Arab Republic and Afghanistan were at the bottom.

The most typical conversion of sustainability status or impacts into a comparable 'currency' is into money using *cost-benefit assessment.* CBA compares the monetary value of the benefits arising from an activity or alternative with the monetary value of its costs. There are two broad approaches to doing CBA: 1. identifying people's stated preferences (e.g. on willingness to pay for environmental resources or accept compensation for changes in resources); and 2. assessment of preferences inferred from peoples behaviour (e.g. how much people would pay to restore the environment to its original state if it was damaged, or how much they would pay to offset environmental impacts such as noise).

CBA is a well-developed and documented method for appraising project alternatives, and is widely used in business and public decision making. CBA methodologies vary from relatively quick and easy comparisons of the purely economic costs and benefits of particular options, to complex analyses of a range of social, environmental and economic factors combined with theoretical means of transposing costs from social impacts and environmental change. An unusual example of CBA is the Index of Sustainable Economic Welfare, discussed in Box 2.5.

Box 2.5
The **Index of Sustainable Economic Welfare** (tool 5) – also called the Genuine Progress Indicator (tool 34) - aims to measure the portion of economic activity which delivers genuine increases in quality of life. The calculation starts with GDP and, for example, makes a subtraction for air pollution caused by economic activity, and makes an addition to count unpaid household labour - such as cleaning or child-minding. It also covers areas such as income inequality, other environmental damage, and depletion of environmental assets.



However some of the most interesting sustainability tools and toolkits are those that convert impacts into non-money indices. These are particular relevant where the monetisation of impacts is hard or controversial, which can often be the case with social and environmental issues. Examples of such methods reviewed include:

- Going for Green's *"Eco-Cal"* computer programme (tool 72) calculates the environmental impacts of a household by converting them into "eco-calories". The programme asks a series of questions about six categories of impact (e.g. waste, energy, transport) and converts the answers into six red-amber-green dials that show how sustainable the household is for each topic.
- The concept of *ecological footprinting* takes as a basis that: total human impact on an area (the footprint) = the area's population x per capita impact. It converts activities/ impacts into how much productive land and water area is required to support that activity. If the required area is larger than that which exists, then the activity is unsustainable. The equation can also be turned around to identify the maximum rate of resource consumption and waste discharge that can be sustained indefinitely by a given population in a given area.
- *Quality of life assessment* converts an area's sustainability status into the benefits and disbenefits that people gain from it. The core idea of QoLA is that the environment, the economy and society provide a range of benefits for people, and that it is these benefits that need to be protected and/or enhanced. For example a small woodland on the edge of a town does not matter because it provides x hectares of woodland, but rather because it provides recreation, a habitat for rare species, carbon 'fixing', jobs for foresters etc. Analysing these benefits gives an indication of how the area should be managed in the future.

Advantages and limitations

Conversion of complex sustainability data into a single unit has several *advantages*:

- It allows all impacts to be considered on the same footing by 'integrating' different types of impact appraisal; and thus allowing comparison of alternatives.
- It is educational. CBA makes economists think of impacts that they have not thought about before, and may be the only way that environmental values can be taken into account in some decision-making processes. The Eco-Cal programme informs individuals about how "green" they are and, by allowing them to try out different scenarios (e.g. of recycling, or different modes of transport), allows them to identify more sustainable ways of living[1]. Ecological footprints allow a comparison of different countries' and lifestyles' impacts.
- QoLA provides an equitable basis for comparing sites in terms of the benefits they offer and the degree to which those benefits can be substituted. In doing so, it sets a context for development proposals by stipulating benefits that any development should provide to an area, whilst offering flexibility for developers in terms of *how* they provide the benefits. It most effectively protects those sites that provide the most benefits.

On the other hand, comparing the status or impact of issues from different sustainability areas, or which are normally measured using different units, is complex and sometimes controversial. *Limitations* include:

- Only a limited number of things can be converted into indices: footprinting is limited in what it can convert to land, CBA in what can be converted to money.
- Indices are not very transparent, and require considerable technical experience and data, e.g. economists for CBA, footprinting experts for footprinting.
- The indicators and conversions have to be done correctly. Many CBA or footprinting techniques are very indirect – for instance house values in a given neighbourhood may have little to do with air pollution levels – and the techniques used can greatly affect the results.
- CBA is particularly contentious. For instance, the discount rate – which can have a dramatic effect on the estimated costs and benefits of future impacts – as a result also has a large impact on the CBA's results. Anything other than no discount rate – future

[1] We know this firsthand. As a result of the Eco-Cal programme, one of us has changed their travel behaviour to radically reduce how much they fly (with considerable benefits for quality of life).

impacts given the same cost as today's – contradicts the inter-generational principle of sustainable development. It is unclear over what time period costs and benefits should be compared: the impact on jobs may last for 20 years, on climate change for hundreds of years. CBA can also be perceived as unethical: it relies on individuals' judgements about their personal interests, which is arguably not an appropriate approach to decision-making about public goods. CBA does not consider who wins and who loses: for instance it does not distinguish whether the noise increases are borne by people with already high noise levels or not.

	conversion into…				
	indices	**money**	**eco-calories**	**footprints**	**benefits**
scale	all	all	household	national, regional	regional to site
issues covered	all	primarily environment, health, local economy	environment, transport	primarily environment	all
data used	'hard' and sometimes 'soft' quantitative	'hard' quantitative	primarily 'hard' quantitative	'hard' quantitative	all
reductionist?	yes: non-monetised	yes: monetised	yes: non-monetised	yes: non-monetised	yes: monetised and multicriteria
output	black box	black box	black box	black box	explicit, transparent
cost/time	low cost and time if data are already available, else both high	low cost, high time if data are already available; else both high	low cost, low time if existing programme is used	low cost, high time if data are already available; else both high	reasonably low cost and time

Tools assessed in this category:

Number (from App. A)	Name
5	Index of Sustainable Economic Welfare
9	Social/Human Capital Rapid Appraisal Model
12/13	Index of Deprivation
15	UN Human Development Reports/ Index
29	Quality of Life Assessment
34	Genuine Progress Indicator
44	Sustainability calculator
46	Wellbeing index
47	FSCN Index
72	Eco-Cal
Department of Environment (1991) *Policy Appraisal and the Environment*	
Chambers et al. (2000) *Sharing Nature's Interest*, Earthscan, London.	
Pearce et al. (1989) *Blueprint for a Green Environment*, Earthscan, London.	

Note: This list is indicative rather than comprehensive.

2.5 Presenting sustainability data: matrices, pie charts and rose diagrams

Applies to	scale	international	national/ regional	local	site
	stage	planning	implementation/ operation	monitoring	
	sector	public	private		
Data/ indicators	issues covered	neighbourhood	environment	transport	health
		education	local economy	crime	participation and lifestyle
	data used	'hard' quantitative	'soft' quantitative	qualitative	
Analysis	reductionist?	yes: monetised	yes: non-monetised	no: multicriteria	
	used to:	describe current status	predict future status	aid decision-making	analyse complex situations
	comparative	comparative re. other sites etc.	non-comparative		
	skills needed	expert-based	non-expert based		
	output	black box	explicit, transparent		
Cost/time		cost high	cost low	time input high	time input low

Summary of the approach

Matrices, pie charts and rose diagrams aim to present multiple types of sustainability data in a structured form that brings out key messages. They aid interpretation of data and highlight issues in a simple to understand and unambiguous manner. At their simplest, matrices represent data as simply a plus or minus, depicting whether an indicator, outcome or issue is considered to be good or bad from a sustainability perspective. However graphics, colours and symbols can also be used to convey more complex and detailed data.

How does it work in practice?

Matrices provide a simple means to represent and summarise sustainability data in a structured format. They can use text, symbols (tick/cross, +/-), and/or colours to describe data. The matrix cells can provide different levels of detail of analysis for different criteria as in Box 2.6; or can compare alternatives based on different criteria, as in Box 2.7.

Box 2.6

The **Sustainable Development Commission's analysis of how the UK is performing with respect to the Government's sustainability criteria** is in a matrix form:

Indicator	Score	Comments
1. Economic growth	/ /	The UK is succeeding in the Government's aim of 'high and stable growth', outperforming comparators on growth and above European average for GDP. But some of the growth is in unsustainable directions, and overall it does not seem to be making us happier; and inequalities between rich and poor people, and between regions, are increasing.

Sustainable Development Commission (2004) "Shows promise but must try harder".

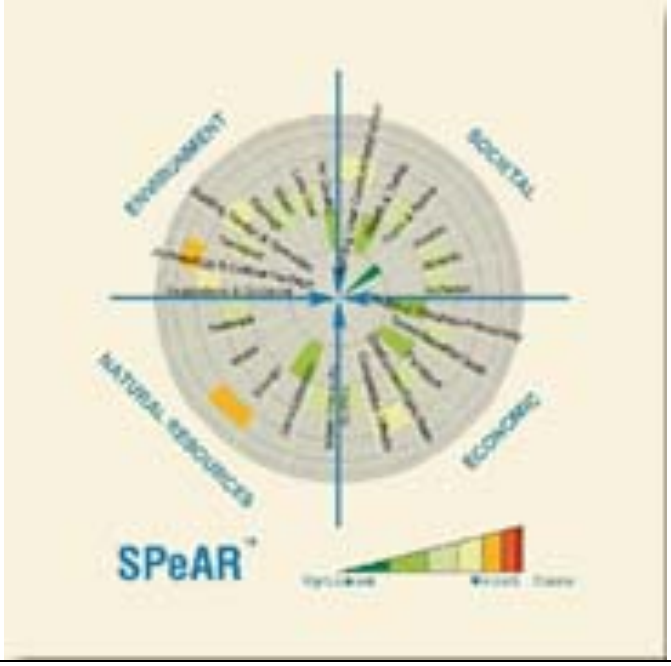
Box 2.7
The matrix below shows how two agricultural management approaches – "orange" and "brown" – compare in terms of four indicators. It is taken from an unpublished **analysis of the National Farmers Union's Little Red Tractor scheme** carried out for the Sustainable Development Commission.

Comparison of "orange" v. "brown" approach	**orange**	**brown**
A. Produce **safe, healthy** food & non-food products in response to **market demands**, now & in the future	✓✓	✓✓
B. Enable **viable livelihoods** to be made from sustainable land management, taking account of payments for public benefits provided	✓	**O**
C. Operate within biophysical constraints & conform to other **environmental imperatives**	✓✓✓	✓
D. Provide **environmental improvements** & other benefits that the public wants – such as re-creation of habitats & access to land	✓	**O**

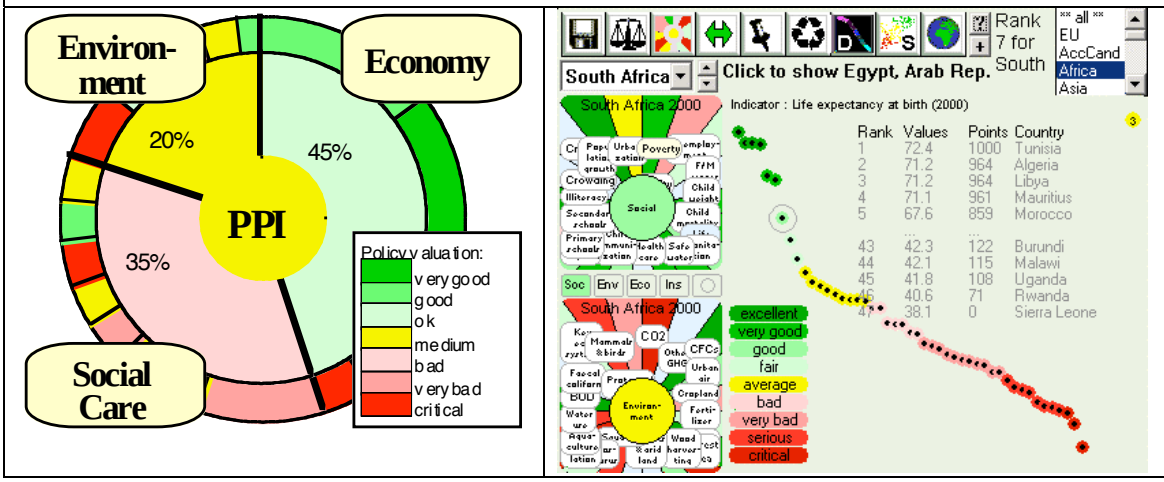
A more complex form of data representation is by using rose diagrams (or, as its originator Tony Clayton calls them, Sustainability Appraisal Maps). Colours describe whether the sustainability status is good or bad, and the size of "slices" of a pie chart describe the importance of the issue. "Traffic light" colours are popular, as shown in Boxes 2.8 and 2.9.

<u>Advantages and limitations</u>
Matrices, pie-charts and dashboards have the *advantages* of:
- being useful across a wide range of issues and fields.
- highlighting key issues; pulling main points out of complex data.
- providing visible, accessible data representation, and thus communication of issues to a wider audience than more technical (or simply boring!) methods.

Box 2.8
SPeAR (tool 78) is an example of a rose diagram designed by Arup to describe organisations' activities regarding sustainability. The segments describe different sustainability aspects; and the colours and position on the diagram describe the level of attainment.



Box 2.9
The **Dashboard of Sustainable Development** (tool 39), developed by the Canadian Consultative Group on Sustainable Development presents sets of indicators in a pie chart format based on three principles: 1. the size of a segment reflects the relative importance of the issue described b the indicator; 2. a colour code signals performance; 3. the central circle summarises the information of the component indicators. The left-hand figure is an example. The group also compiled 46 indicators for more than 100 countries, and compared the countries using maps and rankings: the right-hand figure is an example.



They have the *limitations* of:

- being unable to present spatial data, meaning that they can only present a snapshot of an issue over an entire region or study area with no detailed analysis of pressure points or critical areas.
- being unable to present indirect impacts.

Tools assessed in this category:

Number (from App. A)	Name
1	Quality of Life Counts
29	Quality of Life Assessment
39	Dashboard of Sustainable Development
50	Project innovation matrix
72	Eco-Cal
78	SPeAR
Sustainable Development Commission (2004) "Shows promise but must try harder".	

Note: This list is indicative rather than exhaustive.

2.6 Presenting spatial sustainability data: maps and Geographical Information Systems

Applies to	scale	international	national/ regional	local	site
	stage	planning	implementation/ operation	monitoring	
	sector	public	private		
Data/ indicators	issues covered	neighbourhood	environment	transport	health
		education	local economy	crime	participation and lifestyle
	data used	'hard' quantitative	'soft' quantitative	qualitative	
Analysis	reductionist?	yes: monetised	yes: non-monetised	no: multicriteria	
	used to:	describe current status	predict future status	aid decision-making	analyse complex situations
	comparative	comparative re. other sites etc.	non-comparative		
	skills needed	expert-based	non-expert based		
	output	black box	explicit, transparent		
Cost/time		cost high	cost low	time input high	time input low

Summary of the approach

Maps – including GIS maps – present and analyse location-based sustainability data. They can show the status of sustainability, impacts on sustainability, and impact significance.

How does it work in practice?

GISs link attribute or issue data to map data. Map data (spatial reference points) are essentially points or lines on a map. Attribute data are characteristics of map-features, for instance land use of an area or slope of a road. GISs are thus a combination of a computerised cartography system that stores map data, and a database management system that stores attribute data. Links between map data and attribute data allow maps of the attribute data to be displayed, combined and analysed with relative speed and ease. GISs are often used as analytical tools (see Section 3.4), but can also be used simply to map data. Box 2.10 gives an example.

Considerable data are already presented in GIS form, for instance:

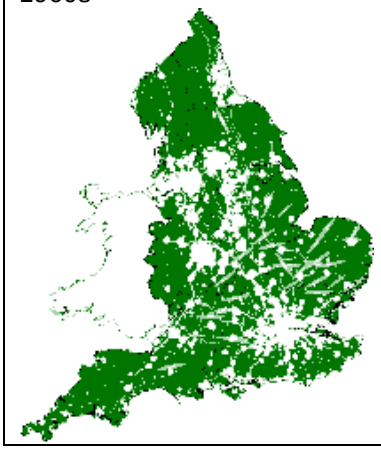
- Multi-Agency Geographic Information for the Countryside (MAGIC) (tool 71), which gives information on UK designations, floodplains, etc., from the national to the district level;
- Neighbourhood Statistics, which enable local authorities and other users to identify spatially specific social, community and service provision characteristics;
- Participatory and reflective Analytical Mapping (tool 20) which provided free international level GIS data for use by (particularly developing country) decision-makers;
- Equity mapping (tool 38), which was used by Los Angeles's Sustainable Cities Programme. Maps showing an 0.25 mile buffer zone from parks were superimposed on maps showing the racial characteristics of the local resident population, and analyses were carried out of the number of park acres per 1000 African American, Latino, White and Asian population. This showed serious differences between the races in terms of access to parks: for instance white were shown to have 100 times better access than Latinos.

Box 2.10

The **Council for the Protection of Rural England's tranquillity maps** show changes in rural tranquillity in England between the 1960s and 1990s. They are overlay maps: they overlay (in white on green, as shown below):

- 4km radius from the largest power stations
- 3km buffers from the most heavily used roads and from major industrial areas
- 2km buffers from other heavily used roads and from the edge of smaller towns
- 1km buffers from roads with medium disturbance, some main line railways, and 400KV and 275KV power lines,
- noise lozenges from military and civil airfields
- areas of very extensive opencast mining

1960s



1990s

Advantages and limitations

Maps and GIS have the *advantage* of:

- allowing location-specific impacts to be clearly visualized. By placing issues in a geographical context, maps/GIS can expose problems and issues which may remain hidden in non-spatial presentation techniques.
- being easy to use in public participation exercises, sometimes in an interactive manner.
- being able to show current status, impacts and significance. GIS's zoning features and ability to consider several layers of information at a time can be used in sensitivity mapping.
- GISs makes it relatively easy to manipulate large amounts of data, with long-term cost savings in map-making.

They have several *limitations*:

- They are limited to impacts that have a direct spatial component. They generally cannot cope well with data about indirect and cumulative effects.
- GIS systems require an appropriate computer system, which can be costly and also requires the compilation or purchase of map data and related attribute data. Analysis of these data is a complex and time-consuming task which requires specialist skills.

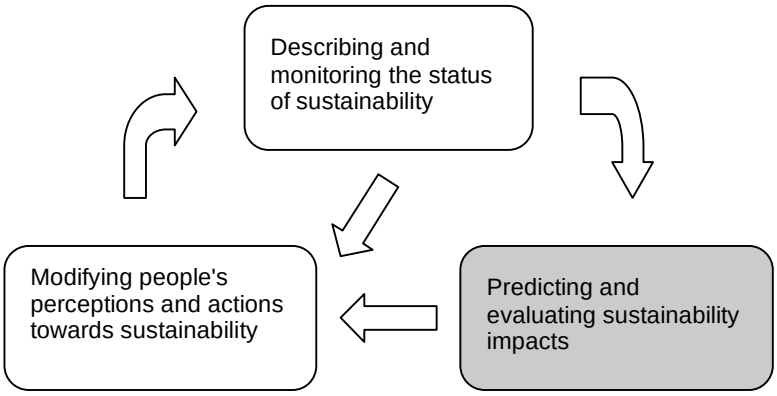
Tools assessed in this category:

Number (from App. A)	Name
20	Participatory and Reflective Analytical Mapping
38	Equity mapping
47	Florida Sustainable Communities Index
71	Multi-Agency Geographic Information for the Countryside
CPRE tranquillity maps (www.cpre.org.uk)	
Environment Agency, www.environment-agency.gov.uk/yourenv	
www.neighbourhood.statistics.gov.uk	

Note: This list is indicative rather than exhaustive.

CHAPTER 3
PREDICTING AND EVALUATING SUSTAINABILITY IMPACTS

3.1 Introduction



A wide variety of tools can be used to predict and evaluate the impact of actions on sustainability. This is because different tools are designed to deal with:

- Different actions, for instance:
  - policies, plans and programmes (e.g. in strategic environmental assessment),
  - large development projects (e.g. environmental impact assessment)
  - individual buildings (e.g. various tools to analyse building energy use, waste management etc)
  - technologies (e.g. life cycle analysis).
- Different scales, from the national to the site-specific scale.
- Different stages of the action: either one stage (e.g. operation) or the action's entire life cycle, including where materials come from and are finally disposed to.
- Different sustainability aspects:
  - social only (e.g. social impact assessment / audit / analysis)
  - social sub-components (e.g. community, equity, crime)
  - environmental only (e.g. environmental impact assessment)
  - environmental sub-components (e.g. energy, water)
  - general sustainability, lifestyle or quality of life (e.g. "rural proofing", benchmarking).

This chapter distinguishes between three main categories of prediction and evaluation tools: those that deal with

- the assessment process as a whole by specifying assessment stages, timing, etc.
- identification and prediction of the magnitude, duration etc. of impacts
- evaluation of the significance of impacts.

Due to the complex nature of prediction and evaluation, the second and third of these sections have been structured slightly differently from others. For each section we have provided a summary of the approach and an overview of how such methods work in practice. However, it has been necessary to sub-divide the latter sections to provide some more specific examples and analysis, rather than doing this once at the end of each section.

3.2 Overview and highlights

This chapter deals with a wide variety of tools, many of which can also be useful in description of impacts (Chapter 2) and modification of actions (Chapter 4). They range from very transparent and simple techniques such as checklists and matrices through to very complex computer models linked to GIS. Some of the most user-friendly tools, and those that can cope with the widest range of data types, are also those that can be used for other purposes, for instance matrices and GIS which can also be used to describe the sustainability status.

In theory, the type of decision that the tool aims to support should determine the tool used. For decisions that are reasonably clear-cut, strategic, not particularly important, and technically non-complex, a simple, quick "shallow" tools is probably sufficient. For others, more complex "deep" tools will be needed. It may be possible to use a "shallow" tool for most of an analysis, and a "deep" tool only for those elements that require more detailed analysis.

Impact prediction tools are quite different from evaluation techniques: the former aims to be comprehensive, detailed and "technical", the latter apply judgement. It may be useful to use several different evaluation tools to the result of one prediction tool, as a form of triangulation of significance.

The UK is probably unusual in its willingness to accept uncertainty, and its acceptance of "shallow" tools. In many other countries – for instance France and, in the researchers' experience, many developing countries – impact prediction and evaluation is expected to be a detailed, quantitative, expert-driven exercise, no matter what the context. Given the complexity and inevitable uncertainty surrounding many sustainability decisions, such an approach is likely to be unnecessarily resource-intensive without necessarily reducing uncertainty or risk.

Some of the newest tools, which take a novel approach to integrating other, more traditional tools, include:

- strategic environmental assessment, which extends impact assessment from projects to more strategic policies, plans and programmes,
- equity mapping (tool 38), which uses GIS to map different communities' access to services,
- "rural proofing" (tool 70), which not only uses a very straightforward checklist to identify problems, but also suggests a range of possible ways of dealing with these problems, and
- causal network diagrams, which help to identify impacts and also assumptions about implementation made by decision-makers.

3.3 Predicting and analysing overall sustainability impacts: impact assessment

Applies to	scale	international	national/ regional	local	site
	stage	planning	implementation/ operation	monitoring	
	sector	public	private		
Data/ indicators	issues covered	neighbourhood	environment	transport	health
		education	local economy	crime	participation and lifestyle
	data used	no data used: procedural tool			
Analysis	reductionist?	no specific type of analysis proposed: procedural tool			
	used to:	describe current status	predict future status	aid decision-making	analyse complex situations
	comparative	comparative re. other sites etc.	non-comparative		
	skills needed	expert-based	non-expert based		
	output	black box	explicit, transparent		
Cost/time		depends on the tool and application			

Summary of approach

These procedures – they are not tools *per se* - suggest steps and approaches for identifying, predicting and evaluating the sustainability impacts of actions. They aim to provide information to decision-makers about sustainability, so that the decision-maker can minimise any negative impacts, and/or reject any actions with significant impacts.

Some of these tools are legally required. In particular, environmental impact assessment is required for many development projects worldwide (by EC Directives 85/337 and 97/11 and about 40 different regulations in the UK); and strategic environmental assessment is increasingly being required (by EC Directive 2001/42/EC and draft regulations in the devolved administrations).

Typically the tool will explain:

- who should carry out the assessment, on what actions
- how the assessment stages fit with the stages of the action: typically the assessment stages will be
  - describe the baseline sustainability status and existing sustainability problems
  - describe the action
  - identify the impacts of the action on the sustainability baseline
  - determine whether the impacts are significant
  - avoid, minimise or compensate for any significant impacts ("mitigation")
  - determine what impacts are left over after mitigation
- who should be consulted on the assessment findings and how
- how the results of the decision-making - which should take into account the findings of the assessment - should be documented

How does it work in practice?

Different tools focus on different scales, levels of "strategic-ness", and stages of actions; and on different sustainability topics.

Environmental impact assessment (EIA) focuses on the construction and operation of large development projects, for instance airports and industrial developments. It focuses on their environmental impacts, although the definition of "environment" also encompasses social aspects affected by the environment, for instance human health and "material assets". EIA is well-developed worldwide, and is legally required for large development projects in the UK.

Strategic environmental assessment (SEA, tool 69) has a similar "environment-plus" focus as EIA, but applies at the plan, programme and (sometimes) policy level. The use of SEA has been advocated because policies, plans and programmes set the context within which projects are planned and implemented, and because cumulative impacts of multiple projects/actions are easier to deal with at the strategic level. Procedurally, SEA resembles project EIA, but the tools required for impact prediction are more focused on qualitative predictions and on techniques that deal with uncertainty (e.g. about the types and locations of project that might arise, likelihood and types of new technologies emerging etc.). Box 3.1 summarises the requirements of the European "SEA Directive".

Box 3.1 Requirements of the "SEA Directive": Directive 2001/42/EC

Preparing an environmental report in which the likely significant effects on the environment of implementing the plan, and reasonable alternatives taking into account the objectives and geographical scope of the plan, are identified, described and evaluated. The information to be given is:

a) An outline of the contents, main objectives of the plan, and relationship with other relevant plans and programmes;
b) The relevant aspects of the current state of the environment and the likely evolution thereof without implementation of the plan;
c) The environmental characteristics of areas likely to be significantly affected;
d) Any existing environmental problems which are relevant to the plan including, in particular, those relating to any areas of a particular environmental importance;
e) The environmental protection objectives, established at international, Community or national level, which are relevant to the plan and the way those objectives and any environmental considerations have been taken into account during its preparation;
f) The likely significant effects on the environment, including on issues such as biodiversity, population, human health, fauna, flora, soil, water, air, climatic factors, material assets, cultural heritage including architectural and archaeological heritage, landscape and the interrelationship between the above factors. (These effects should include secondary, cumulative, synergistic, short, medium and long-term permanent and temporary, positive and negative effects);
g) The measures envisaged to prevent, reduce and as fully as possible offset any significant adverse effects on the environment of implementing the plan;
h) An outline of the reasons for selecting the alternatives dealt with, and a description of how the assessment was undertaken including any difficulties (such as technical deficiencies or lack of know-how) encountered in compiling the required information;
i) a description of measures envisaged concerning monitoring in accordance with Article 10;
j) a non-technical summary of the information provided under the above headings

Consulting:

- authorities with environmental responsibilities, when deciding on the scope and level of detail of the information which must be included in the environmental report.
- authorities with environmental responsibilities and the public, to give them an early and effective opportunity within appropriate time frames to express their opinion on the draft plan and the accompanying environmental report before the adoption of the plan.
- other EU Member States, where the implementation of the plan is likely to have significant effects on the environment in these countries.

Taking the environmental report and the results of the consultations into account in decision-making

Providing information on the decision:

When the plan is adopted, the public and any countries consulted must be informed and the following made available to those so informed:

- the plan as adopted
- a statement summarising how environmental considerations have been integrated into the plan and how the environmental report, the opinions expressed and the results of consultations entered into have been taken into account, and the reasons for choosing the plan as adopted, in the light of the other reasonable alternatives dealt with; and
- the measures decided concerning monitoring.

Monitoring the significant environmental effects of the plan's implementation.

Sustainability appraisal is a form of SEA, but it covers the full range of sustainability issues, at a lesser level of detail and rigour than SEA. Sustainability appraisal of development plans has been carried out in the UK since 1992, and recently became a legal requirement.

Life cycle assessment (tool 58) focuses on the impacts not just of a particular project or technology, but of the materials and energy required to produce the project/technology, and the waste produced by the project/technology: it is a "cradle-to-grave" assessment tool. It has been used, for instance, to determine whether cloth or disposable nappies are more environmentally sound (cloth ones use more water and detergent; disposable ones more landfill space); or whether the impact of providing the extra materials needed to insulate a building is outweighed by the reduction in energy that the building subsequently uses.

Social impact assessment (tools 9, 11, 17, 35, 37, 51) assesses the social (only) impacts of actions. Depending on the technique, this covers more technical/quantitative issues (eg. on population characteristics and demographics) and/or more qualitative issues such as norms, values, community interactions etc. Box 3.2 lists the main contents of the World Bank's Social Analysis Sourcebook.

Box 3.2
The **World Bank's Social Analysis Sourcebook** (tool 52) has five main chapters:
1. Why do social analysis? (participation, dimensions of poverty, forms of social analysis etc.)
2. The scope of social analysis: social diversity and gender; institutions, rules and behaviour; stakeholders; participation; social risks
3. Building social analysis into project design: what does it take?; using the project cycle to integrate social analysis into design and operations; applying the five entry points of social analysis in project design; mechanisms for delivery of project benefits
4. Social assessment: basic concepts; responsibility for social assessment; deciding whether to do a social assessment; the facets and phases of social assessment; tools and methods; ensuring the quality of social assessments
5. The way forward: good practices in social analysis; new instruments for social analysis

Tools assessed in this category:

Number (from App. A)	Name
2 / 16	Social Capital Assessment Tool (SOCAT / SCAT)
9	Social/ Human Capital Rapid Appraisal Model
11	"Community capacity assessment" re. riparian issues
17	Social capital assessment tool
30	Community Profile
35	Community impact assessment
37	Social Audit
41	Corporate Sustainability Assessment (SAM)
42	Community sustainability assessment
51	Social impact assessment
55	Whole Life Costing
69	Strategic environmental assessment
Glasson et al. (2004) *Introduction to Environmental Impact Assessment*, 3rd ed., Spon Press, London.	

Note: This list is indicative rather than exhaustive.

3.4 Predicting sustainability status and impacts

Applies to	scale	international	national/ regional	local	site
	stage	planning	implementation/ operation	monitoring	
	sector	public	private		
Data/ indicators	issues covered	depends on the tool and application			
	data used	depends on the tool and application			
Analysis	reductionist?	depends on the tool and application			
	used to:	describe current status	predict future status	aid decision-making	analyse complex situations
	comparative	comparative re. other sites etc.	non-comparative		
	skills needed	depends on the tool and application			
	output	depends on the tool and application			
Cost/time		depends on the tool and application			

Summary of approaches

Impact prediction tools all start with some information and assumptions about the action and the baseline (without-action) sustainability status, and then identify and predict the future status of sustainability with the action. The action's impacts are the difference between the with-action and without-action baseline.

The dimensions of impact that the tools predict include:

- the magnitude/size of the impact
- whether the impact is positive or negative
- the impact's timing and duration (short/medium/long term, temporary/permanent)
- how likely the impact is to occur
- indirect impacts caused by the primary impact, e.g. additional traffic caused by a new retail development
- cumulative impacts of multiple actions

Where significant negative impacts are identified, the tools might suggest measures for avoiding or minimising these effects.

Typical tools to predict sustainability impacts are, in order of complexity:

- checklists and matrices
- causal network diagrams
- resource balance accounting
- Geographical Information Systems
- models
- systems analysis

Checklists and matrices

The simplest impact prediction techniques rely on expert judgement: they set up a framework within which the views of experts are structured and documented. Checklists (see Sec. 3.5) and matrices are the most commonly-used tools for this. Box 3.3 shows a typical impact prediction matrix. The right-hand column fosters the consideration of mitigation measures.

Matrices and checklists have the *advantages* of being very easy to set up and understand. They can be used as *aide memoires*, and/or as a framework for presenting the results of other, more detailed impact prediction techniques. They can be used for qualitative as well as quantitative data; and for data from non-experts as well as experts. If set up like in Box 3.3, they can suggest mitigation measures

Box 3.3
Matrix for assessing and mitigating components of a development plan (based on the draft strategic environmental assessment for West Sussex Local Transport Plan)

plan option or sub-component	**sustainability criteria/objectives**				**comments and overall assessment** (e.g. assumptions made, further studies needed, how implementation might make impact negative or positive)	**proposed changes to the option or sub-component**: • where text is not clear, possible changes to clarify it • where impact is negative (-), possible changes to reduce or reverse impact • where impact is positive (+), possible changes to further enhance impact • where impact depends on how the plan is implemented (I), measures needed to ensure that the implementation is done positively
	1. Improve health, reduce health inequality	2. Reduce poverty and social exclusion	3. Reduce crime and fear of crime	…		
T1….	+	-	?	I		
T2…						

They have *the limitation* of being unable to predict indirect and cumulative impacts – those that are several stages removed from the original action or that are due to several actions. They can also end up being very large, and it can be difficult to "see" the key data.

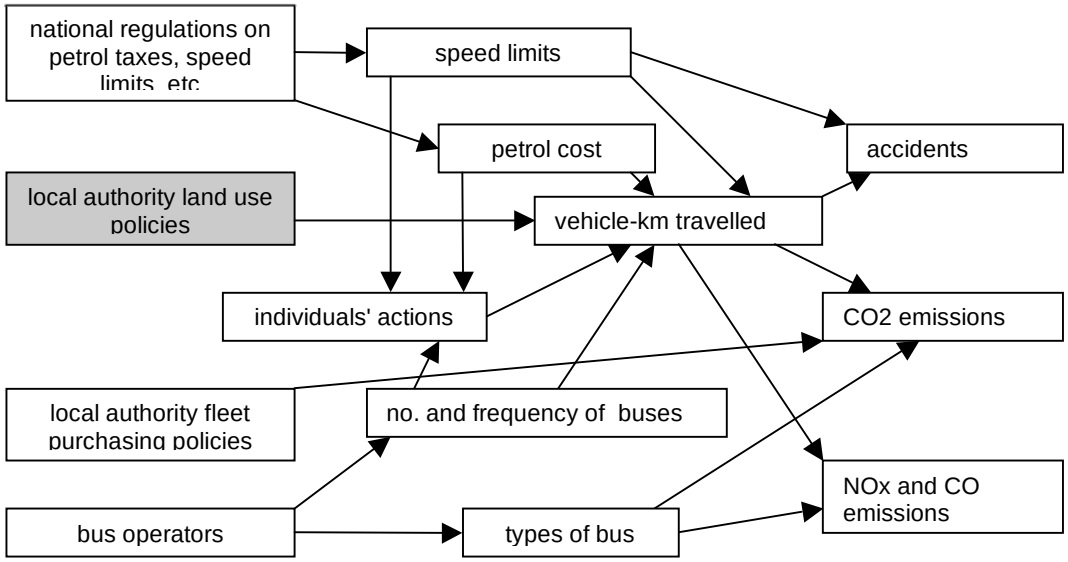
Causal network diagrams

Causal network diagrams – also called cause-effect analyses or causal chain analyses - involve, through expert judgement, drawing the direct and indirect impacts of an action as a network of boxes (activities, outcomes) and arrows (interactions between them). These diagrams explicitly recognise and show that sustainability systems consist of a complex web of relationships, and that many activities' impacts occur at several stages removed from the action itself. They can identify cumulative and indirect impacts, and factors that support or constrain the effective implementation of an action. Box 3.4 shows an example.

Causal network diagrams have the *advantages* of being easy to understand, quick and cheap to draw, and can integrate non-expert views. They are probably the best way of identifying cumulative and indirect impacts. They are a useful starting point for other impact prediction techniques, for instance for modelling.

They have the *limitation* of missing important impacts if not done well, and of not dealing well with spatial impacts. They can also look cumbersome and user-unfriendly.

Box 3.4 Example of a causal network diagram (Therivel, 2004)



Resource balance accounting

Resource balance accounting (RBA) is based on the concept that "pools" if resources can be identified and accounted for using a variant on economic input-output accounting. For finite resources such as minerals, fossil fuel and water, RBA models where the resource is at a given point (using sources and sinks). For non-finite resources such as wood and fish, RBA also models growth (e.g. reproduction) and depletion (e.g. fishing).

RBA is already used in practice, for instance, to predict future fish stocks and oil resources. This has identified limits to future development, and problems such as over-fishing and years of remaining mineral reserves.

RBA has the *advantage* of acknowledging that many resources are finite. It is often carried out for international-level issues, and is one of the few sustainability tools that deals well with the international level. Ecological footprinting (see Section 2.4) is based on RBA.

RBA has the *limitation* of applying only to natural resources. It does not work for social issues, except the concept that social resources can be run down. It does not integrate findings for the different resources, and is thus not a "sustainability" tool.

Geographical information systems

GIS, already discussed at Section 2.x, can be used for impact prediction as well as description. For instance GIS can be used to:

- generate overlay maps to illustrate the spatial coincidence of environmental features
- generate basic spatial measurements (distance, area, length) and statistics relating to attributes contained in the database
- construction buffer zones around features
- identify viewing areas from a point
- 'clip' data from one map into another map
- interpolate between values from existing monitoring points to generate a continuous surface or contour map
- perform “map algebra” to identify areas that satisfy a series of predetermined rules (e.g. all areas that are within 2km of a town and more than 5km from a designated conservation area)

- implement a spatial version of multi-criteria analysis by weighting the relative importance of different criteria
- generate maps that show topography and act as a base for 'virtual' models of the landscape (Therivel and Wood, 2004).

GIS has the *advantage* of presenting data in an accessible, visual manner, and of dealing well with spatial data. As such, it is particularly useful for public participation. It can identify constraints; simulate scenarios; and can act as a platform to draw together data from other tools (e.g. models, impact matrices, multi-criteria analysis).

GIS has the *disadvantage* of requiring much data and specialist knowledge. If the data are not readily available in a GIS compatible format, a GIS database must be built up. Data must be kept up to date, which is particularly difficult for some criteria (e.g. developed land, coastlines). GIS often represents things that are fuzzy on the ground – for instance soil types or ecosystems – as being inaccurately distinct, and is only as accurate as the least detailed data in it. Most importantly, GIS only works for issues that have a spatial expression, and does not deal with issues that change over time or indirect impacts.

Models and systems analysis

Models quantify the cause-effect relationships leading to impacts. They typically take the form of algorithms or mathematical equations that describe the interactions between different system components. Given inputs like the time frame, spatial boundary, starting environment and action, models typically predict what the final outcome/impact will be. For instance, given an air pollutant, prevailing wind directions, height of chimney stack etc., a model could predict the height and location of air pollution plumes. This allows users to test scenarios that make assumptions about future circumstances, for instance different levels of economic growth, new technologies, or use of resources.

Models may typically:
- interpolate data about one action based on information about other existing actions;
- extrapolate (using trend analysis) from current impacts and trends into the future;
- use resource balance accounting to analyse the sources, flows and sinks of resources such as water or energy (Box 3.5 gives an example);

Box 3.5
The **Stockholm Environment Institute's Water Evaluation and Planning System** (tool 61) models water flows at the regional and local level:

"Operating on the basic principle of water balance accounting, [the Water Evaluation and Planning System] is applicable to municipal and agricultural systems, single subbasins or complex river systems… The analyst represents the system in terms of its various supply sources (e.g. rivers, cre groundwater, reservoirs); withdrawal, transmission and wastewater treatment facilities; ecosystem requirements; water demand and pollution generation…

WEAP applications generally include several steps. The study definition sets up the time frame, spa boundary, system components and configuration of the problem. The Current Accounts provide a snapshot of actual water demands, pollution loads, resources and supplies for the system. Alternati sets of future assumptions are based on policies, costs, technological development and other factors that affect demand, pollution, supply and hydrology. Scenarios are constructed consisting of alterna sets of assumptions or policies. Funally, the scenarios are evaluated with regard to water sufficienc costs and benefits, compatibility with environmental targets, and sensitivity to uncertainty in key variables."

Typically models are computerised, with a user-friendly(ish) interface, "black box" algorithms, and a manual that explains the model. Some models allow fine-tuning or adaptation of the black box.

Examples of models include:

- Envest (tool 59), BRE-designed software which predicts, based on input building design (height of building, window area etc.) the impact of the building's material use, heating, cooling and operation. Impacts include climate change, acid deposition, water extraction and water pollution.
- Long-Range Energy Alternatives Planning system (LEAP, tool 59), which models how energy is consumed, converted and produced in a given region or economy under a range of alternative assumptions about population, economic development, technology etc.
- The Building Life Cycle Cost (tool 56) and P2/FINANCE (tool 64), which provide an economic analysis of proposed capital investments to buildings or buildings systems, incorporating environmental costs and benefits. They calculate lowest life-cycle costs, net savings, savings-to-investment ratios and payback periods. They allow a calculation, for instance, of whether building improvements will reduce energy use and thus energy costs.
- PoleStar (tool 63), which models environmental pressures based on assumptions about future scenarios. The user enters hypothetical data about households, transport, industry etc.; the model calculates resource (energy, minerals, land, water), and pollution (air, toxics, solid waste, water) implications according to scenarios developed by the user.

Typically the models have a narrow remit (e.g. waste or energy) and deal with quantifiable environmental and/or economic impacts.

Systems analysis tools are essentially causal network diagrams with models integrated into the arrows, and with the possibility of feedback loops. They allow complex systems to be modelled: for instance the link between demand for resources (which could be specified by the user) through to sustainability impacts. Users can generally model different scenarios by inputting start data and watching its conversion into outcomes (a bit like the "Sim City" computer game). Systems analysis tools may include components that represent government policies, social values and fads.

Examples include:

- ISCAM (tool 10), QUEST (tool 22) and SPARTACUS (tool 76) which model and forecast – given initial inputs about human actions and policy and economic scenarios – how these affect the infrastructure, development and then environment at a city or regional scale;
- the European Commission's (2004) project MOLAND (Monitoring land cover / land use dynamics), which carries out a similar process using points on a GIS map as the basis for "transition rules" which quantify how a cell is affected by its neighbours, to model the implications of various policy changes over time e.g. the effect of altering transport networks or adjusting policy areas; and
- "Simulating Society" (tool 19) which models more general human interactions.

Models and systems analysis tools have the *advantage* of being able to compare scenarios and alternatives; produce quantitative data, which often provides a more robust base for decision-making than the more qualitative data that result from matrices, flowcharts and GIS. where the models result in economic data this can be used on a par with the results of cost-benefit assessment.

However models have the *limitation* of requiring much data, time and thus cost. Some of the systems analysis tools we reviewed, in particular, were so time and labour intensive as to be virtually unusable. A model that works well in one situation may not work well in another one and so may require calibration and adjustment. Outputs can create an

impression of greater certainty than is really possible. Models often act as a black box: in particular they can "hide" uncertainties and problems with the input data. Models are generally not transparent or user-friendly. They generally deal only with hard quantitative data, so they can cover SOME environmental (e.g. water, energy) and economic aspects but not social or other environmental (e.g. landscape, biodiversity) aspects. As such, it is pretty well impossible to have "sustainability" models.

The table below summarises aspects of the prediction tools not shown earlier.

	matrix/ checklist	**network analysis**	**resource based accounting**	**GIS**	**model/ systems analysis**
issues covered	all	all	those that involve resources and can be quantified	those that can be mapped	those that can be quantified, primarily environment , transport, local economy, health
data used	all	all	'hard' quantitative	'hard' and 'soft' quantitative	'hard' quantitative
reductionist?	no: multicriteria	no: multicriteria	yes: non-monetised, sometimes monetised	no: multicriteria	yes: non-monetised, sometimes monetised
skills needed	expert and non-expert based	expert and non-expert based	expert based	expert based	expert based
output	explicit	explicit	reasonably explicit	explicit or black box	black box
cost/time	cost low, time input low	cost low, time input low	cost high, time input high	cost high, time input high	cost high, time input high

Tools assessed in this category:

Number (from App. A)	Name
10	ISCAM
19	Simulating Society
22	QUEST
38	Equity mapping
53	Multi-scale integrated analysis of sustainability
55	Whole Life Costing
56	Building Life Cycle Cost
57	Building for Environmental and Economic Sustainability
58	Life cycle assessment: Sima Pro 5
59	ENVEST
60	Long-Range Energy Alternatives Planning System
61	Water Evaluation and Planning System
62	Waste Plan
63	PoleStar
64	P2/FINANCE
65	E2/FINANCE
66	EXMOD
67	EXMOBILE
76	SPARTACUS
77	Green Building Tool

Economics for the Environment (1999) *Review of Technical Guidance on Environmental Appraisal*, report to the DETR, www.defra.gov.uk/environment/economics/rtgea.

European Environment Agency (1998) Spatial and Ecological Assessment of the TEN: Demonstration of Indicators and GIS Methods, Environmental Issues Series No 11, Copenhagen, http://reports.eea.eu.int/GH-15-98-318-EN-C/en/seaoften.pdf.

European Commission Institute for Environment and Sustainability (2004) MOLAND (Monitoring land cover / land use dynamics), http://moland.jrc.it

Rodriguez-Bachiller A (2004) Expert Systems and Geographic Information Systems for Impact Assessment. Taylor & Francis, London

Therivel (2004) *Strategic environmental assessment in action*, Earthscan, London.

Note: This list is indicative rather than exhaustive.

3.5 Evaluating sustainability status and impacts

Applies to	Scale	international	national/ regional	local	site
	Stage	planning	implementation/ operation	monitoring	
	Sector	public	private		
Data/ indicators	issues covered	neighbourhood	environment	transport	health
		education	local economy	crime	participation and lifestyle
	data used	Depends on tool and application			
Analysis	reductionist?	yes: monetised	yes: non-monetised	no: multicriteria	
	used to:	Describe current status	predict future status	aid decision-making	analyse complex situations
	comparative	Comparative re. other sites etc.	non-comparative		
	skills needed	Depends on tool and application			
	output	black box	explicit, transparent		
Cost/time		Depends on tool and application			

Summary of approach

Evaluation involves judgement: the key to evaluating sustainability is establishing a basis by which to assess the relevance, importance or relative significance of particular sustainability impacts, status or changes. Evaluation tools seek to provide meaning to otherwise often abstract sustainability scores, measures and outcomes. What does an indicator result mean in practice? What level or form of emission, pollution or change in social fabric is significant and why? What outcome is desirable and how should choices between conflicting options be made? Evaluation tools (or elements of tools which deal with evaluation) seek to provide a structure to form solutions to these problems. They provide a common scale or an agreed measure to assess change against.

In practice evaluation is about establishing a meaningful framework or set of agreed boundaries in which to place the outcomes of descriptive tools, predictive modelling and the results of behaviour, technology or process changes. In general evaluative tools seek to establish agreed objectives or acceptable levels of particular issues and then provide a methodological framework which users can apply to any particular situation in order to evaluate specific outcomes.

The tools/elements analysed in more detail here are:

- Checklists and score cards as evaluative tools
- Benchmarking or targets
- Stakeholder participation as a form of evaluation
- Weighting and multi-criteria analysis
- Equity assessment

Many of the tools reviewed under this section are also discussed in other sections. Tools focused on description and modification essentially seek to simply measure historic levels of a particular issue, and predictive assessment simply transposes such measurements into the future based on assumptions of change. However evaluative tools seek to put such measurements in a particular context and provide the means to make structured value judgements between outcomes. In this section we highlight specific evaluation techniques, however in practice there may well be some form of evaluation (or at least value-laden judgement) in most social sustainability tools.

Testing against a checklist or score cards

Checklists and score cards are a well developed and used method of encouraging sustainability thinking and ensuring social, environmental or economic priorities are accounted for in project proposals or programmes. They literally ‘check’ that a proposal or project meets previously defined, or ideal characteristics.

Checklists tend to include detailed information on criteria, or things to look out for and consider during the planning phase of a project. Typically constructed by councils or other authorities in the UK, but also used in the commercial sector as part of corporate social or sustainability policy. They often also provide a ‘score’ which is based on the performance of a project, community, proposal or policy against the criteria included in the checklist. In theory this can enable comparison from a sustainability perspective of e.g. different policy options or construction methods. It is in this way that checklists form an evaluative framework.

Existing checklists and score cards cover:

- policy impacts on communities (Rural Proofing, tool 70; see Box 3.6)
- social and spiritual elements (Community Sustainability Assessment, tool 42; see Box 3.7)

Box 3.6

The **Rural Proofing Checklist** (tool 70) written and compiled by the Countryside Agency is one of the more high profile and most widely used checklists in the UK as it is linked directly to UK Government policy and is a mandatory part of the policy process. It represents a commitment by Government to ensure that all its domestic policies take account of rural circumstances and needs (Rural White Paper, 2000).

The checklist provides a framework that allows policy makers to systematically consider, as policies are developed:

- whether their policy is likely to have a different impact in rural areas, because of particular rural circumstances or needs
- proper assessment of those impacts
- if these are likely to be significant, adjust the policy, where appropriate, with solutions to meet rural needs and circumstances

Example questions are shown below.

Rural Proofing applies to all policies, programmes and initiatives and it applies to both design and delivery stages.

It also has a reporting requirement. Government Departments and Government Offices for the Regions are required to report annually on how their policies have been rural proofed. The Countryside Agency also publishes an annual assessment of the rural proofing of central Departments and Government Offices for the Regions.

The rural proofing checklist

Consider all the questions below to help establish whether your initiative is likely to encounter the challenges presented by rural circumstances. Some potential solutions are indicated to help you consider appropriate adjustments.

1. **Will the policy affect the availability of public and private services?** Might it encourage closure or centralisation and will this have a disproportionate effect in rural areas where services are already limited? How will it affect the Rural Services Standards for key services published in the Rural White Paper (and updated in August 2002)?
   Rural solutions: improve transport/accessibility to compensate for the centralisation of services; encourage alternative funding streams for threatened rural services; provide additional funding to rural outlets to maintain service standards.
2. **Is the policy to be delivered through existing service outlets, such as schools, banks and GP surgeries?** How will you ensure rural residents can access services in areas where outlets are few and far between?
   Rural solutions: use mobile and outreach services; use ICT to avoid the need to visit outlets; share premises or staff with other service providers to maintain or create a rural outlet ('joint provision').
3. **Will the cost of delivery be higher in rural areas where clients are more widely dispersed or economies of scale are harder to achieve?** Will longer travel times or distances to clients add to the cost of service provision? Will services need to be run out of smaller outlets, so losing economies of scale?
   Rural solutions: allow for higher unit delivery costs in funding formulae (eg. a 'sparsity' factor) or when specifying cost-efficiency criteria; encourage joint provision to reduce costs.

Box 3.7
Checklist example from Community Sustainability Assessment

SOCIAL CHECKLIST 1

1. Openness, Trust & Safety; Communal Space

A. The extent to which there is a basic sense of safety and trust within the community:

☐ mostly (6) ☐ some (3) ☐ little (0) ☐ not at all (-1)

B. The extent to which the community is a safe environment for women:

☐ completely (6) ☐ mostly (3) ☐ sometimes (0) ☐ not at all (-1)

C. The extent to which the community is a safe environment for children:

☐ completely (6) ☐ mostly (3) ☐ sometimes (0) ☐ not at all (-1)

D. The extent to which people in the community know and relate supportively with their neighbors:

☐ almost always (6) ☐ often (3) ☐ sometimes (0) ☐ not at all (-1)

E. Adult crimes in the community are best described as:

☐ rare (6) ☐ occasional (3) ☐ frequent (-3) ☐ constant (-5)

F. Juvenile crimes in the community are best described as:

☐ rare (6) ☐ occasional (3) ☐ frequent (-3) ☐ constant (-5)

G. Indoor spaces available for communal gatherings and activities are:

☐ excellent (6) ☐ adequate (3) ☐ minimal (1) ☐ inadequate/none (0)

H. Outdoor spaces available for communal gatherings and activities are:

☐ excellent (6) ☐ adequate (3) ☐ minimal (1) ☐ inadequate/none (0)

I. Places available for youth gatherings and wholesome activities are:

☐ excellent (6) ☐ adequate (3) ☐ minimal (1) ☐ inadequate/none (0)

J. The frequency of social gatherings for the whole community: Check as many as apply -

☐ Daily (7) ☐ Weekly (5) ☐ Monthly (3) ☐ Seasonally (2) ☐ Annually (1) ☐ Rarely (-1)

Add up the numbers in parentheses behind each item above that you checked.

1. Openness, Trust & Safety; Communal Space Total: _____

50+	**Indicates excellent progress toward sustainability**
25-49	**Indicates a good start toward sustainability**
0-24	**Indicates actions are needed to undertake sustainability**

Comments:

- more technical site or building assessments where physical sustainability issues are addresses (LEED, tool 74)
- project or site safety during construction (Rethinking Construction, tool 4).

They can be designed to reflect various organisational (commercial, corporate, public etc.) and focal viewpoints (construction, policy setting, planning, biodiversity, community etc.).

Equally varied is the range of approaches to presentation and use. Checklists vary from a very simple list of questions that should be asked (such as the Network 21 checklist or Rural Proofing, tool 70) to hyper-linked windows based programs which lead the user through a series of criteria with links to case studies, advice, and guidance on how sustainability issues can be included in a range of projects (SEEDA Sustainability Checklist).

Sustainability checklists and score cards have the *advantage* of being simple and quick to use. They require little quantification or expertise in application and can cover a broad range of sustainability issues. They are a tried and tested method, well understood by users, and can produce results generally easily translated into policy / project modifications or translated into communicable format for dissemination. Due to their relative simplicity and usability, they may be more accepted and therefore adopted into standard procedures than more complex tools and techniques. This also makes checklists popular for corporate sustainability monitoring.

Checklists have some *limitations*. They may be ambiguous: for instance, answering questions such as 'does the project have a significant impact on people's travel needs?' may appear relatively simple, but such a question could be interpreted in various ways, and thus the user's perceptions (and potentially business or policy preferences) may affect results. Different issues may have greater significance in particular circumstances and thus weighting of scores may be appropriate in some cases but less so in others: incorrectly set weightings (or no weightings) may make checklist ranking / scoring essentially arbitrary.

Checklists are almost exclusively a qualitative approach (though quantitative elements can be introduced). This means that more technical issues (such as noise, emissions etc.) may be sidelined or overlooked.

<u>Testing against benchmarks or targets</u>
Benchmarking involves setting targets, generally based on success or achievements in the same field or issue elsewhere to evaluate the relative performance of a particular action. Establishing average and best practice performance, based either on real data or on results produced through technical analysis, permits a range to be identified, and an externally oriented performance spectrum created. Though benchmarking does not necessarily have to relate to sustainability, in recent years it has become increasingly associated with it.

Benchmarking, in setting 'objective' levels of performance, can give a clear target than simply stating a direction of change, and in doing so can be more persuasive. Benchmarks enable users to see instantly how their project or process is performing against an agreed standard or level, against the existing performance of others working in a particular sector, or against best practice. In so doing, they "make people aware of improvements that are orders of magnitude beyond what they would have thought possible". (Benchmarking paper, tool 40).

Benchmarks have the advantage of providing a clear and motivational structure against which to evaluate performance. Where they use standards, they allow users to determine

how well they are doing objectively; where they use other organisations as the benchmark, the allow users to assess how they are doing compared to their "peers". In a commercial climate, benchmarking may also provide a strong motivational factor as an organisation or construction project seeks to be competitive against sustainability criteria benchmarks.

However benchmarking has *limitations*. Sustainability is a multi-faceted goal, and one where interactions and links between issues and outcomes are sometimes crucial. Benchmarking may in some cases over-simplify evaluation. Providing meaningful benchmarks for social issues is also much more difficult than for environmental and economic ones.

Testing against stakeholder opinions

Stakeholder participation is a broad approach to involving people in decisions and understanding their needs, aspirations, desires and roles in the process of policy, development or change. This is significantly different in approach to more technical or data dependent assessment methods such as indicators or computer based input-output models. Stakeholder participation is also reviewed in Section 4.3, but this section focuses on its evaluative aspects.

Information gathered through qualitative questionnaires can form an important input to evaluate predicted and existing impacts. By involving those affected, and understanding their needs and through this evaluating likely responses, project or policy outcomes are far more likely to succeed and be sustainable from a social perspective.

Weighting and multi-criteria analyses (MCA)

Weighting and MCA analyse and compare how well different alternatives achieve different objectives, and identify a preferred alternative.

Weighting involves reflecting a subject's importance by giving it additional "weight" in decision-making. For instance, noise may have been identified in the SEA baseline stage as being much more important than air pollution and landscape: it could be given a weighting of, say, 3 compared to the other weightings of 1. Weighting would normally be carried out by a panel of experts or public participation.

MCA involves choosing relevant assessment criteria/impacts and alternatives; scoring how each alternative affects each criterion; assigning a weight (value of importance) to the impact; and aggregating the score and weight of each alternative. The scores and weightings are then multiplied and the results added up for each alternative. The alternative that scores most highly ‘wins’. Box 3.8 shows a hypothetical example of this. In Box 3.8, alternative B ‘wins’; despite very good scores for air and landscape, alternative D comes out poorly because of the significance of the noise criterion.

Weighting and MCA have the *advantage* of reflecting the fact that some issues ‘matter’ more than others. They are simple and intuitive, and can be used in a variety of settings, including public participation. MCA can compare alternatives, and can be used with both quantifiable and unquantifiable data.

MCA has the *limitation* that it can be used to ‘twist’ data through the choice of indicators and weightings. It can lead to very different results depending on who establishes the weightings and scoring systems. It also generally does not cope well with irreversible/critical limits: ‘show stoppers’ which mean that no matter how important other aspects are, they cannot outweigh the adverse implications of one factor.

Box 3.8
Ranking of alternatives based on weighted scores (based on Therivel 2004)

Criterion	**Weight** (w)	**Alternative**							
		A		B		C		D	
		score (a)	a x w	a	a x w	a	a x w	a	a x w
Noise	3	0	0	+1	+3	-2	-6	-3	-9
Landscape	1	+2	2	-2	-2	+1	+1	+2	+2
Biodiversity	1	-2	-2	0	0	0	0	+3	+3
Total			0		+1		-5		-4

Testing for equity: equity assessment

Equity assessment tests whether the action has an equal (or equality-promoting) impact among and between for example different racial, social and religious groups. It could ask:

- whether any groups are currently being discriminated against, to set a context for future actions (e.g. Box 3.9), or
- whether a proposed action is likely to affect any group more than other groups (e.g. Box 3.10).

Box 3.9

Equity mapping (tool 38) was used by Los Angeles's Sustainable Cities Programme. Maps showing an 0.25 mile buffer zone from parks were superimposed on maps showing the racial characteristics of the local resident population, and analyses were carried out of the number of park acres per 1000 African American, Latino, White and Asian population. This showed serious differences between the races in terms of access to parks: for instance white were shown to have 100 times better access than Latinos.

Box 3.10

Section 75 of the Northern Ireland Act 1998 (tool 68) requires government departments to have due regard to the need to promote equality of opportunity between:

- Persons of different religious belief, political opinion, racial group, age, marital status or sexual orientation;
- Men and women generally;
- Persons with dependants and persons without.

The process to ensure this involves consideration of available data and research, assessment of impacts, mitigation measures, consultation, decisions, publication, monitoring. Thus a method is defined which considers different aspects of equality (religious equality being particularly important in Northern Ireland).

An important sub-sector (in the context of development projects) of this approach is gender analysis. Gender analysis follows largely the same process of engagement and information gathering, but focuses on the differentiated needs and roles of women and men. In doing this, gender analysis allows detailed, informed evaluation of how these groups and their social 'norms' might be affected by actions. It in essence defines a

process for assessing and evaluating the roles of men and women. In its evaluative phase it can have an important role in sustainability prediction – what will impacts be? Who will be affected and how?

Equity assessment has the *advantage* of dealing with a cross-cutting issue that is poorly covered b other sustainability tools. In particular it focuses on intra-generational equity, which is a key component of sustainability. In doing so, it can highlight the effects of multiple impacts on specific social groups. For instance,

> "*Most of the negative effects of increased traffic and car use most heavily impact on those same groups that benefit least from the present transport system... As well as the disproportionate impact of traffic accidents on children and pensioners, higher number of lower socio-economic groups are killed or injured on the road as a consequence of greater exposure to risk. Low income groups are more likely to live on or near main roads; they are more likely to walk or cycle, while the lack of gardens means children playing near busy main roads... lower income households tend to bear a greater share of external accident risk, air pollution and noise costs*" (Lucas and Simpson, 2000).

Depending on how it is carried, out, equity assessment can also act as an educational as well as an evaluative tool.

However it is *limited* in that it only deals with one aspect of sustainability. Choosing the groups to assess for could be problematic. The assessment may end up being so generic and "politically correct" that it covers every group – people with brown, blond, auburn and no hair, people with long v. short hair etc. – that it loses track of key impacts.

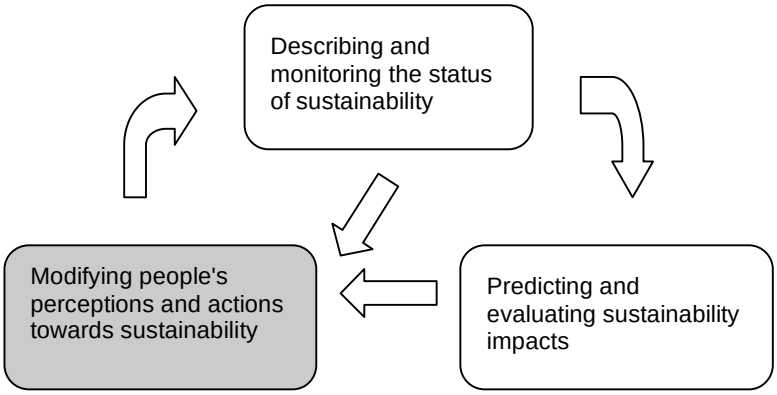
Tools assessed in this category:

Number (from App. A)	Name
4	Rethinking Construction
8 / 48	GRI Reporting Framework
11	"Community capacity assessment" re. riparian issues
21	Sustainability Balanced Scorecard (SBSC)
23	LASALA
25	POET
29	Quality of Life Assessment
32	Navigating Gender
33	Gender Analysis Matrix
38	Equity mapping
40	Bench-marking
50	Project innovation matrix
68	NI equality impact assessment
70	"rural proofing"
74	LEED

Note: This list is indicative rather than exhaustive.

CHAPTER 4
MODIFYING PEOPLE'S PERCEPTIONS AND ACTIONS TOWARDS SUSTAINABILITY

4.1 Introduction



As opposed to the tools considered in Chapters 2 (description) and 3 (prediction and evaluation), modification tools seek to directly influence the decision making process. Such tools aim to change the way an action is developed and managed. This is sought either through modified resource and technology choices, process change (such as manufacturing or employee rights) and/or accounting for stakeholder needs, aspirations and historical or cultural background. Tools in these clusters thus seek to achieve sustainable development outcomes by bringing about significant change in the 'way things are done'.

This influencing role is represented by a number of methodological approaches, however they can be grouped for analysis into:

- Changing how the public act or perceive an issue: participation and stakeholder involvement
- Changing how economic decisions are made: cost analysis and accounting
- Changing how companies act: corporate social responsibility.

Inevitably overlaps exist between these clusters, and between the tools discussed in this and other chapters. However these tools are distinct in that they all focus primarily on change.

4.2 Overview and highlights

Quite specific tools have been developed to modify the views and actions of three main groups towards sustainability: the public, accountants and companies. There are few overlaps between these tools. Tools that educate the public involve much interaction; those for accountants focus on economic costs and benefits; those for companies focus on gradual improvement, reporting and (indirectly) marketing. The key common theme is "fitness for purpose": the tools must speak the right language to reach their audience.

For the *public*, understanding the social context to a proposed action provides invaluable information on its likely impacts and helps to ensure its effective implementation. The qualitative and multi-criteria nature of such information is likely to be particularly relevant for large construction projects which tend to have significant impacts on communities, and which have traditionally relied on more expert-driven analytical approaches. More generally, tools like gender analyses and other equity analyses can be used to inform communities and possibly change their behaviour.

For *accountants*, data on the economic benefits of acting in a sustainable manner are likely to be persuasive in encouraging a move to more sustainable technologies or processes. A typical tool in this category would provide information about the medium-term savings in energy costs versus the short-term costs of installing energy-saving equipment.

Corporate Social Responsibility and Sustainability Reporting has become an increasingly popular means for *multinational corporations* to assess, report on and if necessary modify their procedures and practices based on agreed standards and guidelines. Many of these tools allow corporate users much flexibility: for instance, reporting is often voluntary. This may facilitate greater take up, but may end up being so weak that it is used more for marketing actions already taken by the company than to change the company's actions.

4.3 Changing how the public act or perceive an issue: participation and stakeholder involvement

Applies to	Scale	international	national/ regional	local	site
	Stage	planning	implementation/ operation	monitoring	
	Sector	public	private		
Data/ indicators	issues covered	neighbourhood	environment	transport	health
		education	local economy	crime	participation and lifestyle
	data used	'hard' quantitative	'soft' quantitative	qualitative	
Analysis	reductionist?	yes: monetised	yes: non-monetised	no: multicriteria	
	used to:	Describe current status	predict future status	aid decision-making	analyse complex situations
	comparative	Comparative re. other sites etc.	non-comparative		
	skills needed	expert-based	non-expert based		
	output	black box	explicit, transparent		
Cost/time		cost high	cost low	time input high	time input low

Summary of approach

Stakeholder engagement and participation is a broad approach to involving people in decisions and understanding their needs, aspirations, desires and roles in the process of policy, development or change. Stakeholder engagement tends to involve a combination of questionnaires and interviews, supplemented by focus groups and meetings. This enables decision-makers to understand community characteristics, explore future development options with those who will be affected by them, and provide information on the background to a project or policy.

An important sub-sector (in the context of development projects) of this approach is gender analysis, already discussed at Section 3.5. Gender analysis follows largely the same process of engagement and information gathering, but focuses on the differentiated needs and roles of women and men.

Information gathered in this manner can form an important resource to facilitate improved decision making and lead to changes in planning and project management. By involving those affected, and understanding both their needs and likely responses project or policy outcomes are far more likely to succeed and be sustainable from a social perspective.

How does it work in practice?

The stakeholder participation and engagement methodologies and examples reviewed cover a broad range of approaches to gathering information at a variety of social levels and on a broad multi-criteria range of issues. Most take the form of guidelines providing detailed guidance on how to co-ordinate fieldwork and identify which groups to talk with and interview, along with example questionnaires and checklists. Information gathered from questionnaires is typically gathered into a matrix based presentation format for ease of assessment such as the one at Box 4.1. However common to all are the use of questionnaires and the active engagement with individuals or groups affected by a project.

Box 4.1 Example matrix for gathering stakeholder information

Stakeholder categories	Relevant stakeholders	Characteristics Social situation, location, size, organizational capability	Interests Commitment to status quo vs. openness to change	Influence H=High, M=Medium, L=Low
Government policymakers				
Implementing agency staffs				
Intended beneficiaries				
Adversely affected persons				
Organized interest groups (business associations, trade unions)				
Civil society (NGOs, CBOs, religious organizations)				
Donors				
Other external / international stakeholders				

Typically researchers will gather information at the household and community group level. This is the case with the social capital assessment tools (tools 2/16/17), beneficiary assessment (tool 14), participatory impact monitoring (tool 24), community profiling (tool 30), and social audits and analysis (tools 37 and 52). However, a similar approach can be used to assess organisational health and status through participatory self-assessment (tool 25). Figure 4.2 shows a typical assessment framework.

Advantages and limitations

Stakeholder participation has the *advantages* of:

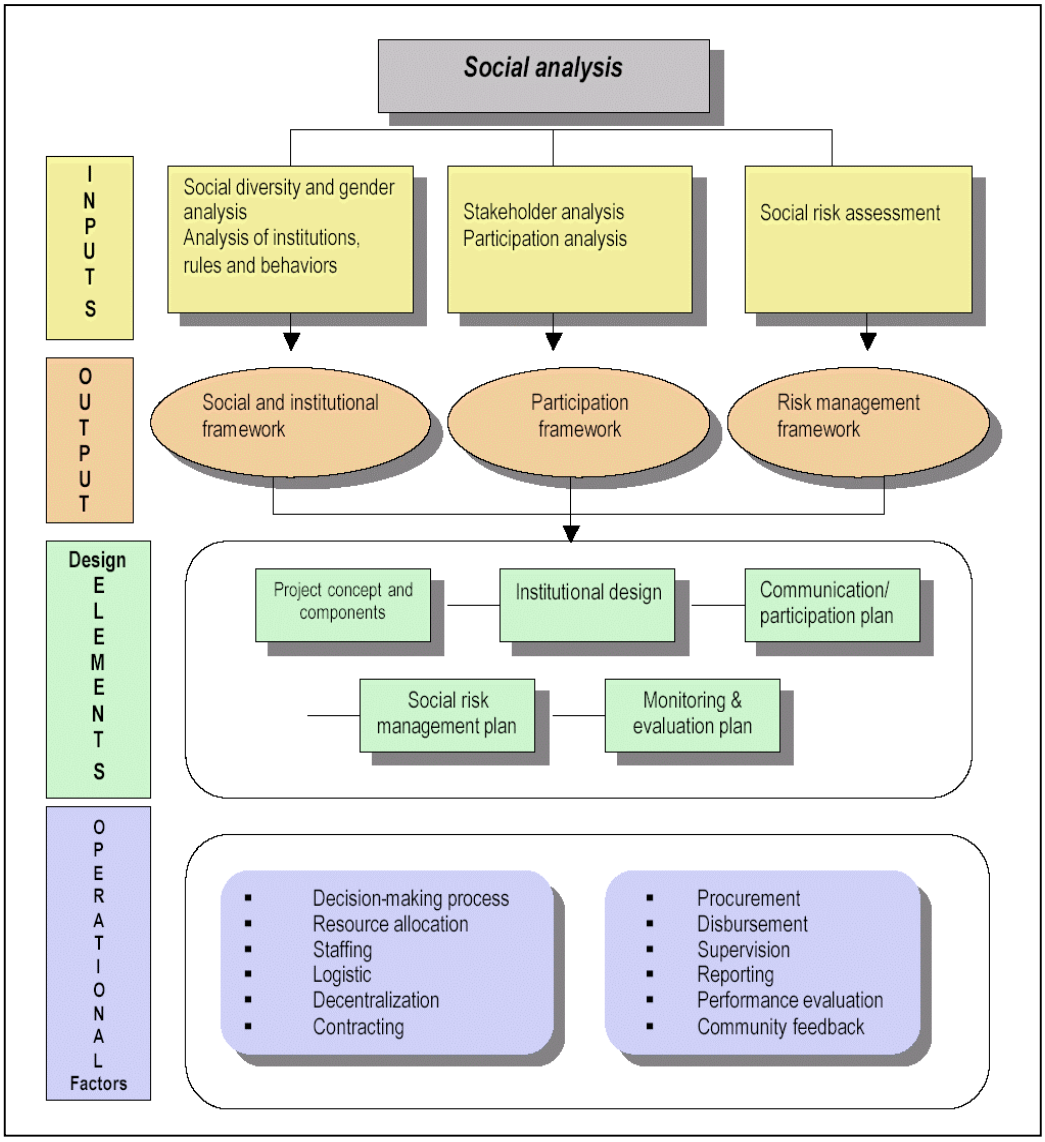
- Promoting participation, which is one of the key aspects of sustainable development;
- Allowing a detailed picture to emerge of communities with respect to constraints, opportunities and likely social impacts;
- Facilitating and encouraging communication between those proposing a project or policy and groups affected by it. This can be particularly relevant in construction projects / developments as their impacts tend to be physical and often large scale, with significant effect on people.
- Focusing decision-making on the needs of communities.

Box 4.2

International development organisations are leading the use and application of structured stakeholder engagement and participation methodologies. Organisations such as the World Bank have produced numerous case studies, worked examples and source books, such as the **World Bank Social Analysis Source Book** (tool 52).

> *"Economic growth is more likely to reduce poverty when development is equitable and sustainable. Since poverty is multi-dimensional, equitable and sustainable development entails measures that strengthen inclusion, empowerment and/or security outcomes to sustain the gains of economic development. Social analysis enables the [World] Bank to assess whether a proposed program or operation is likely to meet its social development objectives and to recommend measures to help meet them."* (World Bank Social Analysis Sourcebook, Social Development Department, World Bank, 2002)

The figure below gives the World Bank's framework for social analysis.



It has the limitations of:

- Being labour and time intensive. Questionnaires in particular tend to be very long and detailed. To be conducted thoroughly this method can be very time consuming, and requires a motivated team of trained or experienced interviewers and facilitators. This clearly has related cost implications and may make this approach too slow and costly to be applicable in broader contexts. Checklists or questionnaires must be applicable and focussed.
- They have generally only been applied in developing country contexts. While consultation and stakeholder engagement is a recognised (and legally required in many circumstances) element in much construction planning and policy making in the UK context, all of the examples of established models / guidelines reviewed come from a developing country context.
- The results produced from stakeholder engagement require assessment themselves – and decisions made remain rooted in judgement and interpretation.
- Stakeholders and participants in questionnaires may be aware of the potential influence their responses can have on a project – and thus manipulation of the process is possible (for example) where stakeholders form co-ordinated groups.

Tools assessed in this category:

Number (from App. A)	Name
2/16/17	Social capital assessment tool (SOCAT)
14	Beneficiary assessment
24	Participatory Impact Monitoring (PIM)
25	Participatory Organisational Evaluation Tool (POET)
26	Tree maps
28	Gender analysis tool
30	Community profile
31	Participatory and Integrated Development (PIDEP)
32	Navigating gender
33	Gender analysis matrix
37	Social audit
52	Social analysis

Note: This list is indicative rather than exhaustive.

4.4 Changing how economic decisions are made: cost analysis and accounting

Applies to	Scale	international	national/ regional	local	site
	Stage	planning	implementation/ operation	monitoring	
	Sector	public	private		
Data/ indicators	issues covered	neighbourhood	environment	transport	health
		education	local economy	crime	participation and lifestyle
	data used	'hard' quantitative	'soft' quantitative	qualitative	
Analysis	reductionist?	yes: monetised	yes: non-monetised	no: multicriteria	
	used to:	Describe current status	predict future status	aid decision-making	analyse complex situations
	comparative	Comparative re. other sites etc.	non-comparative	Depending on tool	
	skills needed	expert-based	non-expert based		
	output	black box	explicit, transparent	Depending on tool	
Cost/time		cost high	cost low	time input high	time input low

Summary of approach

Accounting and cost analysis tools encompass a number of different approaches that include the economic (monetary) costs and benefits of environmental and social issues in decision-making. They seek to establish and advocate the economic benefits of choosing more sustainable options (be it through the adoption more efficient technologies, or company revenue and marketing benefits).

This section discusses two distinct types of tools. Cost analyses highlight cost saving and environmental benefits or implications over a particular management or time period of different technology choices. Accounting tools such as eco-efficiency analysis and Activities Based Costing accounting make explicit reference to sustainability issues, normally in the form of environmental resource use.

As these tools and methods focus on cost implications, they are in essence abstracted from social elements and there is in general little assessment of social costs, partly because these costs are very difficult to quantify. However as environmental costs (such as pollution or noise) do impact directly on people and communities, and as such these tools are included in our analysis.

Due to the technical nature of much of the literature and methodology relating to accounting, a detailed review has not been possible. Rather we have concentrated on drawing broad practical conclusions from the information available.

How does it work in practice?

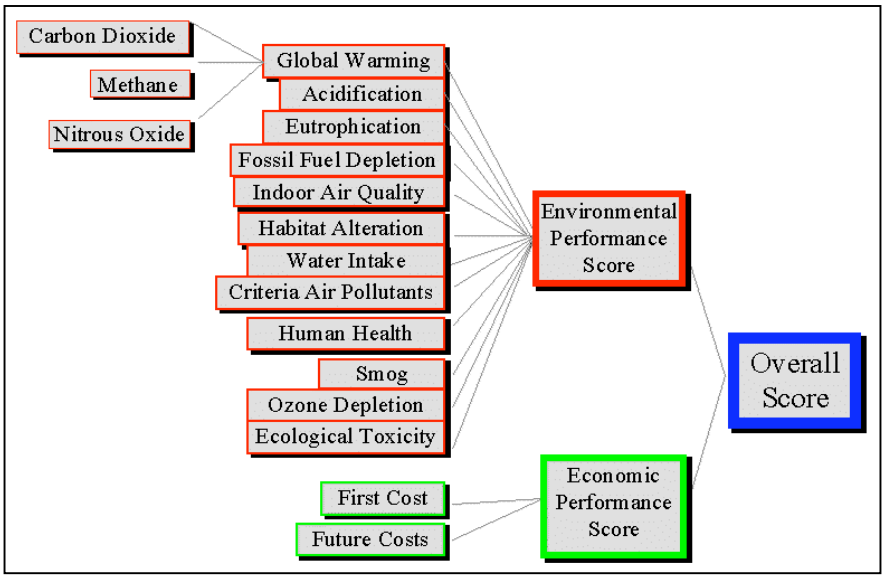
Cost analysis tools allow users to calculate the cost implications over a period of time of making different technology choices or investments. The tools reviewed are typically software-based tools which enable users to explore the cost implications of various investment or technology decisions. They tend to use agreed environmental performance standards (such as ISO14000) and apply a relatively detailed life cycle analysis of different technology choices. They allow decision-makers to view outcomes of potential choices in a 'virtual' manner in order to improve decision making and account for longer term sustainability or cost benefits which may not be immediately visible.

For example BEES and Building Life Cycle Cost (tools 56 and 57) are free to download software tools which seek to encourage users to select cost-effective, environmentally preferable building products. The BEES software is supported by and has the endorsement of the US EPA Environmentally Preferable Purchasing Program. Box 4.3 shows the type of elements included in the BEES tool. Box 4.4 shows an example output page from BEES.

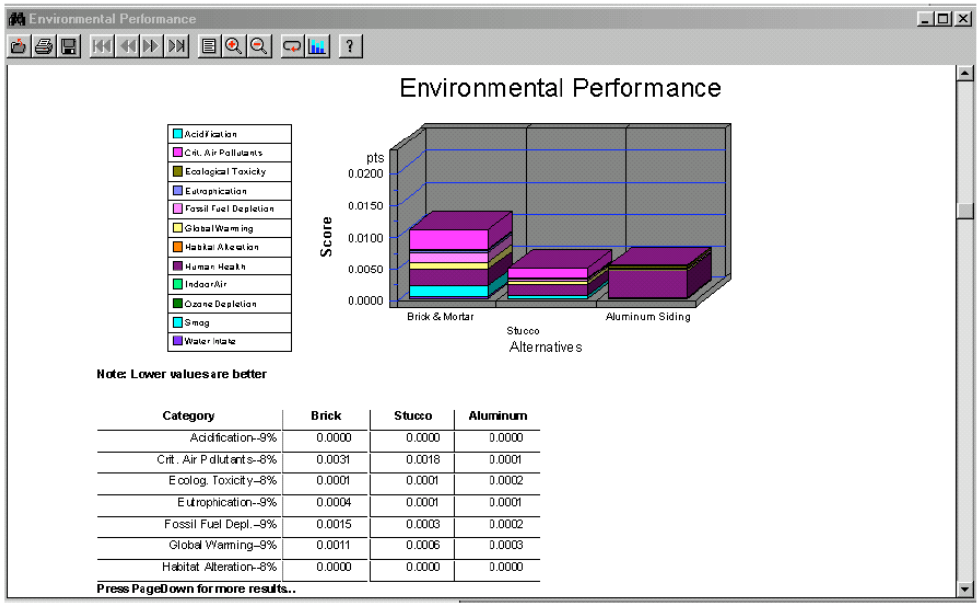
Accounting tools focus on broadening technical accounting practices to include sustainability issues. This is a relatively new field, but the aim of these methods is to provide managers with information on the cost implications of different business practices. Some element of continued business growth is considered vital for most companies, and this has led to some conflict with sustainability accounting. Some businesses have adopted the term 'sustainable growth' as a blanket term, essentially encompassing the aim of increasing turnover and expanding (for example to new markets) but doing so with reduced environmental and social impact.

There are several different ways of compiling company / project accounts that take more or less account of environmental, social (including employee health and safety) and long-term economic issues. Some tools (e.g. GEMI) treat environmental and social aspects as being important components of the business 'bottom line', and promote increased revenue through sustainability related marketing opportunities and focussed response to public perceptions and desires. Activity Based Costing aims to allow managers to see, and thus respond to, resource implications of different production processes or business activities.

Box 4.3
Elements included in BEES



Box 4.4
Example result output from BEES



Advantages and limitations

Cost analysis and accounting tools have the *advantages* of:

- enabling detailed and focussed analyses of decisions and their sustainability outcomes. Cost analysis software can make complex long-term cost and benefit calculations relatively easy, facilitating more informed decision-making.
- leading to easier identification of economic-environmental (and possibly social) win-win situations.
- being based on the principle of providing financial as well as resource / environmental signals, and thus advocating the value and importance of sustainable choices to commercial organisations.

- because of their focus on commercial and business sectors, such tools may be more effective in practice than tools that focus on policy and / public sectors.
- allowing organisations to continue being profitable but with reduced resource implications.

They have the *limitations* of:

- not including the social aspects of sustainability.
- often appearing to offer black-box solutions. While this may be necessary in some circumstances they may also distance decision-makers from the information being calculated.
- being notoriously complex and technical: to fully account for cost implications of projects and production processes is a potentially massive task requiring considerable expertise and time.
- public disquiet exists over the sincerity of corporations to accurately disclose social and environmental costs and impacts and reflect these in decision making.

Tools assessed in this category

Number (from App. A)	Name
54	Full Cost Accounting
55	Whole Life Costing
57	Building for Environmental and Economic Sustainability
56 (LCA crossover)	Building Life Cycle Cost
64	P2/Finance: Pollution Prevention Financial Analysis and Cost Evaluation System
65	E2/Finance: Energy and Environment Financial Analysis and Cost Evaluation System
Eco Efficiency Analysis: http://corporate.basf.com/file/15378.file4	
Cost Analysis for Sustainability (Course Notes): http://courses.dce.harvard.edu/~envre105/mar22/virtual_talkingpoints.pdf	
GEMI (Global Environmental Management Initiative) Environment – Value to the Top Line: http://www.gemi.org/evtl.pdf	

Note: this list is indicative rather than comprehensive

4.5 Changing how companies act: corporate social responsibility

Applies to	scale	international	national/ regional	local	site
	stage	planning	implementation/ operation	monitoring	
	sector	public	private		
Data/ indicators	issues covered	neighbourhood	environment	transport	health
		education	local economy	crime	participation and lifestyle
	data used	'hard' quantitative	'soft' quantitative	qualitative	
Analysis	reductionist?	yes: monetised	yes: non-monetised	no: multicriteria	
	used to:	Describe current status	predict future status	aid decision-making	analyse complex situations
	comparative	Comparative re. other sites etc.	non-comparative		
	skills needed	expert-based	non-expert based		
	output	black box	explicit, transparent		
Cost/time		cost high	cost low	time input high	time input low

Summary of approach

Corporate Social Responsibility and/or Corporate Sustainability Reporting has become a very popular aspect of corporate assessment and reporting and is used by a broad range of organisations internationally, nationally and regionally. CSR aims is to go beyond the traditional financial reporting of companies, which focuses on providing economic information to shareholders, to provide a broad range of information on non-financial issues and impacts to a much wider group of stakeholders.

Typically background information is provided on issues to be reviewed, and reporting structures and processes are provided. In some cases checklists and example questionnaires are also provided. The aim of certain initiatives (such as the Global Reporting Initiative) is to provide a common approach and framework so as to set international corporate sustainability reporting standards: in such cases, scope exists for comparison, benchmarking and best-practice initiatives.

CSR focuses on the preparation of a report which explain a company's economic, environmental and social management and performance to a range of stakeholders. Organisations are expected to review and assess their activities against a broad list of environmental and social issues. This in turn provides an opportunity to develop more strategic management and is likely to enhance awareness and motivation to modify processes in order to improve performance against sustainability measures.

By disclosing sustainability information to stakeholders and shareholders through CSR, a company can gain market value and competitiveness through reputation and raised profile. Monitoring and audit of social and environmental issues can also provide a company with opportunities to improve performance by highlighting areas where efficiency and interconnections can be improved. Certain industries may also want to identify and avoid public concern over their environmental and social impacts, and pre-empt possible future litigation over social (i.e. health) and environmental damage caused by their business practices.

How does it work in practice?

CSR assessments and standards are generally provided by outside organisations (such as the Global Reporting Initiative (tool 48) and Social Accountability International (tool 6)), though some companies, in particular larger multi-nationals, have defined reporting and monitoring procedures of their own. Many tools focus solely on the social influence and impacts of a company's operations, however others attempt to bring all three elements of sustainability together (e.g. government of Canada Sustainability Reporting Toolkit, tool 49).

CSR tools are generally in the form of toolkits that explain how to identify issues, data, indicators and standards, as well as reporting structure and presentation. They often use checklist style questionnaires to guide users through the process. Their emphasis tends to be on identifying the appropriate level of reporting (from a basic environmental health and safety report through to full sustainability reporting) and emphasising the value of reporting from a commercial perspective.

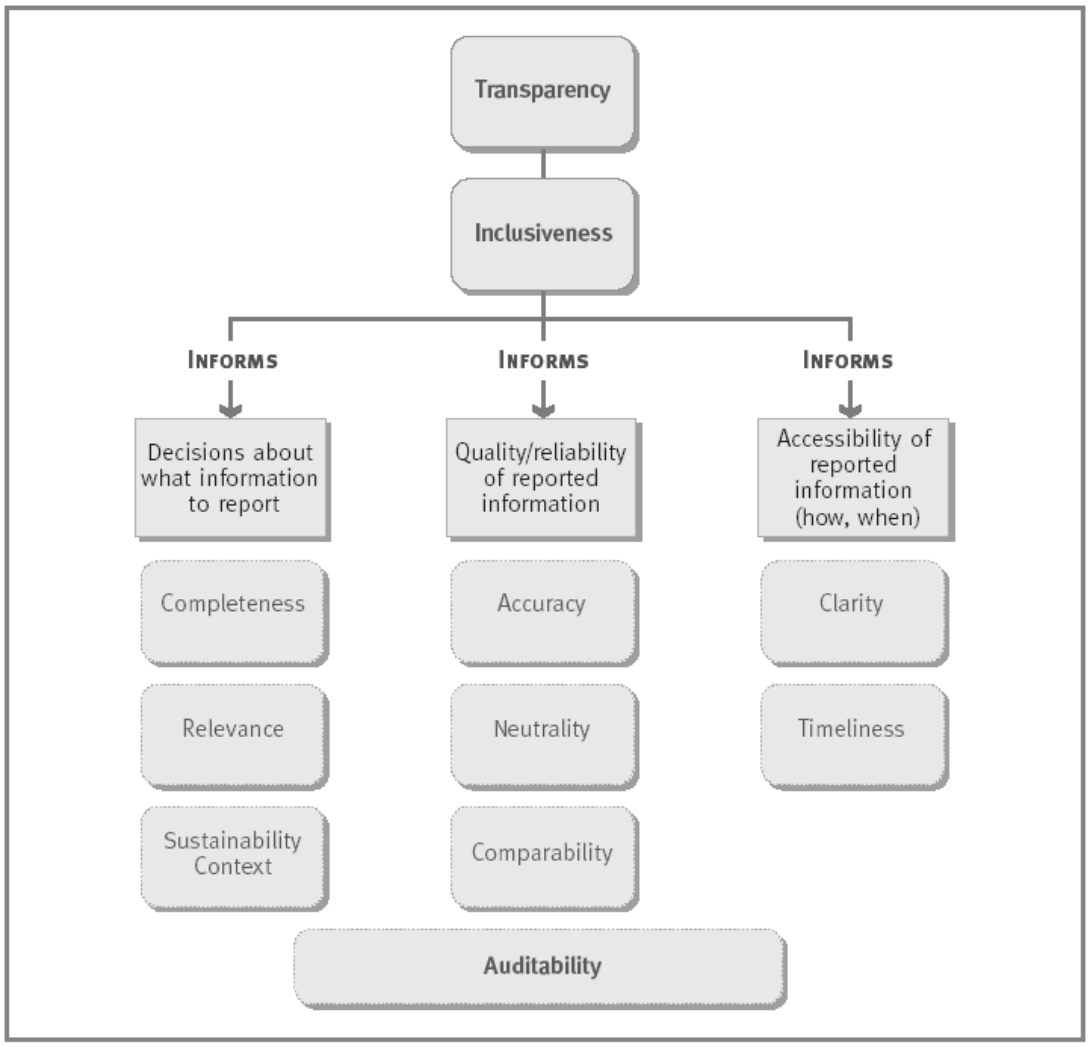
Most recommend monitoring and audit of performance against agreed standards, typically using nationally or internationally accepted standards such as ISO14001, the United Nations *Global Compact,* the OECD *Guidelines for Multinational Enterprises,* and International Labour Organisation (ILO) guidelines. Such standards focus on issues of accountability, transparency, combating corruption and workers rights and conditions and are generally aimed for use within multinational corporations. More commercially or sector specific guidelines focus on individual indicators of social and environmental performance, such as percentage of renewable energy, number of women in senior management, or accessibility to training and development plans.

Reporting requirements are generally voluntary. Due to this, a common element to the tools reviewed is flexibility. For example the Global Reporting Initiative (tool 48) which is one of the most recognised guidelines for CSR, notes that:

> "*There are numerous ways to use the Guidelines. An organisation may choose to simply use them for informal reference or to apply the Guidelines in an incremental fashion. Alternatively, an organisation may decide to report based on the more demanding level of "in accordance". This level of reporting relies on transparency to balance the need for flexibility in reporting, with the goal of enhancing comparability across reporters."*

Box 4.5 shows the framework of principles and aims of CSR from the Global Reporting Initiative guidelines.

Box 4.5
Principles of **GRI Corporate Sustainability Reporting**



Advantages and limitations

CSR has the *advantages* of:

- being flexible in scope and use, and thus being easily acceptable and useable for commercial enterprises.
- generally suggesting the gradual introduction of reporting and assessment, which enables organisations to trial the procedures at a cursory level, or in certain aspects of operation.
- being linked to well known and recognised standards, which may increase the acceptance of the report findings.
- Linking sustainability to marketing and public opinion can be a powerful lever in encouraging take up of corporate social and sustainability reporting.

It has the *limitations* that:

- because of this flexibility and voluntary nature, it may not be a strong catalyst for change.
- it is often used in practice as a marketing tool rather than a process for change;
- fully and thoroughly conducted social or sustainability reporting can be very time consuming and costly.

Tools assessed in this category

Number (from App. A)	Name
6	SA8000: Social Accountability International (SAI) workplace standard
7	AA1000: Stakeholder engagement assurance Standard
8 / 48	GRI Reporting Framework
21	Sustainability Balanced Scorecard (SBSC)
41	Corporate Sustainability Assessment (SAM)
49	Gov. of Canada Sustainability Reporting Toolkit
OECD Guidelines for Multinational Enterprises: http://www.oecd.org/dataoecd/56/36/1922428.pdf	
UN Global Compact: http://www.unglobalcompact.org/Portal/Default.asp	

Note: this list is indicative, not comprehensive.

CHAPTER 5
CONCLUSIONS

This chapter explains the key findings from this research and identifies possible next steps for future research on sustainability tools.

5.1 Key findings

General trends

There are plenty of existing sustainability metrics, models and toolkits. The 78-plus that were analysed as part of this research are only the tip of the iceberg, although they arguably represent the full gamut of (current) broader approaches.

There is no such thing as 'a good tool' in the abstract, only a good match between a tool and the purpose it is being used for (though there are bad tools - ones which can't do any worthwhile job well - as well as tools being used poorly or inappropriately). Tools can be made generic for many different levels and purposes, but at the price of requiring extensive customised guidance and interpretation, and/or only being able to be used effectively by users who are experienced, insightful and confident enough to adapt and interpret the tool as necessary.

The existing tools do not seem to be converging on one approach, for instance consistent involvement of the public, presentation of data in a spatial form, or views on how, and how far, different aspects of sustainability performance should be aggregated.

The decision determines the tool needed. The purpose of a tool is to connect effectively with decision or planning processes so as to have the greatest possible chance of influencing their sustainability effects for the better. What form the tool takes will vary depending on the scale of the action, the stage of decision-making, the time and skills available, etc. As a simple example, tools designed to support decisions about building construction are unlikely to be of help in comparing different regional transport policies and vice-versa. "Squeezing" a decision into an inappropriate tool is counterproductive and may be misleading, for example if the tool excludes, devalues or misrepresents issues which are in fact important for the decision.

The tools *vary in terms of how they deal with uncertainty*. Some tools – particularly computer models, GIS and systems analysis – require full sets of detailed data so as to reduce uncertainty, and thereafter assume that there is no uncertainty. Others, like public participation techniques, take uncertainty on board. The former do not necessarily lead to "more certain" results than the latter (although more data will often help to reduce uncertainty): they often merely disguise, rather than reduce, uncertainty.

This suggests that, depending on the context, issues that anyone developing sustainability tools should be aware of are:

- the tool's 'fitness for purpose'. This includes understanding the context within which the decision takes place, time and resources available, level of detail needed etc.
- what sustainability tools already exist, so that new tools do not need to be developed from scratch where existing tools may be adapted to the situation
- how much can be expected from any one tool
- the need for tools to cope with uncertainty and incorporate the precautionary principle

Social issues within sustainability

Few of the existing tools come close to being "sustainability" tools in terms of being inclusive, holistic, multi-dimensional and capable of simultaneously addressing the social, environmental and economic core issues together with other factors such as political, technical or legal constraints. Many focus on one aspect of sustainability, for instance energy or water management, or impacts on communities. Very few even try to weave together the three "legs" of the sustainability "stool".

Sustainability is enormously complex, and involves judgements about integration, win-win solutions, trade-offs. These judgements can be replicated ("faked") by sustainability tools, but are ultimately for politicians and other decision-makers to take. The role of sustainability tools is to aid decision-making, not make decisions. As such, *the concept of a true "sustainability tool" may be impossible to achieve in practice*.

Environmental and economic tools predominate in the tools that we analysed, with *less emphasis on the social dimension*. This is despite the fact that we specifically looked for and analysed "social" tools.

There is *less consensus about the dimensions of social issues* than about environmental and economic ones. For instance some tools discuss norms and values, dimensions of equity, and social interactions, whilst others are limited to demographic issues. Specific tools exist for social impacts, intragenerational (within this generation) equity and public participation – all components of sustainable development. However, intergenerational (between generations) equity - constraints and thresholds that should be achieved to ensure that future generations enjoy a good quality of life – is covered much less well.

On the other hand, *treating social issues with techniques and frameworks designed for the natural sciences may lead to inappropriate sustainability results*. The search for robust, simple and demonstrable causal relationships (the heuristic that has driven all good tool design since Occam and Bacon) may preclude looking at exactly those matters which may be most important for understanding the 'social' strand of sustainability: for instance why, when two people are in identical material circumstances, one may be content and the other resentful, envious and rancorous. The focus of some sustainability tools on measurable social factors – demographics, survey results, etc. – means that much subtle and rich data can get lost, and that socially acceptable actions may not be identified.

This suggests that, depending on the context, issues that anyone developing sustainability tools should be aware of are:

- whether/how to cover the full range of sustainability issues, without necessarily aiming to integrate them into "sustainability solutions";
- coverage of social issues vis-à-vis environmental and economic issues;
- the full range of social issues is taken into account: norms, community interactions etc., as well as basic demographics;
- intergenerational equity (typically as environmental constraints on development today to ensure quality of life in the future);
- the appropriateness (or not) of using natural science techniques to analyse social issues.

Usability of sustainability tools

Comprehensiveness, rigour, transparency, user-friendliness and low cost are not all compatible. Those existing sustainability tools that aim to be rigorous – for instance several of the environment-energy models - often do so only by requiring much expert

input and essentially being a "black box". Conversely those tools that are user-friendly, such as questionnaires and checklists, may be comprehensive (cover many topics) or rigorous (cover the topic in depth) but not both. Cost-benefit assessment is user-friendly in part by not being transparent. Trade-offs need to be struck between the different dimensions, and some may need to be sacrificed in a given situation.

Several of the tools analysed require so much data and expert input, and their results are so complex that they are essentially unusable in practice. This includes the tools whose authors describe them as being "based on complex thinking, including multi-scale mosaic effect, impredicative loop analysis (dynamic budget analysis), and narratives for surfing complex time" (tool 53) and "computer models of complex human interactions involving agents (people) who follow changeable heuristics in their day-to-day behaviour" (tool 19). These tools may be useful for exploring the possibilities of new computer systems or analytical processes, but are unlikely to support real-time, real-life decisions involving real agents (people). This does not suggest that no attempts should be made to, for instance, get to grips with the complexity of human perceptions, behaviour changes and decisions, but it does mean that developers of sustainability tools must be aware of the context in which they are used.

In our opinion, *some of the most interesting sustainability tools bring together different disciplines* and are easy to use. Examples include:

- "rural proofing" (tool 70, equity analysis and checklist): the tool is also easy to understand and suggests solutions to identified problems;
- equity mapping (tool 38, equity analysis and GIS): the tool gives a clear pictorial understanding of equity problems;
- Quality of Life Capital (tool 29, public participation and capacity analysis): it allows the views of experts and non-experts to be considered at the same 'level', and suggests rules for future development, usable by politicians and the public;
- Index of Sustainable Economic Development (tool 5, cost-benefit assessment using novel assumptions/ indicators): it uses a very traditional technique in a quite radical manner;
- gender analysis matrix (tool 33, public participation and checklist/matrix): it can be used both to identify problems and educate people about them; and
- Eco-Cal (tool 72, questionnaire, model, "dashboard"): it acts as an educational tool by allowing people to try out different scenarios for their personal behaviour.

This suggests that, depending on the context, issues that anyone developing sustainability tools should be aware of are:

- the appropriate point of trade-off comprehensiveness, rigour, transparency, user-friendliness and cost. The choice should depend on the decision that the tool is informing;
- the efficiency of the tools: the amount of time and effort they need as input should be proportional to the benefits that they provide as output;
- multi-purpose tools - tools that can be used for several different functions – and tools that bring together different disciplines; and
- two-stage tools or processes, with a "shallow" initial stage which gives a broad-brush analysis of a problem, and a "deep" focus on those issues that were identified in the first stage as being particularly problematic, contentious or important to the decision making process.

5.2 Possible next steps

These findings suggest some themes that could be the focus of future research and information-sharing.

- By far the most important is the issue of *what sustainability questions, challenges, and decisions are currently poorly served by tools*, and therefore what gaps exist in the toolkit. For instance, from our experience we would argue that there is an urgent need to better formulate economic wellbeing (i.e. the outcomes of economic activity rather than the inputs) and to measure eco-efficiency in terms of the amount of environmental consumption needed to achieve these outcomes.

Other next steps, focused on the development and dissemination of sustainability tools, include the need for:

- *Better information about existing tools, and particularly "rules" that help decision-makers to choose what tool is appropriate*. The most useful sustainability "tool" may in fact be a suite of tools with guidance on which one to choose for what purpose.

- *More understanding of, and consensus on, the social dimension of sustainability*, to help give it an equivalent "weight" to the other dimensions.

- *More understanding of how the three dimensions of sustainability can be integrated*, to help identify and achieve win-win-win solutions, rather than reinforcing the division into separate disciplinary silos.

- A focus on *efficient tools that are "fit for purpose*". In many cases, this is likely to mean an emphasis on tools that are fast, not resource-intensive, and transparent, with associated costs in terms of rigour and comprehensiveness. However it may be possible to develop tools that are selective: that cover most issues quickly and shallowly, but that can become more rigorous for key, problematic issues.

- A *focus on tools that can be used in different ways* for different purposes: for instance tables (describe sustainability status, compare options), causal flow diagrams (identify impact interactions, identify assumptions and necessary precursors to actions) and GIS (describe sustainability baseline, identify impacts, public participation).

- Exploration of *tools that bring together different existing technologies and approaches*. In particular, as GISs become more ubiquitous and user-friendly, they could be combined with other techniques (e.g. scenario testing, public participation techniques).

APPENDIX A
SUMMARY OF TOOLS

No	Name	Comments	Good/bad points
1	Quality of Life Counts	UK quality of life indicators	
2 / 16	Social Capital Assessment Tool (SOCAT / SCAT)	(WB) Provides definition and theoretical discussion of Social Capital as a concept. Development context. - Gives detailed analysis framework, questionnaire format to understand community / social / QoL (though term not used here) dimensions of an area / neighbourhood / village. - Questionnaire templates provided and very detailed!	Links social assess-ment to broader community / individual setting. Very detailed, and many useful concepts/guidance. Too complex perhaps, though definitely scope to apply / adapt to variety of uses
3	Conjunction of Criminal Opportunity	Conceptual framework that aims to 1. define terms related to crime; 2. bridge cultural gaps in the field; 3. help practitioners to devise and implement interventions in the causes of crime and integrate different approaches. Focuses on identifying crime problems, diagnosing the causes of the problem, selecting interventions, implementing them, evaluation and adjustment.	In-depth look at narrow topic (crime, nothing else). International approach. Gives good understanding of causes and ways of preventing crime.
4	Rethinking Construction	Focus on health and safety at project level. Series of checklists and scorecards for 1. conception, design and planning; 2. site health; 3. site safety, plus personal risk assessment card. Checklists lead to radar chart which helps to identify weak points: repeating the process over time is recommended, with first time as benchmark.	Straightforward 5-point scale checklists. V. clear about no problems photocopying. Need to register is a pain.
5	Index of Sustainable Economic Welfare	Country scale. Measures the portion of economic activity which delivers genuine increases in quality of life. Starts with GDP and, for example, subtracts for air pollution caused by economic activity, and adds to count unpaid household labour. It also covers areas such as income inequality, other environmental damage, and depletion of environmental assets. Includes e.g. services from unpaid domestic labour, expenditure on health and education	Country scale. Needs a lot of data and open to interpretation, but becoming increasingly accepted as alternative to GDP
6	SA8000: Social Accountabi-lity International (SAI) workplace standard	Company business based standard based on defined assessment criteria: - Child labour - Forced labour - Health and safety - Freedom of association - Discrimination - Disciplinary practice - Working hours - Remuneration - Management system Levels / standards based on international law etc.	Useful and clear compilations of broad range of corporate accountability issues with methodology for assessment and reporting. Focus is on internal corporate function / practices. SA8000 more user friendly, AA1000 more thorough and detailed.

No	Name	Comments	Good/bad points
7	AA1000: Stakeholder engagement assurance Standard	A framework for assessing and monitoring social and ethical accounting and reporting Organisation / business oriented Includes guidelines for stakeholder engagement Sets out process model / template	
8 / 48	GRI Reporting Framework	Initiative to establish standardised sustainability reporting 'guidelines' / framework for businesses: - Sets out set of 11 principles and guidance on reporting - Reporting is against a number of social, environmental and economic criteria - Includes guidance on indicators	A good simple overview and guidance for corporate accountability and sustainability assessment and reporting. Full guidelines are very long.
9	Social/ Human Capital Rapid Appraisal Model	Article proposing a series of Australian indicators to represent social and human capital.	Clear explanation of choice of indicators, linked to theoretical framework. Australia-specific, though theory can be adapted for other countries.
10	ISCAM	ESRC-supported research by University of Manchester "Integrated Sustainable Cities Assessment Method". Systems-based approach for sustainability analysis of city/region (shows links from social values, through demand side, need for infrastructure, supply side, environmental pressures, human impacts). Defines indicators for a sustainable city, links to targets/thresholds, shows links between indicators to represent complex systems; allows scenario-based sustainability appraisal.	Needs lots of data, seems v. complex/ academic: good for describing systems, probably less good for helping to make decisions.
11	"Community capacity assessment" re. riparian issues	"Capacity assessment tool": Excel spreadsheet designed to help policy-makers to understand and assess "social capacity": norms/values, knowledge, working together, "interactional infrastructure". Ch.4 in larger project to assess whether the Australian Riparian Lands R&D Program "Demonstration and Evaluation" Projects of Land & Water Australia have built capacity for long-term change in approaches to river and riparian management within the communities that have undertaken. Series of spreadsheets require description of project, weighting of importance of various factors, maps results in red/amber/green.	Oriented to resource management / riparian issues. Typical problem of who fills it in leading to range of
12	Index of Deprivation	Web site with list of deprivation assessment and economic development related publications	Not a usable tool / framework
13	Index of Deprivation	UK context (DETR). Describes methodology and details an Index based on: - Income - Employment - Health deprivation and disability - Education, skills, training - Housing - Access to services Ward (but flexible) scale intended Describes example and provides data links	Simple and useable method of social assessment. Focus is on 'exclusion'. Indicator based assessment requires data to be available – most useful therefore at larger scales.

No	Name	Comments	Good/bad points
14	Beneficiary Assessment	Compilation of other sources Beneficiary assessment summarised as appendix to much broader WB participation sourcebook. It is a methodology for stakeholder consultation and involvement A qualitative assessment tool based around participation in meetings / focus groups and interviews. Detailed guidance / methodology not given. Development context	Very detailed, perhaps overly so, makes it a little confusing. Useful lessons / principles of stakeholder engagement
15	UN Human Development Reports/ Index	Country scale. Index is based on average longevity, educational attainment and standard of living (all with equal weights). Used to compare "human development" in all UN countries. Includes health, wealth and futurity (though not environment in any form)	Simplistic, uses GDP ranking plus two other criteria. But transparent, and thus good focus of debate.
16	see 2		
17	Social capital assessment tool	World Bank website with wide range of information about social capital: concepts, questionnaires and organizational profiles, etc. Several tools downloaded: community questionnaire, organisational profile scoresheet.	Good range of tools, but no one specific tool. Simple to use. International application.
18	Living Standards Measurement Survey	Survey and data based assessment tool (WB) Development context – aimed at understanding and assessing poverty in developing countries (at country scale) Uses detailed questionnaires Extensive guidance on questionnaire format – template provided	Country scale. Relies on / was intended to motivate large amount of data collection.
19	Simulating Society	Springer-Verlag book on using Mathematica for socioeconomic modelling, written by Richard J. Gaylord & Louis J. DAndria: *Simulating Society: A Mathematica Toolkit for Modeling Socioeconomic Behavior* Book describes how to create with Mathematica code, computer models of complex human interactions involving agents (people) who follow changeable heuristics - rules of thumb - in their day-to-day behavior. Topics addressed are: - movements, fads, norms, game playing, social networks, culture, and conformity - span traditional social scientific boundaries. Many of the models assume that others - friends, family, peers, and role models - influence our actions.	book costs $39.95
20	PRAM	Participatory and Reflective Analytical Mapping (PRAM). Essentially a series of map overlays using a simple GIS system, Map Maker, which "allows users to create simple maps using complex environmental and social information on any geographic area from the farm level to the planet. These maps can then be used by researchers and policymakers to assess the degree of sustainable development throughout the target area. http://life.csu.edu.au/cgi-bin/gis/Map	Articles about work carried out in 1996. Map Maker is still on the Web but doesn't seem to work any more. Looks potentially very user-friendly, and inter-national/developing country approach is good.

No	Name	Comments	Good/bad points
21	Sustainability Balanced Scorecard (SBSC)	Discussion paper. - Provides discussion of various types of 'scorecard' and recommendations - Outlines example framework / template for scorecard - Aim to translate Corporate SD strategy into action…	Academic paper on CSR. As such discusses concepts and process, but does not provide clear guidance or methodology.
22	QUEST	Computer model developed by Univ of British Columbia in 1999 that allows participants to explore different scenarios for the development of their region. It is composed of interlinked modules: sustainability audit of the region, development of scenarios, interface with user. Once the model – which is developed separately for each region – is set up, participants can devise and "run" different scenarios like a computer game. Puts the user in the role of the decision-maker and lets them run different scenarios: essentially Sim City writ large. In 4 stages: 1. invent a future for 40 years: land use goals, population growth, economic activity, world view etc.; 2. choose policies on housing, agriculture etc for 10 years; 3. model comes up with consequences for air, water etc.; 4. repeat 2. and 3 for each decade; review scenario at the end of the 40 years.	Very complex, and must be adapted to the region in question. But works as learning tool for public (those members who are sophisticated enough and have enough time to try it) and decision-makers. Probably more of an educational than a decision-making tool. Not clear whether it's been used since in practice.
23	LASALA	The LASALA project, run by ICLEI in 2000-1, aimed to register progress made in the areas of 'eco-efficient urban management' and 'new schemes of urban governance' brought about through Local Agenda 21. An innovative technique of *tele-guided concerted self-assessment* utilising web-based resources and a virtual training centre was at the heart of the project. The overall objectives pursued by LASALA over an 18 month project period were: - to conduct a 'tele-guided, concerted LA21 self-assessment' by 200+ local authorities in Europe; - to evaluate Local Agenda 21 in European local authorities and achieve a comprehensive LA21 overview that will be published in a report; - to identify and disseminate best practices in urban governance and eco-efficient urban management; - to assess the functioning of the method of 'concerted self-assessment' and provide guidelines for its application that will be published in a LA21 Self-Assessment Manual.	Info about self-assessment package not available on Web
24	Participatory Impact Monitoring (PIM)	A methodology for understanding and accounting for social and cultural issues in development projects to improve outcomes No actual framework / checklist, but narrative and diagrams describing methods and role of discourse, situation analysis etc.	Simple but thorough. More a guidance document than a methodology.

No	Name	Comments	Good/bad points
25	POET	Participatory Organisational Evaluation Tool - for assessing organisations and capacity based on a methodology called PROSE (Participatory, Results-Oriented Self-Evaluation) Development context (and specifically for Civil Society Organisations) Measures organisational strengths and weaknesses in terms of HR, Equity, Governance and Sustainability…) Very confusing and detailed Provides detailed narrative and quantification guidance based on self-assessed scoring system with template questionnaire	Very detailed, but reliant on judgement of user with respect to organisational self-assessment.
26	Tree Maps	A structured process for managing and under-standing qualitative information. Focus on participation and stakeholder involvement / analysis. Use also in scenario planning. Methodology described briefly Developing country context	Easy to understand guidance for managing participation. No single tool / checklist.
27	The Sustainable Livelihood Framework	Tool / framework to understand / analyse livelihood and opportunities: - Framework of inter-linkages defined - Provides checklist of issues - Aim to help eliminate poverty - Community scale - Large amount of narrative describing technique and methodology Developing country context	Detailed framework and useful social / poverty issue checklist. Places social issues in context of vulnerability. Process is fairly complex and labour intensive.
28	Gender Analysis Tool	Aim to provide guidance on where Gender Resources can be found. Has many links to other sites / tools. Development context Brief intro to gender and gender analysis as a method. Matrix format gender analysis framework - Focus is on gender roles and relations, needs etc in project development – through stakeholder engagement - Also provides brief framework for analysis of national policy	Good introduction to issues of gender, and involvement in development process. Stakeholder engagement guidance applicable in range of circumstances.
29	Quality of Life Assessment	Focuses on, and aims to manage, benefits provided by things, e.g. woodland provides recreation, biodiversity, CO2 fixing. Asks who benefits and how, whether there is "enough" of the benefit, and how the benefit can be substituted. Comes up with management proposals which conserve/enhance benefits… though these can be achieved with a range of management approaches to the things.	Participative, takes views of both local people and experts into account. Converts "things" into "benefits": applicable to whole suite of sustainability issues and scales of development
30	Community Profile	Simple framework for profiling communities in terms of: - Resources - Livelihoods - Community structure / institutions - History Uses observation and interviews / focus groups with maps / location info Brief guidance and framework provided Developing country context	Structured process for understanding a community. Some useful guidance to structure process. Covers 'background' socio-economic issues

No	Name	Comments	Good/bad points
31	Participatory and Integrated Development	PIDEP. Aims to facilitate participatory analysis of problems, needs, resources and potentials, and to support a change in development efforts: from top-down to bottom-up development planning, from supply to demand driven development services, from disintegrated to co-ordinated development efforts. PIDEP emphasises: 1. Participation of all in development; 2. Integration: the combined/ coordinated efforts of different sectors, institutions, scales; 3. Development: movement from an unsatisfactory present situation to a better one; 4. Process: development work has to be a continuous activity, involving interdependent actors. PIDEP works as a cycle involving phases: Initial, Planning, Check and Channelling, Implementation, and Monitoring and Evaluation.	Essentially a way of structuring support (primarily for developing countries or disadvantaged communities) throughout the life of the project/analysis.
32	Navigating Gender	Development context. Provides info on gender concepts and roles. - Answers questions – why, how, when through narrative explanation - Gives simple guidance to analysis process and outlines example framework - Provides links to gender analysis frameworks and related info	32 and 33 have useful elements regarding a structure for social / gender related project review and stake-holder engagement – though this process is such that will tend always to be dictated by individual preference of user. Some principles and processes may adapt well to broader social assessment
33	Gender Analysis Matrix	Development context. - answers questions – what, why, who when through narrative - provides example gender analysis matrix and explains use through categories to be assessed - Gives options for levels of assessment	
34	Genuine Progress Indicator	Country/region scale. See 5.	An early version of ISEW
35	Community impact assessment	Assesses the impact of transport "actions" on communities. Includes population demographics, severance, noise, aesthetics etc. Essentially a type of non-technical EIA focused on social impacts (and those environmental and economic effects that affect social effects)	Written for US context but has international applications. Non-technical language, reference to data sources. Work seems manageable
36	Capability Poverty Measure	Gender / women focussed and development context - provides narrative on nourishment and health, reproduction and literacy. No framework or assessment tool / template.	Useful information on important gender/ development issues, but no tool/framework.
37	Social Audit	University of Technology, Sydney. Handbook that presents a "cookbook" of approaches that allow community activists to describe the "social capital" of their communities. Includes definitions of social capital, suggested questions for surveys, ideas for other techniques (e.g. observation)	Useful re. "what is social capital". No one approach per se, but basket of approaches. Good intro for tricky topic.

No	Name	Comments	Good/bad points
38	Equity mapping	Maps access to facilities v. characteristics of population. In Sustainable Cities Program, maps in Los Angeles were mapped, with 0.25 mile buffer zones (within which parks were felt to be accessible to local residents). This was superimposed on racial characteristics of the local resident population, and analyses carried out of e.g. park acres per 1000 population of Latinos, African Americans, Whites. This showed serious differences between races in terms of access to parks (e.g. whites have 100 times better access than Latinos)	Very powerful/ striking use of GIS, applicable to wide range of scales, impacts, countries etc. Would require lots of info, e.g. on racial makeup of neighbourhoods.
39	Dashboard of Sustainable Development	The Dashboard tool, developed by a small group of Canadian indicator programme leaders called "Consultative Group on Sustainable Development Indices" is an attempt to help and launch the process of putting indicators at the service of democracy. The Dashboard presents sets of indicators in a simple pie chart format based on three principles: 1. the size of a segment reflects the relative importance of the issue described b the indicator; 2. a colour code signals performance; 3. the central circle summarises the information of the component indicators. 46 indicators used to describe/compare more than 100 countries.	Visual, and easy to understand once you get your head around it (but really daunting at first). Can easily identify strong/weak aspects of countries. Includes 3 legs of SD stool.
40	Bench-marking	Setting a point of reference standard/target for indicators, often based on existing good practice	Three page theoretical article, but fine concept, often used
41	Corporate Sustainability Assessment (SAM)	An assessment tool based on environmental, social and economic criteria - Questionnaire and analysis of standard company reports used to 'score' companies against criteria - Criteria based on accepted standards, best practices and audit procedures - Questionnaire provides thorough assessment of company policy and practice	Complex to use – and scoring seems somewhat arbitrary.
42	Community sustainability assessment	Ecological/social/spiritual weighted checklists to assess how sustainable a community is. Developed by Global Ecovillage Network/Gaia.	Spiritual dimension v. interesting. No economics. Community scale. Easy to understand. In some ways probably the most "truly sustainable" of the various approaches.
43	Quality of Life indicators	Federation of Canadian Municipalities reporting system to monitor quality of life in Canada. Includes indicators on population, affordability, employment, housing, community stress, health, safety, and participation. Cost of living calculated as average basket of goods, fed into affordability indicator. Second report put out 2002.	Essentially a Canadian version of *Quality of Life Counts*

No	Name	Comments	Good/bad points
44	Sustainability calculator	EPSRC-funded, UCL devised GIS tool that allows people to integrate a wide range of indicators into one single composite indicator using overlay analysis. Can ascribe weights to surfaces. Designed to generate a series of indices of sustainability for town centres. At present, only employment data are shown but aim is to integrate much more data, including social and environmental indicators in London.	Essentially a GIS-MCA tool
45	Calvert Henderson QoL indicators	Another list of indicators, also "bundled" into themes (e.g. energy, education), each with an expert's introduction and analysis of issues/problems. Presented as book, cost $25.	US data. Main new concept is expert analysing field.
46	Wellbeing index	Country scale. Expansion of approach from 15, prepared with support from IUCN, World Conservation Union and International Development Research Centre. Considers human wellbeing (28 indicators), ecosystem wellbeing (49 indicators), wellbeing and stress indices. Compares 180 nations in terms of wellbeing.	Wider range of indices than UN HDI, but requires lots of quantified data, and prone to bias/ problems because of that
47	FSCN Index	Florida Sustainable Community Index: GIS model designed to measure indicators of community sustainability. Indicators include housing density and affordability, transit proximity, employment density and land supply, park space availability. Used in Florida for comprehensive/area planning, neighbourhood planning, site planning. Used on an MCA basis to compare alternative development scenarios.	1999. Uses ArcView which isn't very user-friendly, and limited to "mappable" issues. But overall a good use of GIS for sust dev.
48	see 8		
49	Gov. of Canada Sustainability Reporting Toolkit	Voluntary CSR guidance site – draws on GRI and Canadian Institute of Chartered Accountants guidance. Aimed at first time users (companies). Provides examples and guidance of areas and types of issues to be reported against Provides narrative on logic and benefits of CSR Sets out a stepwise methodology for producing a sustainability report Focus is on producing appropriate corporate sustainability report for a business or corporation. Covers social, environmental and economic criteria.	Draws on GRI (8 and 48) and Canadian Institute of Chartered Accountants guidance.

No	Name	Comments	Good/bad points
50	Project innovation matrix	Not particularly technical: more a form of MCA. Austrian technique that allows projects to be compared based on the degree to which they meet regional sustainable development objectives. The model provides for: a weighting of the objectives of regional development; an assessment of individual projects concerning their contributions to sustainable development; classification of projects by "location of innovation", i.e. whether the measures affect a company, network etc.; classification by "type of innovation", e.g. product, process, organizational or social issues; an assessment of the effective scope of the project; will the effects act at a local, municipal, regional or supra-regional level; an overview of current municipal and regional projects and their respective contribution to sustainable development and, deduced from this, the need for further development.	Allows projects to be compared based on sustainable development criteria… essentially formalises what many decision-makers probably do in their heads.
51	Social impact assessment	US govt. manual for assessing the social implications of a project etc.. Presents matrix of project stages v. SIA variables: population characteristics, community/institutional structures, political/social resources, individual/ family changes and community resources. Like EIA, but focusing on social issues	easy to understand, principles can be applied internationally.
52	Social Analysis	WB Source book: compilation of other sources. A detailed overview/ synthesis of Social Analysis methods and frameworks "Revealing the complex relationships among different groups and focusing on assets and livelihoods, multidimensional social analysis asks how people perceive, act on and negotiate their interests." Encompasses macro-social analysis, sociological appraisal and social assessment. Explores diversity and gender, institutions and behaviour, stakeholders and participation, and social risk And provides checklists / frameworks under each category above…	Very detailed guidance on good practice in social assessment. No one framework or tool. Compilation of other sources Definitely some useful guidance / ideas, though very complex and long document is far from user friendly.
53	Multi-scale integrated analysis of sustainability	INRAN (Italy) devised systems and multi-criteria model/approach for representing sustainability trade-offs. Brings together elements of complex thinking, including multi-scale mosaic effect, impredicative loop analysis (dynamic budget analysis), narratives for surfing complex time, etc.	Completely and totally impenetrable. Might be interesting at a theoretical level but likely to be of little use in decision-making as it stands.
54	Full Cost Accounting	Outlines the following four general steps of a complete FCA analysis: - Identification of stakeholders and relevant values - Generation of project alternatives. - Evaluation of the effects of each alternative on stakeholders. - Tabulation, adjustment, and reporting of results	Useful overview of process, but contains little in way of guidelines or checklist.

No	Name	Comments	Good/bad points
55	Whole Life Costing	PFI/PPP/PC project context. Research programme by University of Dundee which aims to develop a generic approach to whole life costing which is expected to be of value to all the project team (designer, contractor, facilities manager, supplier, etc.) who might be involved in traditional procurement or PFI, PPP, and PC projects. When the cost data structure is populated, it will provide the foundation from which the whole life costs of different alternatives can be estimated and from which the risks such as the technical and financial risks related to WLC elements, operational risks, etc. associated with, PFI, PPP and PC projects can be assessed and minimised.	No obvious link to social issues. Last updated June 2002, so unclear how up to date it is.
56	Building Life Cycle Cost	Individual building and US context. US National Institute of Standards and technology computer model: life cycle cost analysis which aims to help analyse the economic costs of the whole life of a building. Provides an economic analysis of proposed capital investments that are expected to reduce long-term operating costs of buildings or buildings systems. Calculate Lowest Life-Cycle Cost, Net Savings, Savings-to-Investment Ratio, Adjusted Internal Rate of Return, and Payback Period.	Seems to have already been used widely in the US by federal and public sector orgs. Unsure how it links with 57. Converts everything into money. Considers whole life of building, i.e. long term (envir) as well as short term (econ) costs.
57	Building for Environmental and Economic Sustainability	Individual building or product (US) context.. US National Institute of Standards and Technology computer model. Measures the environmental performance of building products by using the life-cycle assessment approach specified in ISO 14000 standards. Analyses all stages in the life of a product: raw material acquisition, manufacture, transportation, installation, use, and recycling and waste management. Economic performance is measured using the ASTM standard life-cycle cost method, which covers the costs of initial investment, replacement, operation, maintenance and repair, and disposal. Environmental and economic performance are combined into an overall performance measure using Multi-Attribute Decision Analysis.	Unsure how it links with 56. US context only. Takes more than an hour to download and then I couldn't figure out how to use it, i.e. not obviously user-friendly. No social info that I could find, though economics were mentioned.
58	Life cycle assessment: Sima Pro 5	Product context. Computer model to describe and assess the product life cycle (life cycle inventory, LCI) of the product. Essentially builds up a model of a product lifecycle, and helps to understand the environmental significance of inflows and outflows. Focus is on environment, and on human health to the extent that it is influenced by the environment.	Deals with product life cycles only. Primarily focuses on the environment. Devised by Dutch consultants.

No	Name	Comments	Good/bad points
59	ENVEST	Individual building context.. BRE designed software that helps to design environmentally friendly buildings. Input building design (height, number of storeys, window area, etc) and choices of elements (external wall, roof covering, etc), and ENVEST identifies those elements with the most influence on the building's environmental impact, and shows the effects of selecting different materials. It also predicts the environmental impact of various strategies for heating, cooling and operating a building.	Individual buildings only.
60	Long-Range Energy Alternatives Planning System	Software tool for integrated energy-environment and greenhouse gas mitigation analysis devised by Stockholm Environment Institute. Its scenarios are based on comprehensive accounting of how energy is consumed, converted and produced in a given region or economy under a range of alternative assumptions on population, economic development, technology, price and so on. Using LEAP, scenarios can be built and then compared to assess their energy requirements, social costs and benefits and environmental impacts. Users can build simulations and data structures, but doesn't estimate the impact of energy policies on GDP or employment.	Nation or region scale, focuses on energy and environment, no visible links to socio-economic impacts. Allows decision makers to move rapidly from policy ideas to policy analysis without having to resort to using more complex models.
61	Water Evaluation and Planning System	Software tool for integrated water management. Tellus Institute (Stockholm Environment Institute). Calculates water demand, supply, flows, and storage, and pollution generation, treatment and discharge under varying hydrologic and policy scenarios. Evaluates water development and management options, and takes account of multiple and competing uses of water systems	Focuses on water, no visible links to socio-economic impacts
62	Waste Plan	Tellus Institute software tool for waste planning and analysis. User "builds" and runs a solid waste management system: describe a community or region's waste generation; routes them into programs of source reduction, recycling, composting, etc.; and then to existing or planned waste management facilities.	As above
63	PoleStar	Software tool enabling environmental pressures to be assessed based on assumptions about future scenarios. Data (hypothesised by user) is entered under modules (households, transport, industry etc.) and resource (energy, minerals, land, water) and pollution (air, toxics, solid waste, water) implications are calculated according to levels assumed. Scenarios are developed to explore alternative futures. A scenario is a set of future economic, resource and environmental accounts, based on assumptions developed by the user. Enables different scenarios to be compared and assessed against sustainable development targets.	Can be used at regional, national and global scales. Dependent on data assumptions of user. Very much a 'black-box' No clear link to socio-economic or social factors

No	Name	Comments	Good/bad points
64	P2/FINANCE	Pollution Prevention Financial Analysis and Cost Evaluation System. Excel based assessment tool for calculating long term financial / profit implications of investment / technology decisions. Calculates Net Present Value and profitability based on assumptions input by user as to resource use and costs of new technology.	Relatively simple to use. Deal solely with financial analysis of investment decisions. No visible social, or socio-economic link.
65	E2/FINANCE	Energy and Environment Financial Analysis and Cost Evaluation System. E2/Finance software could not be used (downloaded but not working) however user guide suggests that E2 carries out the identical function to P2 in relation to energy relevant investments and technology.	
66	EXMOD	Environmental externalities	
67	EXMOBILE	Vehicle Environmental Strategies	
68	NI equality impact assessment	Section 75 of the Northern Ireland Act 1998 requires government departments to have due regard to the need to promote equality of opportunity between: • Persons of different religious belief, political opinion, racial group, age, marital status or sexual orientation; • Men and women generally; • Persons with dependants and persons without. Involves consideration of available data and research, assessment of impacts, mitigation measures, consultation, decisions, publication, monitoring.	Considers different aspects of equality (religious equality being particularly important in NI). Well used and understood. Pretty straightforward impact assessment but focusing on equality.
69	Strategic environment-tal assessment	Environmental impact assessment for policies, plans and programmes. Required by European Directive 2001/42/EC.	Only partly covers socio-economic issues, primarily environmental. EC Directive covers plans and programmes, not policies.
70	"rural proofing"	Rural proofing developed by Countryside Agency for the UK government to ensure that all its domestic policies take account of rural circumstances and needs Using a 'checklist' as policies are developed, policy makers can systematically: - consider whether their policy is likely to have a different impact in rural areas, because of particular rural circumstances or needs; - make a proper assessment of those impacts, if they are likely to be significant - adjust the policy, where appropriate, with solutions to meet rural needs and circumstances Checklist is a 'screening' tool to indicate whether more thorough impact assessment / consultation is required	Though in rural context covers a good range of social, infrastructure, economic and environmental issues. Simple to use checklist of 15 questions, which could be applied / used in broad range of circumstances
71	MAGIC	Multi-Agency Geographic Information for the Countryside. A one-stop shop for rural and countryside information, e.g. designations, floodplain, agricultural land classification etc.	National and regional levels only; countryside information only; one layer at a time only. User friendly.

No	Name	Comments	Good/bad points
72	Eco-Cal	Computer based tool for assessing and measuring the environmental impact of a household. Household data / qualitative information entered by user under series of activity area questions (such as transport, waster etc.) and a score calculated by programme. Allows comparison with other households.	Very user friendly and clear. Depends on user's honesty / knowledge. Application only really for household level – but methodology if adapted could be useful elsewhere.
73	Natural Step	The Natural Step is an organisation which offers a range of sustainability services to business. The process methodology involves 4 phases: - Building awareness and understanding - Baseline - Vision and strategic plan - Step by step implementation Natural Step is not a tool, toolkit or metric, but a structured and supported method of sustainability assessment, reporting and planning for business.	Useful introduction to a simple methodology for Corporate Social Responsibility and Sustainability Reporting. No single method, guidance or template, as is a consultancy service to business.
74	LEED	Essentially a checklist and rating system for environment and energy friendly commercial buildings. Can compare buildings (and alternative forms of building) on their "greenness".	Developed for US context but can apply worldwide; commercial building focus. No socio-economics. Simple to use.
75	SIGMA	Sustainability Integrated Guidelines for Management. BSI/AccountAbility/Forum for the Future programme that aims to embed sustainability issues within organisational structures. Proposes a 4-phase management framework (leadership and vision, planning, delivery, monitor/review/report) to manage the "5 capitals" (natural, social, human, manufactured, financial). Oriented to organisations. Essentially a form of ISO14000	
76	SPARTA-CUS	System for Planning and Research in Towns and Cities for Urban Sustainability. EC-funded urban planning system that aims to analyse and forecast interactions between land use, transport, economy, the environment and social factors. Based on a land use/transport model (MEPLAN) combined with a set of urban sustainability indicators, a GIS system, a database, and a decision support tool. Used for assessing options for urban sustainability policies for Helsinki, Bilbao and Naples. Indicators cover equity etc., but very much from transport perspective (e.g. "justice of exposure to particulates").	Brings together indicators, GIS, decision support tool.
77	Green Building Tool	Computer tool for building performance labelling. Focuses on environmental components: energy, waste, noise etc. e-mailed Herb for more information.	Version that I saw was from 1998
78	SPeAR	Arup 2004 Sustainable Project Appraisal Routine. Essentially translates indicators into a rose diagram. Indicators chosen separately for each project analysed. Allows analysis of alternatives and progress over time.	Pretty way of presenting data, more user friendly than massive lists.